JOURNAL OF THE ROYAL MICROSCOPICAL SOCIETY;

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS,

AND A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.

Edited by

A. W. BENNETT, M.A. B.Sc. F.L.S.

Lecturer on Botany at St. Thomas's Hospital;

WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

R. G. HEBB, M.A. M.D. F.R.C.P.
Lecturer on Forensic Medicine at Westminster Hospital,

J. ARTHUR THOMSON, M.A. F.R.S.E.
Regius Professor of Natural History in the University of Aberdeen,

AND

A. N. DISNEY, M.A. B.Sc.

FELLOWS OF THE SOCIETY.

Minimis partibus, per totum Naturæ campum, certitudo omnis innititur quas qui fugit pariter Naturam fugit.—*Linnæus.*

FOR THE YEAR

1900.

LONDON:

TO BE OBTAINED AT THE SOCIETY'S ROOMS,

20 HANOVER SQUARE, W.;

OF MESSRS. WILLIAMS & NORGATE; AND OF MESSRS. DULAU & CO.

245

THE

Royal Microscopical Society.

(Established in 1839. Incorporated by Royal Charter in 1866.)

The Society was established for the promotion of Microscopical and Biological Science by the communication, discussion and publication of observations and discoveries relating to (1) improvements in the construction and mode of application of the Microscope, or (2) Biological or other subjects of Microscopical Research.

It consists of Ordinary, Honorary, and Ex-officio Fellows of either sex.

Ordinary Fellows are elected on a Certificate of Recommendation signed by three Ordinary Fellows, setting forth the names, residence, and description of the Candidate, of whom the first proposer must have personal knowledge. The Certificate is read at two General Meetings, and the Candidate balloted for at the second Meeting.

The Admission Fee is 2*l.* 2*s.*, if paid at the time of election, or 2*l.* 10*s.* payable in five consecutive annual instalments of 10*s.* each; and the Annual Subscription is 2*l.* 2*s.*, payable on election, and subsequently in advance on 1st January in each year, but future payments may be compounded for at any time for 31*l.* 10*s.* Fellows elected at a meeting subsequent to that in February are only called upon for a proportionate part of the first year's subscription. The annual Subscription of Fellows permanently residing abroad is 1*l.* 11*s.* 6*d.* or a reduction of one-fourth.

Honorary Fellows (limited to 50), consisting of persons eminent in Microscopical or Biological Science, are elected on the recommendation of five Ordinary Fellows and the approval of the Council.

Ex-officio Fellows (limited to 100), consisting of the Presidents for the time being of any Societies having objects in whole or in part similar to those of the Society, are elected on the recommendation of ten Ordinary Fellows, and the approval of the Council.

The Council, in whom the management of the property and affairs of the Society is vested, is elected annually, and is composed of the President, four Vice-Presidents, Treasurer, two Secretaries, and twelve other Ordinary Fellows.

The Meetings are held on the third Wednesday in each month, from October to June, at 20 Hanover Square, W. (commencing at 8 P.M.). Visitors are admitted by the introduction of Fellows.

The Journal, containing the Transactions and Proceedings of the Society, and a Summary of Current Researches relating to Zoology and Botany (principally Invertebrata and Cryptogamia), Microscopy, &c., is published bi-monthly, and is forwarded post-free to all Ordinary and Ex-officio Fellows residing in countries within the Postal Union.

The Library, with the Instruments, Apparatus, and Cabinet of Objects, is open for the use of Fellows daily (except Saturdays), from 10 A.M. to 5 P.M. It is closed for four weeks during August and September.

Forms of proposal for Fellowship, and any further information, may be obtained by application to the Secretaries, or Assistant-Secretary, at the Library of the Society 20 Hanover Square., W.

Patron

HIS ROYAL HIGHNESS

ALBERT EDWARD, PRINCE OF WALES,

K.G., G.C.B., F.R.S., &c.

Past-Presidents.

	Elected
*Sir Richard Owen, K.C.B., D.C.L., M.D., LL.D., F.R.S.	1840–1
*John Lindley, Ph.D., F.R.S.	1842–3
*Thomas Bell, F.R.S.	1844–5
*James Scott Bowerbank, LL.D., F.R.S.	1846–7
*George Busk, F.R.S.	1848–9
*Arthur Farre, M.D., F.R.S.	1850–1
*George Jackson, M.R.C.S.	1852–3
*William Benjamin Carpenter, C.B., M.D., LL.D., F.R.S.	1854–5
George Shadbolt	1856–7
*Edwin Lankester, M.D., LL.D., F.R.S.	1858–9
*John Thomas Quekett, F.R.S.	1860
*Robert James Farrants, F.R.C.S.	1861–2
*Charles Brooke, M.A., F.R.S.	1863–4
James Glaisher, F.R.S.	1865–6–7–8
*Rev. Joseph Bancroft Reade, M.A., F.R.S.	1869–70
*William Kitchen Parker, F.R.S.	1871–2
*Charles Brooke, M.A., F.R.S.	1873–4
Henry Clifton Sorby, LL.D., F.R.S.	1875–6–7
*Henry James Slack, F.G.S.	1878
Lionel S. Beale, M.B., F.R.C.P., F.R.S.	1879–80
*Peter Martin Duncan, M.B., F.R.S.	1881–2–3
Rev. William Hy. Dallinger, M.A., LL.D., F.R.S.	1884–5–6–7
Charles Thos. Hudson, M.A., LL.D. (Cantab.), F.R.S.	1888–9–90
Robert Braithwaite, M.D., M.R.C.S., F.L.S.	1891–2
Albert D. Michael, F.L.S.	1893–4–5–6
Edward Milles Nelson	1897–8–9

* Deceased.

COUNCIL.

ELECTED 17TH JANUARY, 1900.

President.

*WILLIAM CARRUTHERS, Esq., F.R.S., F.L.S., F.G.S.

Vice-Presidents.

ALFRED W. BENNETT, Esq., M.A., B.Sc., F.L.S.
*GEORGE C. KAROP, Esq., M.R.C.S.
*A. D. MICHAEL, Esq., F.L.S.
E. M. NELSON, Esq.

Treasurer.

J. J. VEZEY, Esq.

Secretaries.

REV. W. H. DALLINGER, LL.D., F.R.S.
R. G. HEBB, Esq., M.A., M.D., F.R.C.P.

Ordinary Members of Council.

JAMES MASON ALLEN, Esq.
CONRAD BECK, Esq.
*ROBERT BRAITHWAITE, Esq., M.D., M.R.C.S., F.L.S.
E. T. BROWNE, Esq.
REV. EDMUND CARR, M.A., F.R.Met.S.
EDWARD DADSWELL, Esq.
RT. HON. SIR FORD NORTH, P.C., F.R.S.
HENRY GEORGE PLIMMER, Esq., M.R.C.S., F.L.S.
THOMAS H. POWELL, Esq.
*CHARLES F. ROUSSELET, Esq.
JOHN TATHAM, ESQ., M.A., M.D., F.R.C.P.
GEORGE WESTERN, Esq.

Curator.

CHARLES F. ROUSSELET, ESQ.

Librarian and Assistant Secretary.

MR. F. A. PARSONS.

* Members of the Publication Committee.

CONTENTS.

TRANSACTIONS OF THE SOCIETY.

NOTES.

OBITUARY.

SUMMARY OF CURRENT RESEARCHES

Relating to Zoology and Botany (principally Invertebrata and Cryptogamia), Microscopy, &c., including Original Communications from Fellows and Others.* 14, 171, 298, 439, 559, 653

ZOOLOGY.

VERTEBRATA.

a. Embryology.

---

* In order to make the Contents complete, the papers printed in the 'Transactions' and the Notes printed in the 'Proceedings' are included here.

b. Histology.

c. **General.**

Tunicata.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

γ. Gastropoda.

β. Myriopoda.

γ. Protracheata.

δ. Arachnida.

ε. Crustacea.

Annulata.

Nematohelminthes.

Platyhelminthes.

Incertæ Sedis.

Rotatoria.

Echinoderma.

Cœlentera.

Porifera.

Protozoa.

BOTANY.

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

a. Anatomy.

(1) Cell-structure and Protoplasm.

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

(3) Structure of Tissues.

(4) Structure of Organs.

β. Physiology.

(1) Reproduction and Embryology.

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

(3) Irritability.

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

γ. General.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Muscineæ.

Algæ.

Fungi.

Myxomycetes.

Protophyta.

a. Schizophyceæ.

β. Schizomycetes.

MICROSCOPY.

A. Instruments, Accessories, &c.

(1) Stands.

(2) Eye-pieces and Objectives.

(3) Illuminating and other Apparatus.

(4) Photomicrography.

(5) Microscopical Optics and Manipulation.

(6) Miscellaneous.

B. Technique.

(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.

PROCEEDINGS OF THE SOCIETY.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY

FEBRUARY 1900.

TRANSACTIONS OF THE SOCIETY.

I.—*On the Preparation of Marine Worms as Microscopical Objects.*

By H. C. Sorby, LL.D., F.R.S.

(*Read 15th November*, 1899.)

According to Pliny, animals were sometimes preserved in honey. For example, he says he saw a young centaur so kept, which had been born in Thessaly; and that honey is of such a nature as will prevent putrefaction. It therefore seemed to me desirable to try whether a strong solution of cane-sugar would be useful, in order to dissolve out the salt from marine animals which I wished to dry on glass and mount in Canada balsam. After remaining a short time in the syrup, they were treated with water, to remove the greater part of the sugar. The results were to some extent satisfactory; but it appeared to me probable that bad effects might follow from the subsequent crystallisation of the sugar. It therefore occurred to me that a moderately strong solution of glycerin might answer equally well in removing salt, and could not subsequently crystallise. I very soon found that, in thus treating a species of *Nereis* worm, very common in some of the Essex estuaries, it was possible to dry small specimens and mount them in balsam, without decomposition obliterating the minute blood-vessels. After trying various modifications of the process, I at length found that good results could be obtained by adopting the following method. I took specimens only 2 or 3 in. long, because the structure is confused when they are too thick. These were put direct from the sea-water into strong glycerin diluted with an equal volume of water. In this they quickly died, and after remaining in it for about 10 minutes, were seen to be considerably reduced in size by the transfusion of water into the glycerin. They were then transferred to water, and kept in it for about ten minutes, so as to remove most of the glycerin, and to cause them to expand to about their original size. They were then quite limp, and could easily be arranged on microscope-slide glasses, and were dried as quickly as they could at the usual temperature in the open air, and in doing so became thin, but shrank very little laterally. Some species dried much more quickly than others. It not being convenient to mount them at once, when living on the yacht, they were well covered over with Canada balsam, which was afterwards dissolved off by benzol. Keeping them thus for a time has the advantage of showing whether the salt has been well removed; but they should not be kept too long, or they may become worthless. They were then mounted in balsam under thin glass covers, in cells made of thin glass strips. Though they have now been kept for above two years, they have undergone no further change. When thus mounted they are not only permanently preserved, but, being made comparatively thin, flat, and transparent, the structure is seen far better than when the animals are alive or recently dead. After having been kept in alcohol or diluted formalin, they are not only made more opaque, but the blood is so altered and lost that the vessels become almost or quite invisible. When kept in strong glycerin, though the natural red colour is somewhat preserved, it is only the larger vessels that are seen to advantage. Though, as I thought, treated in the same way, yet, for unexplained reasons, some specimens turned out very bad. The character and arrangement of the vessels can be studied to great advantage, and is seen to be strikingly different in different species and genera. It is, however, very difficult to prepare specimens so as to show the structures equally well all over. Some kinds of worms are very easily injured in collecting, and though the injury may be invisible, it may cause decomposition to occur locally, before the specimen is dry, and the small and very delicate blood-vessels are lost; though, in other parts not so injured even the small capillaries are quite distinct.

Though it seems to me undesirable to describe the detail, yet it may be well to give a general summary of the characteristic features of the blood-vessels in the case of a few genera. There are very considerable differences in different specimens of the same species, according to their state of development, and apparently also according to the circumstances in which they have lived. The relative amount of blood-vessels varies enormously in different localities, and at different times of the year. In almost all cases there is much difference as we pass from the head to the tail.

Cirratulus.—A characteristic feature of this worm is the presence of so many large vessels passing to the cirri from the main longitudinal vessels, which latter are contracted and enlarged in each joint of the body. Where the cirri are most numerous, the blood-vessels seem to occupy fully one-half of the area in mounted specimens. Between the lateral vessels are numerous branching capillaries, which are much most numerous over the intestine. The hooked character of some of the larger lateral vessels is also a striking feature. Towards the middle of the worm, where the cirri are few in number, the vessels of the intestine are so small and numerous that they cannot well be seen separately, but give rise to a general red colour.

Nearer the tail-end are many small vessels, and the enlargement and contraction of the longitudinal vessels gives rise to a sort of spotted appearance. In my mounted specimens the vessels in all parts are very perfectly defined, and the blood of a brilliant red colour, without any indication of decomposition or fading.

Nephthys.—This shows well the larger vessels passing from the centre to the surface in each ring, and numerous smaller ones between them. There is but little difference from one end to the other, except in the amount of vessels, and that near the head-end there are numerous oblique ones. The longitudinal vessels are best seen towards the tail-end. Though well preserved in some parts, and the blood bright red, the vessels are much less perfect in others, decomposition evidently occurring much more readily than in *Cirratulus.*

Nereis.—My specimen shows a single or divided large longitudinal more or less lobed vessel, and sundry large transverse vessels in each ring, with smaller ones between them, especially over the intestine and in the pseudopodia, in which they form a beautiful network. The chief difference in different parts of the body is that the longitudinal vessel is much more simple in the anterior than in the posterior part, where it is enlarged and contracted, and twisted about to a remarkable extent. The blood is of a fine red colour, and the large and small vessels are well preserved in some parts, showing the minute capillaries to great advantage; but the red colour and the vessels are completely lost where decomposition has occurred, probably owing to injury in collecting.

Sabella.—Compared with the genera already described, the development of the blood-vessels is so much less that, when living or recently dead, the blood does not attract attention by its red colour. The character of the vessels also differs greatly, and is very different in different parts of the body. In some places the main longitudinal vessel is well seen, sending the larger lateral branches into each segment, with smaller vessels between them, especially over the intestine. In other parts, this main vessel is represented by a curious development of zig-zag vessels, either of comparatively simple character, or assuming complicated tree-like forms quite unlike anything seen in the other genera. The salt is so difficult to remove that all my specimens show crystals. The blood is now more brown than red. The minute capillaries are well seen in some places, but were either poorly developed originally, or have been lost, though not by general decomposition. The glycerin method is evidently only so far satisfactory in this genus as to show how much its structure differs from that of the other genera, and to indicate to some extent why the method so completely fails with such forms as *Arenicola* and *Terebella.*

Taking then all into consideration, the difference between the different genera is very striking, though in the arrangement of the blood-vessels *Nephthys* and *Nereis* are much the most closely related, and *Cirratulus* and *Sabella* the most distinct.

If I had confined myself to these genera, the explanation of the effects of glycerin would have been comparatively simple. I should have concluded that it acted as a weak steriliser, or, more correctly, retarder of decomposition, so as to make it possible to dry the specimens before serious decomposition had taken place. To some extent this explanation appears correct; but the question, as a whole, is far more complex; and it seems to me that the successful preparation of specimens is almost entirely a question of the adequate knowledge of a somewhat peculiar branch of chemistry. I hope, therefore, that the Society will not think the following remarks of too chemical a character.

The blood of the living animals is a fairly strong solution of hæmoglobin; but in the final preparations the beautiful red substance in the vessels does not give the well-marked absorption bands of hæmoglobin, but a spectrum like that given by blood dried on glass and mounted in Canada balsam, from which the absorption bands gradually fade, without any material change in the colour. It seems to be a fairly stable product of a change occurring under such conditions. It is, of course, important that the blood should not be lost or altered in colour. It is also very necessary to more or less completely remove the salt contained in the living animals; since, unless this is done, the mounted objects may be completely spoiled by being filled to a surprising extent with crystals. What is wanted is to let the animals remain just sufficiently long in glycerin and afterwards in water, to remove the salt, but not so long as to lose any material amount of blood. I am sorry that I am unable to say whether or no ten minutes is the best length of time for each process, and am inclined to think it ought to vary according to the species of worm and its size; and it might be better to use a stronger solution of glycerin than that with an equal volume of water. It also appears to me that there are individual differences in the same species, which cannot be foreseen; and, in the present state of the question, the best plan is to prepare a number of specimens, and finally select the best.

Independently of its partially retarding decomposition, glycerin and water seem to give better results than anything I have tried. Diluted formalin rapidly changes the red colour of blood to a dull brown. Though diluted alcohol is free from this objection, yet both it and formalin are apt to make the specimens hard and not easy to arrange on the glass, and the minute blood-vessels are lost, except in such parts as dry very quickly.

The decomposition of the body of the worms which obliterates the blood-vessels, and in some species can be overcome by the use of glycerin, seems to depend on some other substance in other species. Thus, for example, though the blood-vessels of *Arenicola* are remarkably well developed, the employment of glycerin not only is useless but seems to make the results worse than if not used. I have tried over and over again, and could scarcely believe it possible to get such bad results. They were nearly as bad in the case of *Terebella* and some other genera.

This last year I had made up my mind to devote much attention to the study of suchlike peculiarities in the chemistry of marine animals; but my time was too much taken up in preparing them as museum specimens, so as to show, as I hope permanently, all their beautiful natural colours. I, however, did try some experiments, which serve to throw light on the subject of this paper, and to show that in some cases decomposition may be much modified, not only by the presence or absence of septic organisms, but by more or less slight changes in the chemical constitution of the decomposing substances. My experiments were made with the mollusc *Phyllina*, having a small internal shell. Some were kept in strong glycerin, some in alcohol diluted with half its volume of water, and some in a 4 per cent. solution of formalin. After remaining three months, they were well soaked in water to remove the reagents, and a newly collected specimen, and one of each of those named, were kept separately in fresh-water, and the changes carefully watched and recorded. To my surprise I found that long treatment with alcohol did not in any way retard septic decomposition, but previous treatment with a 4 per cent. solution of formalin retarded it so much that I began to think that none would occur. The three months' action of strong glycerin also much retarded decomposition, either by altering or dissolving out some constituent specially liable to change; and even keeping in glycerin for only eight hours had a very marked effect, and this in some measure explains why it is useful in preparing marine worms. In illustration of the different results in the case of different species, I may say that some kinds of *Nereis* do not change colour on keeping when mounted in Canada balsam, whereas another species turned to a dark brown, as though it contained some substance absent from the others. If there is such a considerable difference in different species of the same genus, it is not surprising that the effect of glycerin should vary much owing to some difference in the nature of the constituents. Though this is disappointing when we desire to prepare good microscopical objects, yet it is interesting from a chemical and biological point of view. I have also found that there may be considerable difference in the effect of poisons and other reagents on the same species from different localities, or even on different individuals from the same place; and also that the length of time they have been kept alive after being collected is an important element.

In conclusion, I may say that though I greatly regret my inability to explain and overcome some of these peculiar difficulties, yet the specimens exhibited clearly show that, by the method described in this paper, it is possible to obtain excellent results; and I hope that what I have said may prove useful in dealing with other animals, especially when naturally free from salt, the presence of which is so great a difficulty in the case of marine worms, with which alone I have so far experimented.

II.—*Report on the Recent Foraminifera of the Malay Archipelago collected by Mr. A. Durrand, F.R.M.S.—Part VII.*

By Fortescue William Millett, F.R.M.S.

(*Read 21st December*, 1899.)

Plate I.

Bigenerina digitata d'Orbigny var., plate I. fig. 1.

Bigenerina (*Gemmulina*) *digitata* d'Orb., 1826, Ann. Sci. Nat., vol. vii. p. 262, No. 4; Modèle No. 58. *B. digitata* (d'Orb.) Brady, 1864, Trans. Linn. Soc. London, vol. xxiv. p. 468, pl. xlviii. fig. 8. *B. arcuata* Haeusler, 1890, Abhandl. schweizer. Pal. Gesell., vol. xvii. p. 73, pl. xii. figs. 5–7. *B. digitata* (d'Orb.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 38, pl. vii. figs. 324–341.

This species has hitherto been recorded only from Europe. The Malay variety is confined to Station 9, and the examples, although minute, are moderately abundant. The test is finely arenaceous and of the usual reddish-brown colour. The aperture is a large circular orifice occupying nearly the whole of the distal face. This appears to be the only feature in which it differs from the type.

Bigenerina fimbriata sp. n., plate I. figs. 2–4.

Test hyaline, elongate, straight, compressed. Chambers of the biserial portion numerous, having the outer margin projecting and the surface granular. Chambers of the linear series broad at the base, tapering towards the aperture; the base encircled by a fringed band. Aperture elliptical, with a bordered margin. Length 1·20 mm.

This form may be described as a dimorphous *Bolivina*, the biserial

---

EXPLANATION OF PLATE.

Fig. 1.—*Bigenerina digitata* d'Orbigny var. × 135.
„ 2. „ *fimbriata* sp. n. × 40.
„ 3. „ „ One of the chambers of the linear series. × 80.
„ 4. „ „ Biserial portion, equal to *Bolivina lobata* Brady, changing to the dimorphous condition. × 75.
„ 5. „ (*Siphogenerina*) *Schlumbergerii* sp. n. × 75.
„ 6. „ „ „ By transmitted light showing the internal siphon. × 95.
„ 7.—*Spiroplecta annectens* Parker and Jones sp. × 100.
„ 8. „ *biformis* Parker and Jones sp. × 135.
„ 9.—*Gaudryina siphonella* Reuss. × 75.
„ 10. „ *hirta* sp. n. × 90.
„ 11. „ *Wrightiana* sp. n. × 90.
„ 12. „ „ Specimen with limbate sutures. × 100.
„ 13.—*Verneuilina pygmæa* Reuss. × 135.
„ 14.—*Chrysalidina dimorpha* Brady. × 60.
„ 15.—*Tritaxia lepida* Brady. × 135.

F.W Millett del ad nat

West, Newman lith

FORAMINIFERA OF MALAY ARCHIPELAGO

portion being identical in all points, even in magnitude, with *Bolivina lobata* Brady; whilst the chambers composing the linear series resemble *Lagena fimbriata* Brady.

It is found at several Stations in both Areas, but is nowhere abundant.

Bigenerina (Siphogenerina) Schlumbergerii sp. n., plate I. figs. 5, 6.

Test hyaline, thin, elongate, tapering, slightly compressed; biserial and uniserial chambers both inflated, and both having short spines scattered over the surface. Aperture large and curved. Throughout the uniserial chambers a tube connects the aperture of each chamber with that of the one preceding it. Length 0·46 mm.

The genera *Bigenerina* and *Sagrina* are superficially so much alike that it is difficult to distinguish one from the other by their external characters. The *Sagrinæ* have the test composed of the dense vitreous substance usually found in the family *Lagenidæ*; whilst in *Bigenerina* the test, when hyaline, is thinner and more porous. The internal siphon is common in the *Lagenidæ*, and also occurs, in a modified form, in many of the Malay species of the *Textularidæ*, as will be shown in due course; consequently it cannot be accepted as a feature distinguishing one family from the other. In M. Schlumberger's genus *Siphogenerina* are to be found arenaceous as well as hyaline forms. His *S. ocracea* from New Caledonia differs from *Bigenerina digitata* in little more than the possession of the internal siphon and the consequent alteration in the position of the aperture.

It may be observed that the aperture of *B. Schlumbergerii* closely resembles that of the *B. calcarata* of Berthelin,* as shown by his figures and also by that of Chapman from the Gault of Folkestone.†

From the characters of *B. Schlumbergerii* it seems to be more nearly allied to *Bigenerina* than to *Sagrina*, although there is here plenty of room for a difference of opinion.

Fig. 3 is from a drawing by the late M. Berthelin showing the test viewed by transmitted light.

The species is very common in the Malay Archipelago, and occurs at numerous Stations in both areas.

Pavonina d'Orbigny.

Pavonina flabelliformis d'Orbigny.

P. flabelliformis d'Orb., 1826, Ann. Sci. Nat., vol. vii. p. 260, pl. x. figs. 10–12; Modèle No. 56.

* Mém. Soc. Géol. France, sér. 3, vol. i. 1880, pl. xxiv. figs. 14–16, and pl. xxv. fig. 2.

† Journ. R. Micr. Soc., 1898, p. 15, pl. ii. fig. 14 (*Sagrina calcarata* Berthelin sp.).

Of this rare although widely diffused species there is a solitary example from Station 22. It is almost identical in form with the specimen figured by Brady in the Quarterly Journal of Microscopical Science, vol. xix. 1879, pl. viii. fig. 30.

Spiroplecta Ehrenberg.

Spiroplecta annectens Parker and Jones sp., plate I. fig. 7.

Textularia annectens Parker and Jones, 1863, Ann. and Mag. Nat. Hist., ser. 3, vol. xi. p. 92, woodcut fig. 1. *Spiroplecta annectens* (P. & J.) Brady, 1884, Chall. Rept., p. 376, pl. xlv. figs. 22, 23. *S. annectens* (P. & J.) Chapman, 1892, Journ. R. Micr. Soc., p. 750, pl. xi. fig. 3. *S. annectens* (P. & J.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 275, pl. vi. fig. 14. *S. annectens* (P. & J.) Chapman, 1899, Ann. and Mag. Nat. Hist., ser. 7, vol. iii. p. 58, woodcut fig. 4.

Of this form there is a solitary specimen from Station 30.

Brady says that it had only been found at Raine Island, Torres Strait, and off a neighbouring locality, Ki Island. The 'Gazelle' specimens are from West Australia and New Guinea.

Fossil it is found in the Gault and Cambridge Greensand (Chapman).

Spiroplecta biformis Parker and Jones sp., plate I. fig. 8.

Textularia agglutinans var. *biformis* Parker and Jones, 1865, Phil. Trans., vol. clv. p. 370, pl. xv. figs. 23, 24. *Spiroplecta biformis* (P. & J.) Brady, 1884, Chall. Rept., p. 376, pl. xlv. figs. 25–27. *S. biformis* (P. & J.) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. Sci., p. 333, pl. xiii. fig. 21 and woodcut fig. 2. *S. biformis* (P. & J.) Burrows, Sherborn, and Bailey, 1890, Journ. R. Micr. Soc., p. 554, pl. viii. fig. 21. *S. biformis* (P. & J.) Haeusler, 1890, Abhandl. schweizer. Pal. Gesell., vol. xvii. p. 74, pl. xi. figs. 48, 49–51. *S. biformis* (P. & J.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 275, pl. vi. figs. 48–50. *S. biformis* (P. & J.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 38, pl. vii. figs. 308–312.

Of this arenaceous form a few specimens have been found at Station 9. They are very minute and of the usual rusty colour.

This species is most common in the Arctic regions. The 'Gazelle' examples, which are described as colourless, are from West Africa and West Australia.

Gaudryina d'Orbigny.

Gaudryina pupoides d'Orbigny.

Gaudryina pupoides d'Orbigny, 1840, Mém. Soc. Géol. France, vol. iv. p. 44, pl. iv. figs. 22–24. *Textularia pupoides* (d'Orb.) Goës, 1882, K. Svenska Vet.-Akad. Handl., vol. xix. p. 81, pl. vi. figs. 179, 180. *Gaudryina pupoides* (d'Orb.) Woodward and Thomas, 1885, 13th Ann. Rept. Geol. and Nat. Hist. Survey of Minnesota for 1884, p. 168, pl. iii. fig. 10. *G. pupoides* Sherborn and Chapman, 1886, Journ. R. Micr. Soc., vol. vi. p. 743, pl. xiv. fig. 7. *G. pupoides* (d'Orb.) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 219, pl. xlii. figs. 7, 8. *G. pupoides* (d'Orb.) Fornasini, 1889, Boll. Soc. Geol. Ital., vol. v. (p. 25) pl. i. fig. 7. *G. pupoides* (d'Orb.) Burrows, Sherborn, and Bailey, 1890, Journ. R. Micr. Soc., p. 554, pl. viii. fig. 22. *G. pupoides* (d'Orb.) Chapman, 1892, Ibid., p. 752, pl. xi. fig. 8. *G. pupoides* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 278, pl. vii. figs. 1–3, 49–51. *G. pupoides* (d'Orb.) Woodward and Thomas, 1893, Final Rept. Geol. and Nat. Hist. Survey of Minnesota, vol. iii. p. 31, pl. C, figs. 15, 16. *G. pupoides* (d'Orb.) Grzybowski, 1894, Rozprawy Wydz. mat.-Przyr. Akad. Umiej-Krakowie, vol. xxix. p. 188, pl. i. fig. 9. *G. pupoides* (d'Orb.) Egger, 1895, 16. Jahresbericht Naturhist. Ver. Passau (p. 9), pl. i. fig. 19. *G. pupoides* (d'Orb.) A. Silvestri, 1896, Mem. Pontif. Accad. Nuovi Lincei, vol. xii. p. 85, pl. ii. fig. 7.

This species is represented by a very few feeble examples, and appears to be restricted to Area 1.

Gaudryina siphonella Reuss, plate I. fig. 9.

Gaudryina siphonella Reuss, 1851, Zeitschr. deutsch. Geol. Gesell., vol. iii. p. 78, pl. v. figs. 40–42.

Is represented by a solitary, although well-developed, example from Station 25.

Brady speaks of the species as being comparatively rare in the living condition, although widely distributed.

Gaudryina filiformis Berthelin.

Gaudryina filiformis Berthelin, 1880, Mém. Soc. Géol. France, ser. 3, vol. i. p. 25, pl. xxiv. fig. 8. *G. filiformis* (Berthelin) Wright, 1882, Proc. Belfast Nat. Field Club, 1880–1881, Appendix, p. 180, pl. viii. fig. 3. *G. filiformis* (Berthelin) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 219, pl. xlii. fig. 6. *G. filiformis* (Berthelin) Chapman, 1892, Journ. R. Micr. Soc., p. 752, pl. xi. fig. 7. *G. filiformis* (Berthelin) Perner, 1897, Česká Akad. Císare Františka Josefa (Palæont. Bohemica) No. 4, p. 17, pl. vii. fig. 10.

This species occurs at several Stations in both Areas, and in some of them is fairly abundant. The examples are stout, and well developed.

Found at only four 'Challenger' Stations, but occurs at several places on the coast of the United Kingdom. Brady, Parker, and Jones record a single specimen from the Abrolhos Bank.

Gaudryina hirta sp. n., plate I. fig. 10.

Test hyaline, elongate, tapering towards the aboral end, compressed; triserial portion small and obscure. Biserial chambers numerous and inflated. Aperture erect, oval, with a depressed margin. Surface of test covered with short spines. Length 0·29 mm.

In this species the biserial portion appears to be more Bulimine than Textularian, as well in the texture of the test as in the position of the aperture. In the *Gaudryinæ* there is admittedly considerable variation in these features, and it is not necessary to establish a new genus for the reception of this form. The specimens are remarkably uniform in size and structure, and in the number of chambers.

It is very abundant in the Malay Archipelago, and is found at most of the Stations.

This is one of the forms which illustrate the peculiarity of the Malay Region in containing numerous species, widely distributed and in vast profusion, which have not been recorded from any other locality.

Gaudryina rugosa d'Orbigny.

Gaudryina rugosa d'Orbigny, 1840, Mém. Soc. Géol. France, vol. iv. p. 44, pl. iv. figs. 20, 21. *G. rugosa* (d'Orb.) Chapman, 1892, Journ. R. Micr. Soc., p. 752, pl. xi. fig. 9. *G. rugosa* (d'Orb.) Fornasini, 1893, Mem. R. Accad. Sci. Ist. Bologna, ser. 5, vol. iii. p. 437, pl. i. fig. 9.

Is represented by a few feeble specimens from Station 13.

Brady names seven localities at which it has been found in the living condition. It seems to be at its best in Torres Strait.

Gaudryina Wrightiana sp. n., plate I. figs. 11, 12.

Gaudryina rugosa (d'Orb.) Beissel, 1891, Abhandl. k. Preuss. Geol. Landesanstalt, Heft 3, p. 69, pl. xiii. figs. 30–33.

Test wedge-shaped; triserial portion with flat faces and acute or carinate edges; biserial portion quadrilateral, one of the lateral faces convex, the other concave. Peripheral margins broad and flat, and inclined towards the concave lateral face. Length 0·30 mm.

This is an interesting form of the *G. rugosa* group, and is closely allied to *G. Jonesiana* Wright, from which it differs in its length, and in having one of the lateral faces convex. The sutures of the biserial portion are sometimes limbate.

It is not uncommon at Station 13, and occurs also at Station 2.

The specimen figured by Beissel is from the chalk-marl of Aix-la-Chapelle.

Verneuilina d'Orbigny.

Verneuilina triquetra Münster sp.

Textularia triquetra Münster, 1838, Romer, Neues Jahrb. für Min., p. 384, pl. iii. fig. 19. *Verneuilina triquetra* (Münster) Parker and Jones, 1863, Ann. and Mag. Nat. Hist., ser. 3, vol. xi. p. 92. *V. triquetra* (Münster) Burrows, Sherborn, and Bailey, 1890, Journ. R. Micr. Soc., p. 553, pl. viii. figs. 19, 20. *V. triquetra* (Münster) Chapman, 1892, Journ. R. Micr. Soc., p. 329, pl. vi. fig. 24. *V. triquetra* (Münster) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 280, pl. vii. figs. 12, 13.

This form, rather rare in the living condition, is represented by a somewhat feeble specimen from Station 30.

The Gazelle Stations are Mauritius and off the east coast of Patagonia.

Verneuilina spinulosa Reuss.

Verneuilina spinulosa Reuss, 1850, Denkschr. k. Akad. Wiss. Wien, vol. i. p. 374, pl. xlvii. fig. 12. *V. spinulosa* (Reuss) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 219, pl. xlii. fig. 15. *V. spinulosa* (Reuss) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 281, pl. vii. figs. 11, 14–16.

Occurs in great abundance, and with the usual variety of form at nearly all the Stations in both Areas.

Verneuilina pygmæa Egger sp., plate I. fig. 13.

Bulimina pygmæa Egger, 1857, Neues Jahrb. für Min., p. 284, pl. xii. figs. 10, 11. *Verneuilina pygmæa* (Egger) Parker and Jones, 1863, Ann. and Mag. Nat. Hist., ser. 3, vol. xi. p. 92. *V. pygmæa* (Egger) Woodward and Thomas, 1893, Final Rept. Geol. and Nat. Hist. Survey of Minnesota, vol. iii. p. 32, pl. C, figs. 17, 18. *V. pygmæa* (Egger) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. p. 279, pl. vii. figs. 8–10. *V. pygmæa* (Egger) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 32, pl. vii. figs. 262, 263.

The arenaceous form of the species is not represented in the anchor mud from the Malay Archipelago, but the beautiful little hyaline form here figured is scattered all over the region. It is as transparent as glass, and as usual the aperture is not apparent. Of all the published figures of the species the one which most resembles it is that of *Textilaria triseriata* Terquem.* The arenaceous form is a common deep-water species, but there appears to be no previous record of the hyaline variety.

Verneuilina polystropha Reuss sp.

Bulimina polystropha Reuss, 1846, Verstein. böhm. Kreid., part 2, p. 109, pl. xxiv. fig. 53. *Verneuilina polystropha* (Reuss) Parker and Jones, 1862, Introd. Foram., Appendix, p. 311. *V.* sp. indet. Andreæ, 1884, Abhandl. geol. Special-Karte Elsass-Lothringen, vol. ii. p. 296, pl. vi. fig. 15. *Bulimina polystropha* (Reuss) Chapman, 1892, Journ. R. Micr. Soc., p. 756, pl. xii. fig. 11. *V. polystropha* (Reuss) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II.

* Mém. Soc. Géol. France, sér. 3, vol. ii. 1882, p. 145, pl. xxiii. fig. 10.

vol. xiii. p. 280, pl. vii. figs. 17, 18. *V. polystropha* (Reuss) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 32, pl. vii. figs. 247–255. *Bulimina polystropha* (Reuss) Chapman, 1894, Quart. Journ. Geol. Soc., vol. l. p. 701, pl. xxxiv. fig. 5.

All the Malay specimens of this species are roughly arenaceous and for the most part colourless. The aperture is more Textularian than Bulimine.

It is abundant at Stations 2 and 12, and is found sparingly at other Stations in both Areas.

Chrysalidina d'Orbigny.

Chrysalidina dimorpha Brady, plate I. fig. 14.

Chrysalidina dimorpha Brady, 1884, Chall. Rept., p. 388, pl. xlvi. figs. 20, 21. *C. dimorpha* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 274, pl. vi. figs. 47, 51, 52.

Rare at Station 14, less rare at Station 22. The examples are characteristic, but show a considerable variation in the proportion of the length to the breadth.

Of the five localities given by Brady, one is off Raine Island, Torres Strait. The 'Gazelle' Stations are Mauritius and West Australia.

Tritaxia Reuss.

Tritaxia lepida Brady, plate I. fig. 15.

Tritaxia lepida Brady, 1881, Quart. Journ. Micr. Sci., n.s. vol. xxi. p. 55. *T. lepida* (Brady) Brady, 1884, Chall. Rept., p. 389, pl. xlix. fig. 12.

Of this very rare form there is a solitary but typical example from Station 3.

The only 'Challenger' locality given by Brady is Station 45 off the coast of North America, a little south of the latitude of New York, 1240 fathoms, but I have found several specimens in the rich dredging from Station 185, off Raine Island, Torres Strait, 155 fathoms.

Clavulina d'Orbigny.

Clavulina communis d'Orbigny.

Clavulina communis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 268, No. 4. *C. communis* (d'Orb.) Fornasini, 1885, Boll. Soc. Geol. Ital., vol. iv. p. 106, pl. vi. figs. 1, 2. *C. communis* (d'Orb.) Sherborn and Chapman, 1886, Journ. R. Micr. Soc., vol. vi. p. 743, pl. xv. fig. 1. *C. communis* (d'Orb.) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 220, pl. xlii. fig. 11. *C. communis* (d'Orb.) Fornasini, 1891, Foram. Plioc. del Ponticello di Savena, pl. ii. fig. 7. *C. communis* (d'Orb.) Murray and Renard, 1891, Chall. Rept., "On Deep-

Sea Deposits," pp. 101, 135, pl. xiv. fig. 2[26]. *C. communis* (d'Orb.) Mariani, 1891, Boll. Soc. Geol. Ital., vol. x. fasc. 2, p. 172, pl. vi. fig. 3. *C. communis* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 275, pl. vi. figs. 42, 43. *C. communis* (d'Orb.) Fornasini, 1893, Mem. R. Accad. Sci. Istit. Bologna, ser 5, vol. iii. p. 436, pl. i. figs. 10–12; and 1894, vol. v. p. 14, pl. iv. fig. 3.

The genus *Valvulina* in its simple form is not represented in the gatherings from the Malay Archipelago; and of the dimorphous forms the examples are rare and local. *Clavulina communis* has been noticed only at Station 14.

Clavulina angularis d'Orbigny,

Clavulina angularis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 268, No. 2, pl. xii. fig. 7.

Has been found only at Station 2, and there very sparingly. The examples are however large and characteristic.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Merogonic Fertilisation.‡—Prof. Yves Delage, continuing his experiments on fertilisation, finds that a non-nucleated fragment of the ovum of *Echinus*, *Dentalium*, or *Lanice conchilega*, may be effectively fertilised, and give rise to a Pluteus, a Veliger, or a Trochophore respectively. Three larvæ may be reared from one ovum of a sea-urchin, and a normal blastula was obtained from a 1/37 fragment. There is a cytoplasmic maturation distinct from the nuclear maturation.

An egg-fragment of *Echinus* without chromosomes gave rise, after fertilisation by a spermatozoon with nine chromosomes, to a larva whose cells had the normal eighteen chromosomes. It seems therefore that the number of the chromosomes is a property of the cellular organisation, and is not dependent on the persistent individuality believed by most to be characteristic of the chromosomes.

Non-nucleated fragments seem to be fertilised more readily than normal ova. Merogony favours fertilisation. It seems as if the essential fact of fertilisation were not the fusion of nuclei, but the union of a sperm-nucleus with a mass of ovum-cytoplasm.

Since we reported on this paper, a more complete account § of these remarkable observations has reached us, but the gist of the matter is given above.

Action of Inflammatory Agents on Eggs.‖—Dr. Giuseppe Levi injected turpentine into the ovaries of frogs and salamanders in order to observe the effect upon mature and ripening eggs. He finds that the

* 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.

‡ Comptes Rendus, cxxix. (1899) pp. 645-8.

§ Arch. Zool. Expér., vii. (1899) pp. 383-417 (11 figs.).

‖ Arch. f. Mikr. Anat., lv. (1899) pp. 111-44 (1 pl.).

ovaries of normal frogs often display in winter very marked degenerative processes, so that control observations are necessary during the course of the experiments. He believes that the experiments of some other authors (notably Pfister) are vitiated by ignorance of this fact, for they overestimate the pathological effect.

The author finds that the inflammatory process produces three types of modification, the one produced depending on the state of the eggs:—(1) Those large eggs which, though practically mature, have not been shed at the right season, offer in winter little resistance to the caustic reagent and rapidly degenerate, but the degenerating process differs in no respect from that which is the ultimate normal fate of these eggs; (2) Normal eggs of large or medium size are so modified as to display a much thickened vitelline membrane which protects the egg-contents from injury; later the yolk is gradually absorbed by an unknown mechanism; (3) The third type occurs in small eggs at any season of the year; in it the follicle-cells wander into the protoplasm, which only breaks up after a long period of degeneration. In the first and second types, the two poles of the eggs show a different relation to the follicular cells. The degenerating eggs exercise a strong attraction upon the follicular cells, which may enter the protoplasm. or may merely push the vitelline membrane inwards. This attraction is entirely confined to the follicle-cells, and does not affect the blood-cells or the elements of the other egg-envelopes. Blood-vessels and blood-cells do not enter the egg until the complete destruction of the yolk. The resistance offered by the egg to injurious influences varies greatly, being greatest in young eggs, and least in full-grown ones.

Cleavage of the Egg of the Bony Pike.*—Dr. A. C. Eycleshеimer calls attention to the discrepant observations on the cleavage of the ovum of *Lepidosteus osseus* which Balfour, Parker, and Beard have described as holoblastic, and Dean as meroblastic. Is the egg unlike any other vertebrate egg, now cleaving in a holoblastic fashion, and again following the meroblastic form? Sections reveal a peculiar blastodisc, closely resembling that of *Amia*, plus a conical elongation which extends beyond a plane passing through the equator of the egg, giving to the finely granular blastodisc a pear-shaped outline. The author concludes that the cleavage cannot be called holoblastic, but that it illustrates an intermediate type.

Influence of Salt Solutions upon Eggs.†—Prof. T. H. Morgan finds that sea-urchin eggs, whether fertilised or not, when placed for a short time in sea-water to which 2 per cent. or less of sodium or magnesium chloride has been added, and then returned to sea-water, show clear spots in variable number and disposition. In prepared sections the spots are represented by "stars" like those seen in karyokinesis, and some of the stars have central specks like centrosomes.

Unfertilised sea-urchin eggs may, under the influence of salt solutions, show processes like cleavage, but the cleavage is not normal, nor does it lead to development. The chromosomes are distributed through the egg, apparently by the action of the stars, and the cleavage takes

* Anat. Anzeig., xvi. (1899) pp. 529–36 (5 figs.).

† Arch. Entwickmech., viii. (1899) pp. 448–536 (5 pls.). See Amer. Nat., xxxiii. (1899) pp. 825–6.

place with the chromosomes as centres. Similar phenomena were observed in the eggs of a Nemertean and of a Gephyrean.

The author cites facts that show that the ovum may segment without the centrosome and the aster; and while he regards the chromosome as the most influential part of the cell, he would, as a reviewer says, "depose the centrosome from its assumed rôle of hereditary monarch."

"The author sees in these results of adding salts no direct mechanical phenomena, but only the reactions of living eggs when stimulated by changed environment. The egg becomes a more living thing than it seemed when we were ignorant of these possibilities."

Polar Bodies in Urodela.* — The late Prof. J. B. Carnoy and H. Lebrun have published a third memoir on this subject. The following is a brief summary of the more important of their conclusions. Their preceding memoirs led them to the conclusion that the nuclear elements of the polar bodies arise from the broken-down nucleoli. They now find further that the spindle, the asters, and the radiations of the first karyokinetic figure, all arise from the karyoplasm, and are therefore nuclear products. There are neither centrosomes nor attractive spheres. The chromosomes are complex figures formed by the fusion of certain filaments, spherules, and granules, which are produced by the breaking-up of the nucleoli; they are not identical with the primitive chromosomes of the oocyte. After taking up their position on the rays of the spindle, the chromosomes undergo two divisions, one equatorial and the other axial. The result is to form ultimately the V-shaped chromosomes which retreat to the poles of the spindle. The spindle then disappears, and is replaced by a new "spindle of separation," in which there appears the cell-plate separating the polar body. The spindle is later invaded by a number of enchylematous granules whose function is nutritive.

In general the sexual kineses of newts are similar to those of the Liliaceæ, and in neither is there any trace of Weismann's reducing divisions. Owing to some differences of detail the two constitute two different types, but in both the reduction is purely quantitative and is due to the tetrads. These are so important in sexual kinesis and so characteristic, that the latter may be justly styled quaternary kinesis. The primitive nuclear element of the oocyte does not persist until the sexual kineses, except in the form of certain granules which re-form the nucleoli, and ultimately constitute the chromosomes. The nuclear substance cannot be regarded as the sole bearer of hereditary qualities. The contradictions between these and the statements of preceding authors are ascribed to the incomplete observations of the latter.

Phagocytosis during Metamorphosis.† — Alf. Burnens publishes a brief note on this subject. He believes that leucocytes play an important part in tissue destruction during metamorphosis, but doubts their power to attack normal tissues. In Amphibians, at the beginning of metamorphosis, the respirations become slower, and in consequence the respiratory changes are impeded, and certain of the tissues become loaded with carbon dioxide. These tissues begin to degenerate, and the

* La Cellule, xvi. (1899) pp. 303–401 (4 pls.).
† Arch. Sci. Phys. et Nat., viii. (1899) pp. 182–3.

degenerating cells are consumed by leucocytes. Thus degeneration precedes phagocytosis, and induces it.

Development and Structure of the Lens.* — Prof. C. Rabl concludes his important memoir on the development and structure of the lens in Vertebrata. We cannot attempt a summary of the detailed results, but we would direct attention to a few conclusions of general interest. Rabl discusses the recapitulation doctrine, and finds, in the development of the lens, as elsewhere, evidence that the development of an organ in a higher Vertebrate is in its early stages approximately *parallel* to the development in ancestral forms; gradually, however, the approximately parallel lines diverge. That there is a more detailed recapitulation of the characteristics of near ancestry he admits; but his chief emphasis is on the fact that the embryo is from first to last a specific unity. Early stages of Vertebrate embryos can never be thought of as interchangeable; the human embryo is specifically human from the ovum onwards. Similarly, from the very outset, the primordium of the lens is specifically peculiar; the number of the cells stands in a definite proportion to the number of the first-formed radial lamellæ.

As to structure, the most important new point is Rabl's emphasis not on the concentric layering but on the radial lamellæ. Four main types are distinguished:—(*a*) of fishes and amphibians in water; (*b*) of amphibians (after metamorphosis at least), of mammals, and of some snakes (*Eryx*); (*c*) of reptiles except snakes, and of birds; (*d*) of adders and vipers. But every species has its specific lens,—the organism is a unity through and through. "In der Linse spiegelt sich eben die ganze Lebensweise eines Thieres."

Early Development of Mammals.—Prof. Rauber † briefly criticises Édouard van Beneden's ‡ observations on the development of the bat, and claims priority for the discovery of the existence and subsequent disappearance of the cell-layer called by him *Deckschicht*; a claim which was contested by van Beneden in his recent paper. Rauber further maintains that as van Beneden regarded the *Deckschicht*, or outer ectoblastic layer, as constituting the whole of the ectoblast, the discrepancies between his own and van Beneden's observations were then much greater than would appear from van Beneden's statements now.

In his reply van Beneden § points out that his discovery of the *Deckschicht* was practically simultaneous with that of Rauber, and that he has long since given up his early (1875) views as to the morphological value of this layer. He believes, however, that Rauber and some other embryologists are equally in error in attempting to apply to the layers of the didermic Mammalian embryo the terms hypoblast and epiblast; for these layers, as seen in *Amphioxus*, are certainly not homologous with the layers in the bat or rabbit.

* Zeitschr. f. wiss. Zool., lxvii. (1899) pp. 1–138 (4 pls. and 46 figs.).
† Anat. Anzeig., xvi. (1899) pp. 523–4.
‡ Loc. cit.
§ Tom. cit., pp. 524–6.

Development of Cranial Nerves and Ganglia in Trout.*—Dr. N. Goronowitsch adheres to a conclusion which stands opposed to most of the work of the last quarter of a century as regards the development of cranial nerves and ganglia. The "neural ridges" or outgrowths from the central nervous system, which Balfour and Marshall regarded as the origins of cranial nerves and ganglia, are said by Goronowitsch to be resolved into the surrounding mesoblast and not to have anything to do with the ganglia. These arise from Froriep's *Kiemenspaltorganen*, Beard's "branchial sense-organs." Like Sedgwick, who has described the development of nerve-fibre *in situ* in the mesodermic reticulum, Garonowitsch does not hesitate to call the nerve-forming tissue mesodermic,—which is an interesting return to the position of Remak. It is certainly "upsetting" to be informed—and with no lack of details and figures—that nerve-fibres are not processes of ganglion-cells, and that the neural ridges have nothing to do with the development of the cranial ganglia.

Metamerism of the Elasmobranch Head.†—A. N. Sewertzoff makes a contribution to the subject, dealing in particular with the head of *Torpedo*. It is not possible for us here to do more than indicate his general conclusion. The head-region of Batoids and Selachoids is developed on similar lines; there are two anterior (premandibular and mandibular) segments associated with the visceral arches, and behind these a series of head-somites homologous with the protovertebræ of the trunk. In *Pristiurus* and *Scyllium* there are 7 (3–9 of van Wijhe), in *Acanthias* 8 (3–10 of Hoffmann and Neal), in *Torpedo* 11 (3–13 of Sewertzoff). It seems that in the more specialised forms an increasing number of anterior trunk-segments are appropriated to form part of the head. On this view, *Pristiurus* is primitive, and *Torpedo* specialised. The author compares his conclusions as to Elasmobranchs with the facts known in regard to *Amphioxus* and Cyclostomata, and gives a hypothetical description of the state of affairs in the original Vertebrates.

Metamerism of Head in Petromyzon planeri.‡—Herr N. K. Koltzoff has studied this subject in an extended series of embryos, and publishes a preliminary account of his results. The first trace of segmentation appears at the stage where the fourth and fifth somites are differentiated. Though the first two somites, the premandibular and the mandibular, differ in some respects from the other somites, there is no reason to believe that they are anything but true somites, especially as the evidence is against von Kupffer's suggestion that the premandibular somite is a gill-pocket. This somite is always small, and does not acquire a cavity until the embryo is 3–4 mm. in length. The cells seem to form the oculomotor musculature. As in Selachians, it is difficult to distinguish between the second somite and the mandibular arch. The walls of the former give rise to the *musculus obliquus superior*, and possibly, though not probably, to the "prolongation of the velar muscles" (Hatschek). The gill-pockets do not show the same metamerism as the myotomes;

* Nouv. Mém. Soc. Imp. Nat. Moscou, xvi. (1898, received 1899) pp. 1–55 (3 pls.). See Nature, lxi. (1899) pp. 158–9.

† Bull. Soc. Imp. Nat. Moscou, 1898 (published 1899) pp. 393–445 (4 pls.).

‡ Anat. Anzeig., xvi. (1899) pp. 510–23 (3 figs.).

thus the third gill-pocket developes between the fifth and sixth myotomes; but this fact does not prove that the branchiomerism in Ammocœtes is different from the mesomerism; the dismetamerism is due merely to the exigencies of space in the embryo. The origin of the nerves, and their relation to somites, gill-arches, and gill-pockets, is then described in detail. The position of the first spinal ganglion shows that the head consists of six primary head-somites. The inter-somital clefts correspond above to the dorsal cephalic ganglia, and below to the gill-slits, although the latter have lost their primitive topographical relations. In other animals, secondary somites may be added to the six primary ones, but there is no fundamental difference between primary and secondary cephalic somites. There is an almost exact numerical and topographical agreement between neuromeres and somites.

Skull of Kestrel.*—Herr P. P. Suschkin gives an account of the development and structure of the skull in *Tinnunculus*. Besides contributions to our knowledge of the morphology of the bird's skull in general, and of falcons in particular, the memoir includes an interesting contrast of the development of the falcon with that of the chick. In the former there is slower development in the early stages, and palingenetic phenomena, e.g. the independent primordium of the trabeculæ and the retention of four pairs of "cranial ribs," are observed, which have been lost in the chick. In the later stages the development is relatively more rapid than in the chick. For the preservation of palingenetic traces a prolonged development is essential.

Development of Ductus Endolymphaticus.†—Prof. Kiebel quotes various authors (Netto, Poli) whose observations seem to disprove Hertwig's view that the *ductus endolymphaticus* represents the connection between ear and epidermis in Selachians, and so the last remnant of the ectodermal invagination which produces the ear-vesicle; and then figures a chick section which shows clearly a cord of cells connecting the developing ductus with the ectoderm. His sections prove that this cord of cells is the last remnant of the primitive connection between the ear-vesicle and its place of origin, and thus confirm Hertwig's views in all respects. He believes that the apparent absence of the connection between ductus and ectoderm in some Vertebrates is in all cases due to a hastening of events, the ear-vesicle being separated from the ectoderm long before the ductus originates.

Pads on the Palm and Sole of the Human Fœtus.‡—Mr. R. H. Johnson has studied these, and comes to three conclusions:—(1) There are, on the sole of the human fœtus of 2–3 months, four mounds situated interdigitally along the line of the metatarso-phalangeal joints. Three mounds exist in a similar situation on the palm. On the foot the mounds disappear; on the hand they persist as the less definite "mounts" of palmistry. (2) These mounds are homologous with the walking pads of some mammals, and have a direct relation to the "centres of disturbance" of the epidermic ridges on the palms and soles of man and other Primates. (3) Corresponding with a poorer development of these

* Nouv. Mém. Soc. Imp. Nat. Moscou, xvi. (1899) pp. 1–163 (6 pls.).
† Anat. Anzeig., xvi. (1899) pp. 490–2 (1 fig.).
‡ Amer. Nat., xxxiii. (1899) pp. 729–34 (6 figs.).

mounds on the hand than on the foot in the fœtus, the "centres of disturbance" occur on the foot more frequently than on the hand in the adult.

Cerebral Outgrowths in Geckos.* — Herr F. Melchers reaches the following conclusions. The epiphysis in *Platydactylus* is a simple median intrameningeal evagination of the roof of the thalamencephalon, pear-shaped, and with a solid stalk in adults. The paraphysis appears later, as a long permanently hollow sac, with an often branched blind end which lies in front of the epiphysis. Both are at a certain stage of embryonic life visible externally, and may once have been sensory. In the young animal both become vascularised, the epiphysis degenerates, and the paraphysis acquires a glandular appearance. The hypophysis appears before either of the preceding, and has a double origin as an evagination from the brain, combined intimately with a pharyngeal invagination. The orohypophysis is constricted off, and forms little buds like the paraphysis. The neurohypophysis becomes a long irregular vesicle. No present function can be stated.

Origin of Sexual Reproduction.†—Prof. O. Lignier seeks to show, from studies on the Algæ in particular, that the origin of fertilisation is to be found in its utility as a source of variations which form the raw material of adaptation, and, furthermore, that the dimorphism of the sex elements is an adaptation on the one hand (in the ovum) to providing the necessary nutritive material for early development, and, on the other hand (in the spermatozoon), to securing conjugation.

Female Urogenital Organs of Perameles.‡—Mr. J. P. Hill describes these organs in detail. Contrasted with those of other Marsupials, e.g. *Macropus*, the following features stand out as worthy of remark :—

(1) The absence of any sharply marked separation between the uterine and vaginal segments of the organs, the uterus being directly continued into the median vaginal cul-de-sac, and its os being extremely ill-defined.

(2) The small size and distinctness, in the virgin, of the median vaginal cul-de-sacs ; their termination at a relatively great distance from the urogenital sinus ; and their complete investment by the connective-tissue of the urogenital strand.

(3) The fact that the lateral vaginal canals (except their forward expansions—the vaginal cæca) are imbedded throughout their whole extent, together with the urethra, in an elongated mass of connective-tissue, the urogenital strand.

(4) The extremely short *sinus urogenitalis*, and the existence of a very distinct cloaca.

Features (1) and (4) constitute obvious marks of lowly organisation. As regards (2), the median vaginal apparatus in *Perameles* remains at a stage which is early passed over in the fœtal Macropod, and is without doubt extremely primitive. As concerns (3), the urogenital strand of the adult is nothing else than the persistent genital cord, from the tissue of

* Zeitschr. f. wiss. Zool., lxvii. (1899) pp. 139–66 (2 pls.).

† Miscellanées Biologiques, Station Zoologique de Wimereux, dédiées au professeur Alfred Giard, 1899, pp. 396–401.

‡ Proc. Linn. Soc. N.S. Wales, xxiv. (1899) pp. 42–82 (12 pls. and 3 figs.).

which the posterior ends of the uterine segments of the Müllerian ducts, and the entire vaginal segments of the same, never become free, except in so far as the forwardly projecting vaginal cæca may be said to have become free from the original tissue of the cord.

Pouch of Echidna.*—Prof. R. Semon admits, after Ruge's criticism, that he was mistaken in speaking of the rudiment of the pouch in the very young *Echidna* as paired. It is a single depression. He also refers to his observation of a female *Ornithorhynchus* at the height of lactation which did not show the slightest hint of a pouch. It has been supposed by some that there might be a temporary depression.

Young of Ornithorhynchus.†—V. Sixta communicates the field-notes of A. Topič on the breeding of the duckmole. The mouth of the burrow is below water-level; the nest-chamber (as large as a platter and as high as a loaf) is above high-water mark, and lined with hair from the backs of both male and female. In giving milk the mother lay on her back, and her two young tapped with their bills about the sieve-like openings of the glands. The milk ran into a median groove on the skin formed by the longitudinal musculature, and was thence lapped up. The young remain in the nest till they attain a size of 12 cm.; when 20 cm. in size, they venture with the mother into the water.

b. Histology.

Structure of the Cell.‡—Herr Georg Niessing continues his studies on the cells of the testis in the salamander, with special reference to the centrosome, the central spindle, and the structure of the nucleus. In cells in which the nucleus displays a skein-like structure, the centrosphere is distinct. It contains 2–3 central corpuscles, imbedded in a clear area, which is separated from the rest of the sphere by a finely granular stratum (membrane?). In the next stage, where the strands of the nuclear skein loosen, there is little change in the centrosphere, but as the nuclear skein begins to segment, the central corpuscles enlarge, become mulberry-shaped, and finally break up into granules. The granules occupy the polar spindles during division, and ultimately become the microcentres of the daughter-cells. In consequence the author defines central corpuscles as cell-organs in the shape of minute granules, which constitute the point of origin of the fibrillar rays. The connection with the system of fibrillæ is to be regarded as an integral part of the definition. The centrosome it is as yet impossible to define strictly, though the term may be used without fear of misunderstanding, the granules just described being known as centrosome-granules. They unite to form the centrosome proper. As to the nature of the connection between centrosomes and chromosomes—that is, the origin of the threads of the spindle—the author believes that the spindle is a supporting organ consisting partly of an elastic spindle-substance, and partly of contractile threads, fused with the spindle-substance and capable of bringing about changes of form in the spindle.

In regard to the structure of the nucleus, the author does not believe

* Morphol. Jahrb., xxvii. (1899) pp. 497–8.
† Zool. Anzeig., xxii. (1899) pp. 241–6. See Amer. Nat., xxxiii. (1899) pp. 743–4.
‡ Arch. f. Mikr. Anat., lv. (1899) pp. 63–110 (1 pl.).

that linin forms the ground substance both of chromatin and œdematin. He thinks that linin occurs in the latter only, the chromatin forming a continuous network, and not a collection of granules.

The relation of these results to Heidenhain's cyto-mechanical theories is then considered. The author rejects Heidenhain's theories, especially his law of tension (*Spannungs-gesetz*), and seeks to replace them by a dynamical theory. The fibrillæ are the great mechanical organs of the cell, but they are to be conceived as existing in a certain condition of contraction, which can be increased or diminished by impulses from the microcentre. This is not merely a point of insertion for the fibrillæ, but is a true centre of force, possessing great complexity, both of structure and function.

Nucleoli of Central Nerve-cells.* — Herr Vl. Růžička has found a method for studying the nucleolus, which, he says, is always present in central nerve-cells. It seems that the nucleolus contains several darkly stainable, solid (?) granules imbedded in the lighter nucleolar substance.

Innervation of Urinary Bladder.†—Dr. N. Grünstein, by means of Ehrlich's method, has studied this subject in the frog and in certain mammals. In the frog, as is well known, the bladder is innervated both from the cerebro-spinal and from the sympathetic system, and has in addition an automatic apparatus composed of large or small nerve-ganglia. These consist of nerve-cells and fibres, the former being invested by a pericellular network, and having one or two processes. These are readily distinguished from fibres which have pericellular endings by their structure and staining reactions. These fibres are non-medullated. The other non-medullated fibres are motor nerves, and end in unstriped muscle-fibres; this has not until now been histologically demonstrated for the urinary bladder. The medullated fibres are of two kinds: first, those with a thin sheath, usually regarded as of sympathetic origin; second, the ordinary thick-sheathed cerebro-spinal fibres. The first are few in number, and their origin and importance remains doubtful. The second are sensory, and are furnished with the peculiar end-organs called "trees" by Ehrlich. Among mammals positive results were obtained only in the dog. Here, as in the frog, nerve-ganglia of varying size occur in the bladder-wall. End-organs in the form of trees were demonstrated for the medullated fibres, but they appear to be less complicated than in the frog.

Structure of Neuroglia.‡—Herr Erik Müller has investigated this subject in a series of Vertebrate forms from *Amphioxus* and *Myxine* to Mammals. The methods employed were very various. In *Amphioxus* and *Myxine* admirable results were obtained by fixing for 24 hours in a mixture of 1 part of 3 per cent. potassium bichromate and 4 parts of commercial formol, placing for three days in a 3 per cent. solution of potassium bichromate, washing and hardening in spirit, and staining with Heidenhain's iron-hæmatoxylin. For higher Vertebrates, acid alcoholic fixatives gave the best results.

* Anat. Anzeig., xvi. (1899) pp. 557–63 (1 fig.).
† Arch. f. Mikr. Anat., lv. (1899) pp. 1–11 (1 pl.).
‡ Tom. cit., pp. 11–62 (3 pls. and 1 fig.).

In *Amphioxus* a section of the cord shows the ependyma-cells surrounding the central canal and continued into processes which form the supporting fibres of the cord. The peculiarity of the supporting substance consists not in the presence of these radially branching ependyma-cells, but in the fact that the overwhelming majority of the supporting cells have their cell-bodies placed on the central canal. The prolongations of these cells in part correspond to the ependyma-cells of higher Vertebrates, in part to the "glia" of these animals. In *Myxine* both ependyma-cells and glia-cells are present. The former show much general resemblance to those of *Amphioxus*. Careful examination of the neuroglia shows that it consists of fibrils having the same relation to the glia-cells as the ependyma-cells to their fibrils. In general the supporting tissue of the spinal cord of *Myxine* is a finely cellular tissue whose cells are characterised by the staining reactions of their outgrowths, and in certain places by their epithelial arrangement. A point of great interest is the similarity in arrangement between the glia elements and the nervous elements. Though the study of the neuroglia in the higher Vertebrates is much more difficult, yet the results are sufficient to show a general structural resemblance to the conditions seen in the lower.

The most general conclusions from these results are:—(1) that the most striking peculiarity of the neuroglia is the structural differentiation between its fibrils and the cells from which the fibrils originate; and (2) that the neuroglia forms a tissue transitional between a purely epithelial tissue and connective-tissue.

Cortical Cells of Cerebellum.*—Herr Bjarne Eide, by the use of the formol-chrome-silver method, has succeeded in staining the small cells of the molecular layer of the cerebellar cortex in the cat, so as to render possible the study of these little-known cells. He finds that the "small" cells are of three kinds:—(*a*) cells of the ordinary second type with short processes; (*b*) cells with long transversely arranged processes of remarkable structure; (*c*) transitional forms. In (*b*) the processes arise from the cell-body, or from a protoplasmic continuation of the cell, and almost at once break up into numerous branches (*Anfangsverästelung*). This is eminently characteristic of the cells, and distinguishes them at once from the basket-cells of the molecular layer. The cell-processes (axones) of the two kinds of cell are further distinguished by the fact that in the basket-cells the axis-cylinder is thick, in the small cells very thin. The axones also show a slight difference in position, those of the basket-cells being more deeply placed; the varicose appearance of those of the small cells is also distinctive. The two kinds resemble one another especially in that both ramify in a transverse plane, and in that their ascending branches ultimately end in both cases freely in the molecular layer.

Multiple Division of Nerve-fibres.†—Prof. E. Ballowitz discusses the multiple ("polytome"), brush-like or comb-like, division of medullary nerve-fibres which R. Wagner described in 1847 in the electric nerves of *Torpedo*. He has found a similar multiple division in *Malopterurus*, where the nerve enters the electric tissue, but it is not so marked as in

* Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 637–52 (14 figs.).
† Anat. Anzeig., xvi. (1899) pp. 511–6 (2 figs.).

Wagner's "bouquets." This indeed is the interest of the observation,—that it describes a state intermediate between that which usually occurs and that in the torpedo.

Structure of Stratified Pavement Epithelium.*—Sig. C. Foà has studied this in embryos of ox. He finds that between the cells there run closed chambers, like prisms, with polygonal section; in the older fœtus the limiting lateral laminæ coalesce, gradually thin off, and the lines of their intersection thicken, leaving eventually bridge-like threads between which there are spaces in which the nutritive fluid circulates.

Fat in Cartilage.†—Dr. C. Sacerdotti concludes, from detailed experiments, that the presence of fat in cartilage-cells is normal and constant. It increases *pari passu* with the functional development of the elements; it does not diminish during inanition, but only when the nutrition of the cell is profoundly altered.

Absorptive Affinities of Vascular Endothelium.‡—Henri Stassano has made experiments which go to show that the vascular endothelium has a particular affinity for mercury, thus explaining the predominance of this toxic in the more vascular organs. The same is true also in regard to strychnine and curari; and the general result of the investigation is to show the importance of the endothelial cells in absorption as well as in arrest.

Cell-changes during Digestion.§—Prof. E. Wace Carlier has studied this subject in the stomach of the newt. He finds that in the cells prozymogen is produced by the nuclei at the same time that the zymogen already formed is being secreted by the cell in the form of zymin. The nucleoli consist entirely of effete matter produced during nuclear activity, and ultimately passed out into the cytoplasm. The nucleoli do not become converted into zymogen granules. Nuclear exhaustion is due to the manufacture of prozymogen, which arises from the nuclear chromatin. The chromatin is renewed by the entrance into the nuclear juice of a coagulable substance, which probably includes a proteid. Both chromatin and zymogen contain the same nuclein radicle, but differ in the amount of linked albumin. Parazymogen is chromatin less some of its albumin; it takes up some albumin from the cytoplasm, and becomes converted into zymogen. The albumin separated from the chromatin during the formation of parazymogen goes to form the nucleolus.

Dermis and Epidermis.‖—Dr. Ed. Retterer has always opposed the current views as to the relation of these two structures. He believes that the facts both of histiogenesis and of transplantation experiments show that the epidermis itself, or the subjacent epithelial membrane, gives rise to the connective-tissue of both the adult and embryonic dermis. In other words, it is incorrect to say that the epidermis forms a permanently distinct membrane, growing only from within outwards. Till recently his observations have received no support or confirmation

* Atti R. Accad. Sci. Torino, xxxiv. (1899) pp. 1004–12 (1 pl.).
† Tom. cit., pp. 984–1003 (1 pl.).
‡ Comptes Rendus, cxxix. (1899) pp. 648–51.
§ La Cellule, xvi. (1899) pp. 405–64 (3 pls.).
‖ Journn. Anat. et Physiol, xxxv. (1899) pp. 675–6.

from other authors, but the experiments made by Loeb appear to confirm them, indicating as they do that epidermic cells may be directly converted into connective-tissue cells.

Myelocytes of Invertebrates.* — M. Joannes Chatin finds that in animals in general those nerve-elements usually called myelocytes really consist of cells with a voluminous nucleus surrounded by a ring of cytoplasm. He has recently studied the myelocytes of Annelids and Gastropods by the method of Nissl, and finds that in both there is a distinct nuclear membrane. Further, in both, the structure of the nucleus is the same as in the "small nerve-cells with little protoplasm," studied by Ramon y Cajal in Vertebrates. When the chromatin becomes localised in the myelocytes of either Annelids or Gastropods, it accumulates in little masses at the nodes of the nuclear network, and may then give rise to nucleoli.

Intra-Vitam Granula-Staining.†—Prof. J. Arnold finds that it is possible with neutral red and methylen-blue to demonstrate the granules in living leucocytes. He has also succeeded with the tongue, web, and mesentery of the living frog, showing that the granule does *not* consist of pigment particles taken in from outside, but owes its origin to an intracellular process. The arrangement of the granules, and their relation to indubitable structural elements, lead Arnold to greater confidence in his previous conclusion that the granules are important normal components of the cytoplasm, probably arising from a modification of plasmosomes.

"Islands of Langerhans" in Pancreas.‡ — Dr. Vincenzo Diamare discusses the anatomical and morphological value of these components of the Vertebrate pancreas. He agrees with Giannelli in believing that Langerhans' cells constitute permanent elements of the pancreas; but he does not consider that there is any evidence that they are of importance in modifying the composition of the pancreatic juice; on the other hand, they probably produce a characteristic internal secretion. He does not, further, agree with Giannelli's latest theory that the cells are merely a rudimentary portion of the pancreas without functional importance, but believes them to be an important constituent of an organ whose functions are very complex. The conditions in reptiles afford no support for Languesse's view that in these animals the endocrinous tissue is produced by an alternate metamorphosis of the esocrinous tissue during the course of life. On the contrary, the endocrinous tissue is as constant an element of the pancreas in reptiles as in other Vertebrates.

c. General.

Variation.§—Prof. Adam Sedgwick took for the subject of his presidential address to Section D of the British Association, Variation and some phenomena connected with reproduction and sex. He uses the term variation to include all the differences between members of a species—what we should prefer to call simply the observed differences.

* Comptes Rendus, cxxix. (1899) pp. 554–5.
† Anat. Anzeig., xvi. (1899) pp. 568–72. ‡ Tom. cit., pp. 481–7.
§ Address to the Zoological Section Brit. Assoc., Dover, 1899, 19 pp.

These he distinguishes as genetic variations and acquired modifications, or, as many would now say, simply variations and modifications. Later on he speaks also of "acquired variations."

After pointing out that genetic variation is generally, if not essentially, connected with sexual reproduction, he considers the features of this process, distinguishing :—(*a*) the real reproductive act, which is the division by fission of the parent into two unequal parts, one of which continues to be called the parent, while the other is the gamete; and (*b*) the subsequent conjugation-process, in which a new individuality is formed by the fusion of the distinct individualities of two gametes. The phenomenon of sex, with all its associated complications, is merely a device to ensure the coming together of the two gametes.

Impressed by the fact that every acquired character presupposes a congenital possibility of acquiring it, Mr. Sedgwick observes that "every feature which successively appears in an organism in the march from the uninucleated zygote to death is an acquired character." This, however, is a new usage, and seems somewhat inconsistent with the previous classification of observed differences into (*a*) congenital variations, and (*b*) acquired characters; for while the subject with which Mr. Sedgwick started was variation, at this stage he discusses the development of all the characters of the organism. What others call acquired characters he would call variations in the acquired characters. "A genetic character is the possibility of acquiring a certain feature under the influence of a certain stimulus; it is not the feature itself—that is an acquired character—but it is the possibility of producing the feature." "A genetic character is a character which depends upon the nature of the organism, while an acquired character depends on the nature of the stimulus." Would it not be clearer to return to the old distinction between variation and modification?

The author points out the difficulty of conceiving the mechanism whereby a modification of, say, the right arm, could be transmitted. That changed conditions may have an effect upon the reproductive organs is admitted; but he thinks that the only effects which can be spoken of with certainty are (*a*) the production of sterility, and (*b*) an increase in genetic variability.

Returning to the question, Are genetic variations ever found in asexual reproduction? Mr. Sedgwick inclines to answer in the negative. "If any indefinite variability, recalling genetic variability, makes its appearance, it must be part of the genetic variability, and directly traceable to the zygote from which the asexual generations started." This is opposed to Weismann's view that nutritive changes in the body may induce variations in the germ-plasm.

In considering modifications of the reproductive organs in cases of asexual reproduction, he asks three questions :—Will the modification in the offspring have any adaptive relation whatever to the external cause? (Probably not.) Will all the forms subjected to the modifying influence be affected in the same way? (Presumably they will.) Will the modification last beyond the life of the individuals produced by the affected reproductive organ? (No data for decision.)

Using the word heredity as equivalent to genetic resemblance, he proceeds to point out that "heredity is really applicable only to the appearance in a zygote of some of the properties of the gametes." "A zygote has this property of one of the preceding gametes, and that property of another, in virtue of the operation of what we call heredity; it has a third property, possessed by neither of the precedent gametes, in virtue of the action of variation." But perhaps it is simpler to say that in asexual reproduction the expression of the inherited qualities tends in development to result in a complete genetic resemblance, while in sexual reproduction the expression of the inherited qualities tends in development to result in a new individuality. It seems to us preferable to retain the word heredity as a term for the relation between successive generations.

In conclusion, Mr. Sedgwick suggests that the result of continual selection will be to diminish the variability of a species, and if carried far enough, to produce a race with so little variability, and so closely adapted to its surroundings, that the slightest alteration in the conditions of life will cause extinction. But if selection tends to diminish the variability of a species, then it clearly follows that, as selection has been by hypothesis the most important means of modifying organisms [evolving species?], variation must have been much greater in past times than it is now. In fact, it must have been progressively greater the further we go back from the present time. "Following out the same train of thought, we are inevitably driven to the conclusion that one of the most important results of the evolutionary change has been the gradual increase and perfection of heredity [completeness of hereditary resemblance?] as a function of organisms, and a gradual elimination of variability."

Statistical Study of Variation.*—Prof. C. B. Davenport has published a very useful little book giving a simple presentation of the newer statistical methods in their application to the study of organic variation, or, as he (mistakenly) calls it, biological variation. Chapter I. deals with the methods of measuring organisms; Chapter II. with the seriation and plotting of data and the frequency polygon; Chapter III. with the classes of frequency polygons; Chapter IV. with correlated variability; Chapter V. with some applications of statistical biological study. Then follow tables of much convenience for actual work. The book is marvellously terse, but we wish that it had been less so; we hope that its extensive use will ensure a demand for a second edition in a short time, and that the author will then rewrite the introduction and add a sketch—historical and prospective—convincing the unimpressed of the value of this new departure.

This statistical study of variations is of great importance, not only to evolution doctrine, but to a sound taxonomy (for it is time that the diagnosis of a species on two or three specimens should be ruled out of court in cases where hundreds are readily procurable). Therefore we would direct attention to two other introductions to the subject, viz. G. Duncker's 'Methode der Variationsstatistik,' † his article 'Variation-statistics in Zoology,' ‡ and Mr. H. M. Kyle's lucid article, 'An extension of the method of treating variations, with examples and certain

* 'Statistical Methods, with Special Reference to Biological Variation,' New York and London, 1899, vii. and 148 pp.

† Leipzig, 1899, 8vo, 75 pp. Bibliography of 111 papers. Reprint from Arch. Entwickmech., viii.

‡ Natural Science, xv. (1899), pp. 325-36.

conclusions.' * For concrete illustration, incomparably the best guide is Heincke's 'Naturgeschichte des Herings' (1898), while the mathematical basis must be sought for in the works of Galton and Pearson, to which references will be found in the bibliographies furnished by Duncker, Davenport, and Kyle.

Additional Carpalia.†—Herr P. Eisler has investigated a number of human subjects with a view to determining the frequency of carpal variation. In about sixty extremities, two only showed additional carpals. Both belonged to the same subject—a young male. The right carpus contained three completely separated additional bones—an *epipyramis*, a *trapezoides secundarium*, and a *styloideum*; the left contained only a *trapezoides secundarium*.

Selective Elimination of Sparrows.‡ — Prof. H. C. Bumpus has illustrated the elimination of the unfit in connection with the English sparrow in the United States. After a severe storm a number of benumbed sparrows were brought to the laboratory. Seventy-two revived; sixty-four perished; and a careful comparison (the results of which are tabulated in detail) led to three conclusions:—(1) That the birds which perished were eliminated not indiscriminatingly, but because of observable deficiency in certain structural characters possessed by the survivors; (2) that the process of selective elimination is most severe with extremely variable individuals, no matter in what direction the variation may be; and (3) that disregard of structural qualifications (as in the introduced sparrow) finally produces a throng of degenerates, whose destruction will follow the arrival of adversity.

Variations of Hyla regilla.§ — Dr. F. C. Test reads a lesson to impetuous species-makers. No fewer than seven names have been applied by different persons at various times to tree-frogs from beyond the Rockies. To clear up the matter, Dr. Test has examined the 512 specimens from 75 localities now preserved in the U.S. National Museum. The conclusion is that the various species of Pacific hylas described within the last forty-five years appear to have been established on insufficient characters, and intergrade to such a degree as not to be specifically or even subspecifically separable. All are referable to one species, *Hyla regilla* of Baird and Girard.

Respiration in Birds.‖—Prof. R. Dubois recalls Soum's thesis the conclusion of which was that the air-sacs work not in antagonism but in synergism with the lungs, and that the latter are dilatable. Dubois has confirmed this by using the X-rays, whereby it was possible to prove *de visu* the synergic movements of the air-sacs and the movements of contraction and dilatation on the part of the lungs.

Respiration in Chelonians.¶—Prof. E. Couvreur has made observations on *Cistudo europæa*. He notes the previous results of Charbonnel-Salle that pauses occur in full inspiration and are due to occlusion of the glottis, and that while in *Testudo* the respiratory movements are

* Natural Science, xv. (1899) pp. 410–22.
† Anat. Anzeig., xvi. (1899) pp. 487–9 (1 fig.).
‡ Biol. Lectures Wood's Holl, 1898, Boston, 1899, pp. 209–26.
§ Proc. U.S. Nat. Mus, xxi. (1899) pp. 477–92 (1 pl.).
‖ Ann. Soc. Linn. Lyon, xlv. (1899) pp. 95–6. ¶ Tom. cit., pp. 5–8 (4 figs.).

particularly due to movements of the girdles, those of *Cistudo* are especially due to the muscles *diaphragmaticus* and *transversus abdominis* (expiratory) and *obliquus abdominis* (inspiratory).

To these Couvreur adds the following results:—(1) The pause may occur independently of the state of the glottis,—by the sustained contraction of the inspiratory muscles. It may occur in full inspiration, or in half-inspiration; but, oftenest, immediately after inspiration the expiration begins, lasts long, and is followed by a pause when at its full. (2) Distinct movements of the plastron correspond to the respiratory movements. (3) Below the larynx the pneumogastric contains especially the inspiratory fibres, or, more exactly, the sensory fibres producing the inspiratory reflex.

Respiration in the Frog.*—Prof. E. Couvreur corroborates Paul Bert as to the following mechanism in the frog's respiratory process:—(1) Lowering the floor of the mouth, the glottis being shut, the nares open, entrance of air; (2) Pause in lowering the floor of the mouth, glottis open, nares open, contraction of flank muscles, passage of air outwards by the nostrils (expiration); (3) Raising the floor of the mouth, glottis open, nares narrowed, passage of air to the lungs (inspiration).

He has registered the intra-buccal and the intra-pulmonary pressure, and finds that they do not quite correspond at given times. He concludes that not all the movements of the buccal floor are true respiratory movements, reacting on the lungs; and that the true respiratory movements are not all of the same value, some being especially inspiratory and others expiratory. The lung is at first gradually inflated, then it deflates intermittently. The opening and closing of the glottis permits or prevents the elasticity of the lungs from asserting itself, and limits expiration.

This does not seem quite clear in summary, but a more concrete statement is given. Suppose the lungs full of air; a first contraction of the abdominal muscles drives part of this air out by the open glottis, during a pause with mouth-floor lowered; this air passes out by the nares. At the next raising of the floor, either the glottis is shut and nothing enters the lungs, or only a little air enters, less in quantity than that which has just come out. Soon a new abdominal contraction drives more air out from the lungs. This is repeated four or five times, till the lung is completely deflated. Analogous movements continue, but with this difference, that now more air goes into the lung than comes out, whence the inflation of the lung. One may say that the expiration occurs by instalments, and the inspiration likewise pauses, separating the various periods, with a particularly long pause when the lung is at its maximum inflation.

In birds and mammals inspiration and expiration have the same amplitude and occur without pause. In Amphibians and reptiles there are almost always pauses; inspiration gaining on expiration, the lung inflates; expiration gaining on inspiration, the lung deflates; and the pauses occur either at full inspiration or in half-expiration. We wish that the author had been less terse in his statement, and we are not sure that we have altogether understood his conclusions.

* Ann. Soc. Linn. Lyon, xlv. (1899) pp. 1–4.

Increase of Weight during absolute Fasting.*—Prof. R. Dubois continuing his experiments on hibernating marmots, corroborates the old conclusion of Sace and Valentin that there may be from time to time a slight increase in weight. In part this may be due to fixation of oxygen by the blood; but the larger increase noted by Bouchard is perhaps due to the transformation of fats into glycogen.

Production of Heat by Cold-blooded Animals in Water.†—Prof. R. Dubois has followed P. Regnard in using thermo-electric needles in studying the changes of temperature in cold-blooded animals. Two goldfish of the same size, one living and the other dead, both provided with a thermo-electric needle, were plunged in water warmer than the aquarium from which they were taken. An hour after, the deviation of the galvanometer through four large divisions showed that the living fish was the warmer. When placed in water colder than the body, the dead fish was more rapidly brought into equilibrium with the external temperature than the living fish. It was noticed that the respiratory movements became slower as the temperature was lowered.

Vitality of Cells after Death of the Organism.‡—Prof. J. Orth has, along with some more technical questions, discussed the researches of Grawitz and others on the continued vitality of cells after excision or after the death of the organism. Among lower animals prolonged vitality in such cases is familiar, but it is in many cases associated with regenerative processes and may be interpreted as adaptive. In higher animals a retention of a particular function, such as ciliary action or contraction, must be admitted; but of assimilation or new-formation there seems no sufficient evidence. The facts seem to show that cell-division and the like come abruptly to a standstill.

Sense of Direction during Sleep.§—Prof. R. Dubois has made an interesting observation. Hold a marmot in deep slumber on the spread hands so that its mouth is directed forwards and its body lies in the same horizontal axis as the head; then turn round, and the tip of the snout is still pointed in the previous direction, while the axis of the body forms a somewhat pronounced angle with the axis of the head.

Observations on Torpedos.‖—Prof. R. Dubois has observed that a female torpedo, which had been giving vigorous electric discharges while with young, ceased to do so when the newly-born young ones were gathered about her. After they were removed, the mother once more gave vigorous shocks. He concludes that the discharge is "voluntary," that it is dangerous for the young after, though not before birth, and that the mother must be credited with maternal affection. The unborn young are unaffected by the discharge, just as the internal organs are unaffected.

In another paper ¶ he points out, that in *Torpedo marmorata* and *T. oculata* an examination of the electric organ shows neither sugar nor glycogen. If this be correlated with the accumulation of urea in the organ (Gréhant and Jolyet) after repeated discharges, we are led

* Ann. Soc. Linn. Lyon, xlv. (1899) pp. 101–3. † Tom. cit., pp. 77–8.
‡ Nachr. Ges. Wiss. Göttingen, 1899, pp. 143–65.
§ Ann. Soc. Linn. Lyons, xlv. (1899) pp. 81–2. ‖ Tom. cit., pp. 80–1.
¶ Tom. cit., pp. 98–9.

to the conclusion that this organ, so closely allied to muscle, must derive the energy it expends from proteid substances.

In the marmot's hibernal slumbers, when it is quite unstimulated, there is no sugar or glycogen in the blood and muscles, although movements can be readily provoked, and although those of the heart and those associated with respiration continue. This leads Dubois to conclude that the sugar and glycogen in homœothermal animals are above all useful in producing the temperature necessary for the vigorous functioning of the muscle-fibres.

Phosphorescent Organs of Toadfish.*—Mr. C. W. Greene has investigated these organs in *Porichthys notatus* Girard, which is a common inhabitant of the shore waters off the western coast of North America. The organs are obvious in the living fish as bright silvery spots, arranged in rows chiefly on the ventral and ventro-lateral surfaces of the body; they are closely associated in their distribution with the lateral line sense-organs. Each phosphorescent organ is placed in the deeper portion of the dermis, and consists of the following parts:—(1) the lens, a mass of polygonal cells with highly refractive cytoplasm; (2) the gland, a shallow cup of cells secreting a substance soluble in alcohol; (3) the reflector, a cup-shaped structure composed of modified connective-tissue, whose constituent fibres are largely modified into reflecting "spicules"; (4) pigment, which, in the form of branched chromatophores, occurs in connection with the reflector. The phosphorescent organs have apparently no special nerve supply. They arise late in development, apparently from a proliferation of local epidermal cells. The function of the organs is doubtful; for it would appear that phosphorescence has not been observed to occur under natural conditions. Nevertheless, fish placed in sea-water made alkaline by ammonia are brilliantly phosphorescent, and the phenomenon can also be produced by vigorous electrical stimulation; but in two fish obtained from deep water phosphorescence could not be produced by any means. The majority of the specimens were sexually mature forms obtained from the vicinity of the nests, and as all these could be rendered phosphorescent, there is a possibility that the organs are more highly developed at the breeding season.

Air and Water as Factors in Nutrition.†—Prof. R. Dubois comments on S. Jourdain's observations on the manner in which the eggs of amphibians utilise air and water. Dubois has shown that there is at a certain stage in the development of the glowworm a period when the weight increases, due to a fixation of the results of oxidation and to the absorption of water.

Relation between Structure and Function.‡—Prof. C. S. Sherrington noted, in a presidential address to the Liverpool Biological Society, that at first sight, function seems in many instances more obviously related to morphological structure than is borne out by a more searching examination of the two. He took the arm and hand of man, with particular reference to their nerves, as an illustration of the question—

* Journ. Morphol., xv. (1899) pp. 667–96 (3 pls.).
† Ann. Soc. Linn. Lyon, xlv. (1899) pp. 99–100.
‡ Proc. and Trans. Liverpool Biol. Soc., xiii. (1899) pp. 1–20.

how far the structure helps toward an understanding of the problems of the performance of the function. For the present it seems clear that the laws of morphological structure and of physiological structure, though they must be fundamentally correlated, are much more different than many are accustomed to think of them.

Structure of Bone in its Functional Aspect.* — Dr. J. Wolff has returned to this subject, which he discussed in his '*Gesetz der Transformation der Knochen*' (Berlin, 1892). The leading idea, that the architecture corresponds in detail to what is demanded by the prevalent strains and stresses, was suggested by Bourgery and Ward, and afterwards developed by the mathematician Culman, and also by H. von Meyer. To Wolff, however, belongs the credit of showing how, in the transformation of bones, in response to altered function, the same architectural principles, so to speak, are observed. In normal and abnormal conditions alike, the bone is mechanically correlated to the needs of the case.

Utility of Phosphorescence in Deep-Sea Animals.† — Mr. C. C. Nutting advances the hypothesis that all the more important organisms upon which fixed Cœlentera feed (small Crustaceans, Protozoa, &c.) are likely to be attracted by light, that phosphorescent light affects them in this manner, and that, therefore, the utility of the phosphoresence of so many fixed Cœlentera is to help them to secure their food.

Grouping of Hairs on the Skin.‡—Dr. J. C. H. de Meijere considers one of Maurer's arguments for deriving hairs from integumentary sense-organs. The argument is that both are distributed over the skin in groups, the members of which arise from a single primordium. According to de Meijere the simplest grouping of hairs is in threes, of which the mid-hair exceeds the laterals in length and thickness, but the members of the group do *not* arise from a single primordium. He gives detailed illustrations, showing that Maurer's hypothesis does not fit the facts as regards the grouping of hairs.

Pneumaticity of Mammalian Skull.§—Dr. Simon Paulli begins a series of memoirs on this subject with a discussion of the comparative morphology of the bones of the olfactory capsule. The present paper is devoted especially to the olfactory region in Monotremes and Marsupials, and to the contrast between these and other mammals. He finds that in *Ornithorhynchus* the peripheral olfactory organ is much reduced, while in *Echidna* it reaches a high degree of development. In the latter the cribriform plate is horizontal, a position which is necessitated by the great development of the olfactory lobes, and which modifies the position of the other bones of the olfactory region. Neither in *Echidna* nor in *Ornithorhynchus* are there any pneumatic spaces. Among Marsupials these have been found only in *Phascolarctus*, and in that animal the form of the nasoturbinal and of the fifth endoturbinal is in consequence much modified. These observations lead the author to the conclusion that the olfactory capsule usually displays adaptive

* Virchow's Archiv, clv. (1899) p. 256. See Biol. Centralbl., xix. (1899) pp. 738–44.
† Amer. Nat., xxxiii. (1899) pp. 793–9.
‡ Anat. Anzeig., xvi. (1899) pp. 249–56 (2 figs.).
§ Morphol. Jahrb., xxviii. (1899) pp. 147–78 (1 pl. and 16 figs.).

modifications, varying in accordance with the habit of the particular animal. The paper includes a discussion of the morphology of the olfactory region in Eutheria.

Inner Ear of Echidna.*—Dr. R. Eschweiler has gone over again his serial sections of *Echidna* on account of Hyrtl's statement that a *fenestra cochleæ* does not exist. Eschweiler's sections show clearly the existence of the *fenestra*, and also prove that Hyrtl is mistaken in regard to various other points of minute anatomy.

Myology of Anomalurus.†—Mr. F. G. Parsons, true to his conviction that muscles, if judiciously used, are capable of giving a great deal of information about the relationships of animals, because they do not readily adapt themselves to changed conditions of life, has tested the resources of myology by tackling the problem of the systematic position of *Anomalurus* among Rodents, a question to which many answers have been given. As a result of his comparative myological method applied to *Anomalurus*, he concludes that its affinities are decidedly sciuromorphous in the main, though it shows certain definite myomorphous characteristics.

Pyloric Cæca of Teleosteans.‡—Th. Bondouy has been prompted to make a fresh study of these organs by the discrepancy of the interpretations which have been suggested in regard to them. Some have called them digestive, others have positively denied this; some have regarded them as compensating for the pancreas which, though diffuse, is anything but absent in Teleosteans, others have compared them to the spiral valve of Elasmobranchs, and so on.

The author has studied the structure and even more the function of the pyloric cæca in *Merlangus Pollachius*, *Mugil chelo*, *Motella mustela*, *Cottus bubalis*, *Lophius piscatorius*, *Cyclopterus lumpus*, *Lota molva*, *Gadus luscus*, *Pagellus centrodontus*, *Rhombus maximus*, *Trutta fario*, and *Serranus cabrilla*.

In these species the pyloric tubes have an active rôle in digestion. Almost always their juice digests fibrin, and the proteo-hydrolytic ferment behaves like trypsin. Starch is changed into sugar; inulin and saccharose are not affected; nor is there any effect on fats. The tubes are not homologous with the pancreas, but they supplement its action by passing a surplus of ferments into the alimentary canal. In the Cyprinidæ which have no cæca the intestine secretes trypsin throughout its length; in most species with pyloric cæca the secretion is localised in these. There is no analogy with the spiral valve, for it is absorptive only, not digestive. The absorptive rôle of the pyloric cæca is minimal, very little food goes into them. The abundant mucus which they secrete helps the passage of the chyme down the intestine.

Anatomical Notes on Holocephali and Dogfishes.§—Dr. H. C. Redeke contrasts the kidneys of Holocephali with those of Selachians. In the latter the cranial portion of the kidney in the male comes into relation with the liberation of the sex-elements; but there is no differ-

* Anat. Anzeig., xvi. (1899) pp. 584–90 (3 figs.).
† Journ. Linn. Soc. (Zool.), xxvii. (1899) pp. 317–34.
‡ Arch. Zool. Expér., vii. (1899) pp. 419–60 (3 figs.).
§ Tijdschr. Nederland. Dierk. Ver., vi. (1899) pp. 119–36 (2 pls.).

entiated *Geschlechtsniere* in Holocephali. Furthermore, the caudal zone is still very small relatively; each segment has more or less distinctly its proper terminal canal; and the caudal terminal canals have not coalesced.

In some Selachians, such as *Acanthias*, there is, as Aristotle noted, only one ovary. This is well known; but Redeke points out that in some species of Batidæ the same is true, and that in these the unilateral development is expressed also in the whole genital tract. Thus in ten specimens of *Trygon pastinacea* he found only a left ovary. Four other cases of unequal development are noted, and it is always the right side which tends to be rudimentary. The author seeks to correlate this with the great development of the "spiral valve" of the intestine, which may also affect the size of the kidney, as Howes has shown. There are also in this paper some notes on the polyembryonic egg-capsule of *Trygon*.

Structure of Silurus.*—Dr. Maurice Jaquet gives an account of the skeletal structure and musculature of this interesting fish. He entitles his memoir, Researches on the Anatomy and Histology of *Silurus glanis* L., but there is as yet no histology.

Sylvan Biology.†—Dr. O. E. Imhof puts in a plea for a more systematic study of "*sylvestre Biologie*"—the bionomics of the woods, which, as he rightly remarks, may have quite as much interest as is to be found in the study of the fauna of lake and sea-shore and other habitats. He gives an outline of the representative fauna from the Turbellarians and Anguillulidæ to the Limacidæ and Helicidæ. He might have made his "*vorläufige Notiz*" stronger than he has done; but many field-naturalists who are more at home in the woods than in or on the waters will welcome his vindication of their possibilities of dealing, not merely on *terra firma*, but in the shades of the woods, with the problems of biology, as well as his suggestion of sylvan stations—in short of a scientific "*Walden*."

Fauna of Roumania.‡—Progress is being made with the census of Roumanian animals. Adrien Dollfus deals with a collection of Isopods, of which *Porcellio serialis* is perhaps the most interesting; E. Poncy identifies a large number of Coleoptera; and Carl Verhoeff names 11 Chilopoda and 17 Diplopoda. The collections were all made by Jaquet. A later instalment deals with Lepidoptera, &c.

Plankton of Lake Leman.§—Prof. E. Yung has followed Hensen's method in studying the quantitative variations on the plankton of the Lake of Geneva, but his results have led him to doubt the reliability of the method. He finds that the plankton occurs at all depths; that the distribution is far from uniform, either horizontally or vertically; that during the day (especially in bright sunshine), the larger plankton leaves the surface and descends to the depths; and that there is a great seasonal variation.

* Bull. Soc. Sci. Bucarest, viii. (1899) pp. 129–78, 378–92 (21 pls.).
† Biol. Centralbl., xix. (1899) p. 719.
‡ Bull. Soc. Sci. Bucarest, viii. (1899) pp. 117–28, 365–77.
§ Arch. Sci. Phys. et Nat., viii. (1899) pp. 344–64 (1 pl.).

Influence of Soil on Fauna.*—J. A. Cl. Roux, in his geological study of the Lyonnese mountains, applies his results to an interpretation of the peculiarities of the region, not only climatic, economic, and hygienic, but also as regards the fauna and flora. He comes to the conclusion that the absence of calcareous salts has an undeniable influence on the animal life. In general terms, the fauna of a siliceous region is less vigorous, less rich, less varied in species, less abundant in individuals, than a calcareous region. This is particularly true as regards molluscs, certain kinds of insects, crustaceans, and worms, but it also affects Vertebrate forms.

Perhaps the best illustration is furnished by the terrestrial snails, which are poorer in numbers and species, smaller in size, and have more delicate shells. On the other hand, to pass to the other end of the scale, the Heliozoa, like *Acanthocystis*, are extremely abundant, and are remarkable for the fine proportions of their siliceous skeletons. The essay is a most interesting one in its detailed attempt to correlate geological and biological facts.

Habitat of Whales.†—Dr. Ernst Vanhöffen contests the usual statement that whales and the Cetacea generally are inhabitants of the high seas. The various plankton expeditions have recorded with much exactness the numbers of whales seen, and their observations go to show that whales and dolphins are in reality shore-haunting animals. This is confirmed by the plankton records, which show that surface forms are most abundant near the shore, where their numbers are continually reinforced by the larvæ of the littoral animals. Where whales are frequently found in the high seas, observation shows that the area is one to which currents carry the abundant plankton of the shore waters.

Tunicata.

Embryology of Salpa.‡—Herr Alexis Korotneff has been enabled to supplement his observations on *S. fusiformis* by an investigation of the early stages of *S. maxima-africana*. Some of his sections show the formation of a polar body, which is of much interest, because it is as large as the egg-cell itself; it may be that this is the primitive condition (cf. Boveri). In regard to the segmentation, the following special points were noted. From a very early stage the blastomeres are differentiated into a few large and numerous small cells. The former display yolk-spherules in the later stages of segmentation, but the author believes that these arise from a differentiation of the protoplasm of the cells, and not from follicle-cells taken up by these blastomeres. Among the small blastomeres certain cells are early differentiated as germ-cells. Later the distinction between macromeres and micromeres is obliterated. As to the origin of the atrial chamber, the observations on the present species confirm the author's previous statements that this originates as a split in a mass of follicle-cells, and spreads by the separation of the elements and not by a process of invagination. The basal plate is an entirely provisional structure, formed of follicle-cells, and quite without the importance assigned to it by Heider.

* Ann. Soc. Linn. Lyon, xlv. (1899) pp. 105–56.
† Zool. Anzeig., xxii. (1899) pp. 396–401.
‡ Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 625–6 (3 pls.).

Simple Ascidians from Spitzbergen.* — Dr. Robert Hartmeyer publishes an important paper on the simple Ascidians collected by Dr. Kükenthal in the Bremer Expedition. The paper is later to form part of the article on Monascidia in Römer and Schaudinn's 'Fauna arctica,' and contains many anatomical details, an account of the distribution of the forms discussed, and full literature lists. An interesting point is the erection of a new species (*C. arctica*) for the Arctic *Cynthia* hitherto included under *C. echinata.*

Vascular Ampullæ in Botryllidæ.†—Mr. F. W. Bancroft has studied the function of the terminal enlargements or ampullæ which occur on the (ectodermic) colonial vessels of the Botryllidæ. They are found nearly everywhere within the colony, but are situated principally along the edges, which they often line several rows deep. Some zoologists still hold that these ampullæ may form buds, but most consider them as reservoirs for blood, as organs for the secretion of the test matrix, and as helping in respiration. Bancroft finds that in these three respects the ampullæ perform important functions, but he adds another to the list of their activities,—namely, that of blood propulsion.

In *Botryllus* and *Botrylloides* they normally execute co-ordinated pulsations; these pulsations continue after separation from the rest of the colony, but the nature of the co-ordination changes. In the various zooids the hearts do not beat in time; the rhythm of the ampullar pulsations is not affected by the reversals of the hearts of the zooids. The pulsations are very slow, the systole averaging 38 seconds and the diastole 33; the contracting tissue is a thin pavement epithelium. The co-ordination of the ampullæ is accomplished principally by means of variations in blood-pressure. In the æstivating colony of *Botrylloides gascoi* the circulation is kept up almost entirely by the ampullæ.

Branchial System of Ascidians.‡—Marc de Selys Longchamps concludes a detailed description of the branchial system of *Ascidiella scabroides*, and considers the value of its structural peculiarity as a specific character. The differences at different ages are very marked; thus it seems probable, though not certain, that *A. scabroides* and *A. scabra* are one and the same species at different stages.

INVERTEBRATA.

Mollusca.

a. Cephalopoda.

Experiments on Squid Eggs.§—Herr W. Schimkewitsch finds that extraordinary changes can be brought about in the developing ova of *Loligo* by placing them in solutions containing sulphate of magnesium, bromate of sodium, guanin, &c. Thus, the invagination process may be replaced by what is essentially delamination. The ectoderm-cells, after reaching the yolk in the annular depression, may exhibit a one-sided teloblastic growth; but diagrams would be necessary to make this point clear. In one case, in lithium solution, the normally invaginate

* Zool. Jahrb. (Abt. Syst.), xii. (1899) pp. 453–520 (2 pls. and 11 figs.).
† Zool. Anzeig., xxii. (1899) pp. 450–62 (2 figs.).
‡ Arch. Biol., xvi. (1899) pp. 153–71 (3 pls.).
§ Anat. Anzeig., xvi. (1899) pp. 564–8.

otocyst was represented by a compact evagination, a fact which recalls Herbst's exogastrulæ in sea-urchins. It is suggested that the changes in the division processes, e. g. from indirect to direct, are not the direct result of the solutions, but are due to accumulations of certain substances in the cells, i. e. are the expressions of induced cellular degeneration.

γ. Gastropoda.

"Varieties" of Helix pomatia.*—Herr O. Buchner protests against the careless use of the term "variety." "A true variety," he says, "forms the bridge towards the formation of a new species." A variety cannot be established unless it be shown that there are constantly inherited novel characters interpretable as adaptive to particular conditions. An individual variation must not be made the basis of a variety, nor a hybrid, nor a monstrosity.

Varieties whose characters relate to form, structure, and colour of the shell, may be due either to internal germinal changes, or to external environmental conditions, but the latter (varieties due to "modification," *sensu stricto*) only persist as long as the operative influences persist. That either of these kinds of variety really exists in the case of *Helix pomatia* seems to Buchner more than doubtful; so that he finds a provisional solution (in his museum arrangement) in naming, besides the normal, four "form-types"—*inflata*, *sphæralis*, *plagiostoma*, and *turrita*. There are differences in the distribution of these form-types; but the author will not at present commit himself to any statement as to the causes determining the four main forms which he ranges round the *forma vulgaris*.

Intestinal Epithelium of Helix.†—Herr W. Ellermann states that in the snail the structure of the ciliated epithelium is strikingly different from that of *Anodonta*. He finds that the striped appearance, regarded by Heidenhain as due to the existence of protoplasmic fibres (the roots of the cilia) like those of *Anodonta*, is in reality produced by a folding of the cell-surface in the long axis. This is clearly seen in transverse sections. The folding the author believes to exist in the living cells, and not to be an artificial product. True cilia roots were found in certain of the cells of the digestive gland, but not in the intestinal cells. This confirms the view that these structures do not invariably occur in ciliated cells. The snails investigated were *H. pomatia* and *H. nemoralis*.

Sensory Cells of Helix.‡—Dr. H. Smidt has used Golgi's method for the study of the sensory cells of the mouth-cavity of the snail. He finds that these take three distinct forms. In the lateral lips the cells are prolonged into an excessively fine fibril which terminates in a variously shaped swelling, often of conical form. The presence of this terminal knob was not invariably demonstrated. The two other types occur in the mucous membrane of the pharynx, where a cuticle is present. In the one—the hair-cells—a short thickened fibril ends in a slender

* Jahresheft Ver. Naturk. Württemberg, lv. (1899) pp. 232–79 (4 pls.). See Zool. Centralbl., vi. (1899) pp. 873–7.

† Anat. Anzeig., xvi. (1899) pp. 590–3 (6 figs.). ‡ Tom. cit., pp. 577–84 (6 figs.).

hair which penetrates through the cuticle. In the other—the polyp-cells—the fibril is long, displays various swellings, but always bears an ampulla with a narrow neck at the peripheral end. From the neck a number of secondary fibrils radiate like the tentacles of a polyp. These do not perforate the cuticle, but spread out over its inner surface. These cells are most abundant in the vicinity of the upper jaw. Where a number occur together, the nuclei (cell-bodies) form a compact mass from which nerve-fibre arises. It would appear that the polyp-cells are connected with the buccal ganglion, and the sensory cells of the lips with the cerebral ganglion.

Nerve-cells of Limax.*—Dr. J. Havet has studied these by Golgi's methods. The skin contains unipolar, bipolar, and multipolar cells. The bipolar cells are branched externally, and form an abundant superficial innervation. The ganglia consist of peripheral nerve-cells (unipolar, bipolar, and multipolar) and a punctate central substance. Numerous clear figures illustrate the peculiarities of minute structure.

Water-absorption in Slugs.†—Herr Karl Künkel has made a series of experiments in order to determine the amount of water capable of being taken up by Mollusca without shells, and the way in which it is taken up. By experiments with *Limax cinereus*, the author proved, first that water is absorbed, second that it can be taken through the skin, or through both skin and mouth. Again, when dried up the snails lose their power of movement, because the mucus becomes too thick to flow. Such dried specimens can absorb sufficient water through the skin to make the mucus-fluid, and then recover their power of movement. This is the reason why the slugs leave their hiding places only in the evening or after rain, and the grooves and ridges of the skin serve, the former to retain the water, and the latter to conduct it over the surface. The mucus itself is not hygroscopic, nor can the snails condense water even from air saturated with vapour. The mucus does, however, absorb water, and then greatly increases in volume and becomes fluid; while similarly on drying it diminishes in volume and becomes thick and tenacious. There is some difference in the absorbent power of the mucus of different species of slugs. It seems probable that the absorption of water by dried snails is due to the mucus within the pedal gland, which probably absorbs water through the opening of the gland.

Reversal of Cleavage in Ancylus.‡—Mr. S. J. Holmes finds that in the "fresh-water limpet" (*Ancylus rivulorum* Say)—a sinistral form—there is a reversal of the cleavage, like that described in *Physa* by Crampton. The reversal shows its effects as late as the gastrula stage, which lends considerable support to the view that it may stand in some causal relation to the reversed asymmetry of the adult. As the author points out, the reversal of cleavage in *Ancylus* has a special significance from the fact that the left-handedness occurring in this genus has, in all probability, arisen independently of that of *Physa* and *Planorbis*. It will be of interest to inquire if the cleavage of the dextral species of *Ancylus* (subgenus *Acroloxus*) is of the normal type.

* Anat. Anzeig., xvi. (1899) pp. 241-8 (10 figs.).
† Zool. Anzeig., xxii. (1899) pp. 388-96, 401-4.
‡ Amer. Nat., xxxiii. (1899) pp. 871-6.

Marine Gastropods.*—Miss K. J. Bush publishes a useful revision of the genera *Cyclostrema, Adeorbis, Vitrinella,* and related genera, giving the original descriptions, and lists of the species belonging to the different genera which occur round the coasts of eastern America.

δ. Lamellibranchiata

Morphology of Teredo.† — Stanislaus Beuk published a brief but well illustrated paper on this subject, with special reference to the structure of the nephridia. From a comparative point of view, the question as to the structures which are to be called siphons is of great importance. The author uses the term for the two tubular prolongations of the posterior mantle border, beginning at the end of the gills, and not for that region of the mantle which contains the gills and lies between the siphons and the visceral sac. This latter region is represented in all Lamellibranchs, but is usually short, while in *Teredo* it is greatly elongated. The nephridia are as usual paired, are U-shaped, and the right and left are completely separated. Each consists of a funnel opening into the pericardium, and a nephridial sac followed by a coiled region which opens into a tube directly continuous with the ureter. The general orientation of the organs shows that *Teredo* is the end of a series of forms of which *Pholas* is the most primitive. The genera *Pholadidea* and *Jouannetia* are to be looked upon as intermediate forms.

Classification of Pectinidæ.‡—Mr. A. E. Verrill publishes a study of this family with a revision of the genera and sub-genera. His classification is based entirely upon the shells. An interesting introduction is prefixed to the paper, discussing the value to the animal of the usual modifications of the shell, and the relation of these to the habitat, i.e. to deep or shallow water. The author believes that the ribs and marginal points of shallow water forms are important in enabling these to resist wave action; while in those from deep water strength is sacrificed to a lightness which facilitates swimming. He believes that the power of swimming was an early acquisition, possessed perhaps by palæozoic forms.

Cardiac Rhythm of Pholas dactylus.§ — Prof. R. Dubois notes that we have little precise information in regard to the movements of the heart in molluscs. He placed a minute elder-pith index with a long lever on the heart of *Pholas*, and got a tracing which shows that the diastole is notably shorter than the systole, and that the pulsations occur in groups of two or three separated by long intervals. The operation involved cutting the median line of the mantle and separating the valves of the shell.

Development of Dreissensia.‖—Herr J. Meisenheimer has followed this from the egg to the trochophore larva. The eggs liberated in the

* Trans. Connecticut Acad., x. (1899) pp. 97–144 (2 pls. and 10 figs.).
† Arbeit. Zool. Inst. Univ. Wien, xi. (1899) pp. 269–88 (3 pls. and 3 figs.).
‡ Trans. Connecticut Acad., x. (1899) pp. 41–96 (6 pls.).
§ Ann. Soc. Linn. Lyon. xlv. (1899) p. 83 (1 fi . .
‖ Habilitationschrift, Marburg, 1899, 42 pp. and 1 pl.; Forschungsber. Biol. Stat. Plön, 1899, pp. 25–8. See Zool. Centralbl., vi. (1899) pp. 8?5–902 (4 figs.)

water have no envelope. In the Lake of Plön the egg-laying usually begins in June and continues through the summer.

The first cleavage divides the ovum into a larger and a smaller cell, and the four-cell stage shows the characteristic Lamellibranch state—three equal cells and one much larger. The first two cleavage-planes are said to have little import as regards the future orientation of the larva; at the 49-cell stage the bilateral symmetry becomes distinct. To discuss the details of the cleavage without diagrams is unprofitable; but we may note that the author distinguishes, towards the end of segmentation, nine different cell-complexes, which represent definite regions of the larval body. The occurrence of cavities in the embryo, which enlarge, disappear, and reappear, is noted; the interpretation of these as due to the hindering of excretory exosmosis by the egg-envelopes will not apply to the naked egg of *Dreissensia*.

The differentiation of the larva begins after the invagination of the endoderm-portion; the blastopore, at first wide, narrows to a short slit, and then to a round hole; the archenteron is deep, and the shell-sac invagination is very like it; the blastopore is shunted forwards by the multiplication of the component cells of the ventral plate; stomach and intestine are differentiated from the posterior portion of the endodermic invagination; where the blastopore was closed up the stomodæum arises; the proctodæum arises posteriorly in a similar fashion.

The development of the velar area is traced, and the origin of the mesenchyme and muscular tissue from two primitive somatoblasts, which, however, also contribute to the endoderm. It is noteworthy also that here, as in other molluscs, there is an internal migration of ectoderm cells to assist in internal differentiation. The author ends his study with a comparison of the larva of *Dreissensia* with the glochidium of Unionidæ and with the larvæ of other Lamellibranchs.

Arthropoda.

a. Insecta.

Balloon-making Fly.*—Messrs. J. M. Aldrich and L. A. Turley describes an interesting habit. On June 16th, 1899, while passing along a country road near Moscow, Idaho, they saw some bright white objects moving to and fro in the air at an elevation of eight or ten feet. These were males of *Empis poplitea*, each carrying between its hind feet a peculiar elliptical balloon-like structure about 7 mm. long (nearly twice the length of the fly), composed of a single layer of slightly viscid bubbles. In nearly every case there was a small fly pressed into the front end of the balloon, apparently as food for the *Empis*, as the attached forms (all dead) were partly *Chironomus*, and partly Oscinids and other Acalyptrate Muscids.

The balloon seems to be made while the insect is flying, probably by some modification of the anal organs, as in *Aphrophora* and other leaf-hoppers, and it is possible that the captured victim serves as a nucleus in the balloon-making. One case of a captured fly without a balloon was observed.

The purpose of the structure is to attract the female. It was seen that the males gathered in the path of an approaching female, and that

* Amer. Nat., xxxiii. (1899) pp. 809–12 (3 figs.).

she with little hesitation selected for a mate the one with the largest balloon, taking a position upon his back. "After copulation had begun, the pair would settle down towards the ground, select a quiet spot, and the female would alight by placing her front legs across a horizontal grass blade, her head resting against the blade so as to brace the body in position. Here she would continue to hold the male beneath her for a little time, until the process was finished. The male, meanwhile, would be rolling the balloon about in a variety of positions, juggling with it, one might almost say. After the male and female parted company, the male immediately dropped the balloon upon the ground, and it was greedily seized by ants."

The only known case at all comparable seems to be that of the allied *Hilaris sartor* Becker, where, as Mik and others have described, the male produces a real web which is borne by the hind feet and serves to assist the fly in the somewhat peculiar gyrations of its flight.

Metamorphosis of Insects.*—Dr. J. E. V. Boas briefly discusses this difficult subject. He points out that while in hemimetabolic insects the larva shows a general resemblance to the adult, in holometabolic insects the larva bears to the imago a relation comparable only to that borne by degenerate parasitic insects to typical forms. In the former case the larva resembles the adult more than it resembles any other insect; while in the latter, larva and imago have specialised along different lines, and cannot be directly compared. The cause of the great distinction between larva and imago the author seeks chiefly in the wingless state of the larva, but also in the fact that the larva is chiefly nutritive, and the adult reproductive. The pupa is to be regarded as an incomplete imago, analogous to the sub-imago stage seen in the development of the Ephemeridæ. The limitation of the power of growth to the larval stages produces a marked contrast to the metamorphosis of Crustacea, where the final form is attained while the animal is still exceedingly small. This fact the author again correlates with the winged condition of insects; for the wings are dead chitinous plates which could not be reproduced after a moult. As can be seen by the above, Boas entirely agrees with Fritz Müller in regarding the incomplete metamorphosis as the more primitive state, from which the holometabolic condition has been evolved.

Striped Muscle of Insects.†—Dr. Günther Enderlein has studied these in various larvæ belonging to the Œstridæ. He finds that the majority of the muscles show the following remarkable modification. The muscle-fibres consist of one or several bundles of fibrils imbedded in the middle of a sheath of sarcoplasm, which is quite distinct from the sarcolemma. This sheath of sarcoplasm is divided into compartments by transverse lines, which are continuous with Krause's membrane. These transverse bands are further intimately connected with the sarcolemma, so that Krause's membrane is formed by an ingrowth of sarcolemma.

Temperature of Insects.‡—Prof. P. Bachmetjew has made a long series of observations on the relation of the body-temperature in insects

* Zool. Jahrb. (Abt. Syst.), xii. (1899) pp. 385–402 (1 pl. and 3 figs.).
† Arch. Mikr. Anat., lv. (1899) pp. 144–250 (1 pl.).
‡ Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 521–604 (5 figs.).

to that of the surrounding air, the observations covering a large range of temperatures. He prefixes to his paper a very elaborate historical survey, showing how very varied are the results arrived at by different investigators on the subject, and concludes that these discrepancies are due on the one hand to variation in the insects themselves, dependent on locality, food, age, sex, &c., and on the other to the nature of the apparatus employed. His own apparatus is based on the principle of thermo-electricity, changes of temperature being measured by variations of electrical current as indicated by a sensitive galvanometer. The insect is connected with the instrument by means of a fine thermo-electrical needle sunk in its body. The insects employed were taken in Bulgaria, and the experiments were based upon the natural variations in temperature to which insects living in the special locality are subjected.

The experiments show that resting insects have the same temperature as their surroundings, and can tolerate a very wide range of variation without injury. Moving insects have a temperature higher than that of the surrounding atmosphere. If the temperature of the medium is continuously raised, the insects display active movements as their body-temperature rises to 39°, and die when it reaches 46°–47°. When the temperature of the air is gradually lowered, the body-temperature sinks continuously, sometimes to about −15° (the normal freezing point of the cœlomic fluid or "critical point"), then rises suddenly, usually to about −1·5°. If the lowering of temperature be still continued, the body-temperature then again sinks slowly. If the cooling be continued until the body-temperature sinks for a second time to that at which the sudden rise previously took place (that is to the "critical point"), then death ensues. The temperature of the "critical point" is not constant, even for the same species, but varies with various conditions. Thus it is lowered in fasting insects, and in insects which have been repeatedly exposed to low temperatures (cf. the natural conditions to which insects are exposed in winter). The general phenomena exhibited by insects exposed to low temperatures are all explicable on the same principles as the phenomena displayed by water in capillary tubes, or by citric acid in porous vessels, when exposed to similar temperatures. Further, in general the relation of insects to low temperatures is such as it might be expected the process of natural selection would produce in organisms which are unable, like birds, to escape cold by their own activity, and are unprovided with any external means of defence like the hairy coat of mammals. The adaptation in general is such that the insects are able to adjust their own temperature to that of the surrounding medium, and to maintain life under most natural variations of temperature.

Larva of Microdon mutabilis.*—E. Hecht has studied this interesting form (one of the Syrphidæ) which frequents the nests of ants. The adult is not peculiar, but the larva is remarkably like a little slug. Indeed, it has been referred to *Parmula* and to *Scutelligera*! Hecht shows that the convergence, if it deserves the name, is wholly superficial. He describes the complicated elaboration of the chitinous cuticle. He also notes that in this form at least the muscle-fibres do not enter into relation with the epidermic cells, but are in intimate continuity with the cuticle.

* Arch. Zool. Expér., vii. (1899) pp. 363–82 (1 pl.).

Solidification of Silk Threads.* — Prof. R. Dubois has already indicated that the solidification of the threads of silk, as they pass from the silkworm's glands, is effected by a process analogous to the formation of a blood-clot, but that the fixation of a certain quantity of free oxygen is necessary. Further investigation has shown that the substance in the silk-reservoirs contains a reducing principle, which explains the fixation of oxygen. The glands strongly reduce osmic acid and nitrate of silver, and a solution of their contents rapidly decolorises permanganate of potash. The chemical evidence shows that there is a globulin present in abundance.

Rôle of Insects, &c., as Carriers of Disease.†—Dr. G. H. F. Nuttall makes a timely and valuable contribution to the literature of animal and vegetable parasites, and their definitive and intermediary hosts, in a critical and historical study of the part played by insects, arachnids, and myriopods, as carriers of bacterial and parasitic diseases of man and animals. Among the more important and interesting features of the essay may be mentioned the evidence adduced to establish the connection between flies and the spread of cholera, typhoid, and plague, the association of Texas or tick-fever with *Ixodes bovis*, of Tsetse-fly disease with *Glossina morsitans* and its recent visit to an infected animal, the subject of filariosis, and the mosquito-malaria theory. The bibliographical appendix is extensive, amounting to one-fifth of the monograph.

Mosquitoes and Malaria.‡—Prof. B. Grassi discusses the observations of Koch. He does not consider that they have made any contribution to the ætiology of human malaria. It is also indicated that Ross's discoveries are suggested by, and are confirmatory of, Grassi's previous results.

Development of Wings.§—Messrs. J. H. Comstock and J. G. Needham begin the fifth chapter of their elaborate account of insects' wings with a discussion of the development. "It is well known that wings arise as sac-like folds of the body-wall of the second and third thoracic segments. These folds first appear at the point where the suture between the tergum and the pleuron later developes. In most insects with incomplete metamorphosis they are so directly continuous with the tergum, and become so solidly chitinised with it, that they have generally been interpreted as outgrowths from its caudo-lateral margin." The general appearance in insects with incomplete metamorphosis is that of two layers of very elongate hypodermic cells, which meet in places and form the middle membrane, and remain separate in other places, forming the vein-cavities, which usually contain tracheæ. The external and internal development of wings in insects with incomplete and with complete metamorphosis agrees in some important respects. "In both cases the wings arise in early life, and form a double plate-like fold of hypodermis, between whose layers tracheæ shortly penetrate. In the former the extension of the wings is gradual and moderate, excepting at the time of transfor-

* Ann. Soc. Linn. Lyon, xlv. (1899) pp. 76–7.

† Johns Hopkins Hosp. Rep., viii. (1899) 154 pp. and 3 pls. See also Lancet, Sept. 16, 1899.

‡ Atti R. Accad. Lincei (Rend.), viii. (1899) pp. 193–203, 223–30. Cf. this Journal, 1899, p. 609.

§ Amer. Nat., xxxiii. (1899) pp. 845–60 (9 figs.). Cf. this Journal, 1899, p. 482.

mation; in the latter they early settle down into deep hypodermic pockets, in which their extension is of necessity retarded, although cell-multiplication seems not to be."

The authors proceed to describe the origin of the tracheation of the wing, and the behaviour of the hypodermis, the cells of which are remarkable not only for their secretory and excretory activity, but also for their capacity for rapid shifting and readjustment.

Showers of Insects.* — A. L. Montandon discusses the so-called showers of insects, and has gathered a number of interesting cases. The real problem is not of course in the "shower," but in the unusually prolific multiplication and extended migration. As to showers of "blood," they are probably due to excretions from certain species of *Vanessa* immediately after emergence from the chrysalid stage.

Nesting Habits of Osmia rufa.† — Mr. J. W. Carr has a short account of a nest of this little bee, built in the door-lock of an out-building. The metamorphosis was completed before the winter had begun; emergence occurred in March in a glass-topped box in a warm room. The sexual disparity was of interest; 43 males and 5 females came out, and in the dead remainder there were 9 males, 5 females, and a larva. The nest thus contained 52 males and only 10 females, and it will be noticed that the mortality among the females was very much higher than among the males.

Female Organs of Cicadaria.‡ — Herr Nils Holmgren points out how scanty our knowledge of this subject is. He has investigated a large series of forms, and publishes a brief preliminary note as to his results. In the families Cercopina and Jassina the ovaries consist of a varying number of tubes. The oviducts vary in length, but are usually short, and there is a distinct oviducto-vestibular gland. Into the posterior end of the vestibulum opens a stalked vesicular *bursa copulatrix*, with a short straight tubular sheath. The special conditions existing in a series of species belonging to the two families are described in detail. In the only member of the family Fulgorina which was investigated, strikingly different conditions prevail. There is no oviducto-vestibular gland, but instead there is a tubular gland with a strongly chitinised duct which is dilated proximally.

Alimentary System of Gryllotalpa australis.§—Mr. O. A. Sayce finds that the Victorian mole-cricket differs little in regard to its alimentary system from the European form. The diet appears to consist chiefly of earthworms and insects. On histological grounds the author believes that the true mid-gut comprises the two hepatic cæca only; but he believes that absorption may take place both in the crop and in the hind-gut, in spite of their chitinous lining. The structure of the different parts of the alimentary system is described in some detail.

Derivation of British Coleoptera.‖—Mr. W. E. Sharp points out that the whole British Coleopterous Fauna is simply part and parcel of

* Bull. Soc. Sci. Bucarest, viii. (1899) pp. 179–90.
† Annual Rep. Nottingham Nat. Soc., xlvi. (1897–8) published 1899, p. 33.
‡ Zool. Jahrb. (Abt. Syst.), xii. (1899) pp. 403–10 (1 pl.).
§ Proc. Roy. Soc. Victoria, xi. (1899) pp. 113–28 (2 pls.).
‖ Proc. and Trans. Liverpool Biol. Soc., xiii. (1899) pp. 163–84.

that of north-western Europe. Three diverse components may be distinguished:—(*a*) a small Celtic group, chiefly in Scotland and western Ireland; (*b*) a large Siberian group, with proximate origin in the plain of Central Europe, prevented from complete access into Ireland; and (*c*) a Teutonic (eastern extension) and Iberian (western extension) group, unrepresented in Scotland. "If any of our Coleoptera can be termed autochthonous, the northern or Celtic element can be the only one so regarded; and, while all the rest of the fauna seems to have been derived from the south and east, this only may have had a northern origin and be possibly pre-glacial." But our ignorance vastly exceeds our knowledge of the factors of the problem.

Aphidology.*—N. Cholodkovsky continues his studies on Aphides, which are illustrated by an excellent plate. He discusses *Chermes funitectus* Dreyfus, some new or little known species of *Lachnus*, the male of *Stomaphis graaffii*, the Schizoneurinæ living in coniferous trees, *Callipterus giganteus* sp. n. from *Alnus glutinosa*, *Tetraneura ulmi* De Geer, and *Phylloxera quercus* Boyer occurring in Northern Russia.

Nerve-Cells of Dytiscus.†—Dr. C. Tiraboschi begins an account of his observations on the nerve-cells of invertebrates with a classified bibliography, noting, for instance, those researches which describe the internal structure of the nerve-cell as—(*a*) granular, or (*b*) fibrillar, or (*c*) reticular. In *Dytiscus marginalis* he has found three different forms of cellular elements, connected by intermediate forms—(*a*) nuclei apparently free, (*b*) chromatic cells with a minimum of cytoplasm, and (*c*) ganglionic cells. Further report may be reserved till we see what is to follow.

Ants from Pacific Islands.‡—Prof. C. Emery discusses the Formicidæ taken by Schauinsland's expedition. They are few in number, and belong to species already described. From the Island of Laysan a form was received which is described as a sub-species of *Ponera punctatissima* Rog. (sub-sp. *schauinslandi*). Winged females only were found, and it is possible that the workers may display characters sufficiently marked to justify the erection of a new species.

Swiss Collembola.§—Herr J. Carl gives a faunistic account of 72 species and 14 varieties, to which four other species and a variety reported by Nicolet have to be added. But this is not to be regarded as a complete list. The influence of altitude on distribution is particularly noticed; thus *Orchesella rufescens* forma principalis, which is very common in the mid land, becomes gradually scarcer as one ascends; while *Orchesella villosa* is distinctively an inhabitant of the high-lying regions. The forms from higher altitudes tend to be darker and smaller. The character of the vegetation has also a great influence on the collembolan fauna. A noteworthy result is the resemblance between the Swiss Collembola and those of Northern Europe. About 60 species are shared with Scandinavia. In regard to *Sminthurus pruinosus* and *Achorutes schötti*—two northern forms—it is noted that they are very abundant in

* Zool. Anzeig., xxii. (1899) pp. 468–77 (1 pl.).
† Boll. Soc. Rom. Stud. Zool., viii. (1899) pp. 53–65.
‡ Zool. Jahrb. (Abt. Syst.), xii. (1899) pp. 438–40.
§ Rev. Suisse Zool., vi. (1899) pp. 275–362 (2 pls.).

Switzerland, though the latter species is not known from intermediate regions.

Arctic Polar Collembola.*—Herr E. Wahlgren reports on the Collembola brought home by Prof. Nathorst's polar expedition, including *Achorutes viaticus* Tullb., abundant about the nest of a glaucous gull, *Tetracanthella pilosa* Schött, *Aphorura neglecta* Schäff., *Aph. arctica* Tullb., *Isotoma binoculata* n. sp., and other forms.

Some Australasian Collembola.†—Sir John Lubbock describes three new species of *Anoura* from New Zealand and Tasmania, partly in the hope that his contribution may induce colonial entomologists to devote some attention to this interesting though inconspicuous group.

Fauna of Caves.‡—Herr C. Absolon describes *Dicyrtoma pygmæa* Wankel, and a new species of *Heteromurus* (*H. hirsutus*), from Moravian caves. His paper should be read in conjunction with Verhoeff's criticisms on the value of subterranean "species."

β. Myriopoda.

Fauna of European Caves.§—Dr. Carl Verhoeff discusses the distribution of the Myriopod described by Heller as *Brachydesmus subterraneus*. This form was found by that author in the caves both of Carniola and of Moravia, and subsequent observations have only accentuated the apparent anomalies of distribution. Verhoeff finds the only explanation of these in the conclusion that the species does not exist, the specimens being pale-coloured forms of the widely distributed *B. superus* Latzel, which is a surface-form abundant in Central Europe. It frequently finds its way into caves in districts where these occur, but there is no evidence that the cave specimens constitute even a definite variety.

Swiss Myriopods.‖—Herr H. Rothenbühler gives a systematic account of these, discussing 69 species, sub-species, and varieties. He describes as new 7 species, 2 sub-species, and 3 varieties. The contingent from Germany (about 20 species) seems much greater than that from France (about 6 species), and there are about 15 shared with Austria. Some species which range into North Germany seem to be restricted in Switzerland to the Alps and Jura. Complete comparisons require, however, a survey of the eastern and southern parts of Switzerland.

Palæarctic Myriopoda.¶—Dr. Carl Verhoeff continues his series of memoirs on this subject in a paper on the Julidæ and some other Diplopoda. He breaks up the genus *Julus* into two genera, *Julus* s. s. and *Cylindroiulus*, each of which contains several sub-genera. The phylogeny of the genera of the Julidæ is discussed in some detail.

* Öfersigt. K. Vetensk. Akad. Förhandl., lvi. (1899) pp. 335–40 (8 figs.).
† Journ. Linn. Soc. (Zool.), xxvii. (1899) pp. 334–8 (7 figs.).
‡ Zool. Anzeig., xxii. (1899) pp. 493–6. § Tom. cit., pp. 477–9.
‖ Rev. Suisse Zool., vi. (1899) pp. 199–271 (3 pls.).
¶ Arch. Naturgesch., lxv. (1899) pp. 183–230 (5 pls.).

δ. Arachnida.

Araneidan Fauna of Santa Cruz.* — Mr. W. J. Rainbow publishes what seems to be the first systematic record of any branch of zoology from this island (in the South Pacific). Twenty-four species are recorded, ten of which are new to science; and it has been necessary to create two new genera—*Eunesiotes* and *Gnathopalystes*.

Functions of Mid-gut in Spiders and Scorpions.†—Sig. A. Berlese concludes, from his investigations on this subject, that the epithelial cells of the large glands, or hepatic cæca, have numerous functions, namely the following:—(*a*) they absorb albuminoids, and retain them for a time in coagulated form; (*b*) they digest these substances into peptones; (*c*) they form uric excretions as the result of this fermentative work; (*d*) they pass these excretions into the lumen of the cæcum, or retain them; (*e*) after the intracellular digestion the cells are detached, and the contents are absorbed in the gland or in the colon; (*f*) finally the detached cells pass *en masse* into the colon, where they are broken up into minute spherules, which lie in a substratum of very minute guanin granules, derived from these cells or from those of the Malpighian tubes.

The parenchyma, intercalated between the diverticula of the gland, is probably the matrix of the epithelium; and to its activity is due the rich deposit of rounded uric calculi which are not got rid of. During fasting the animal lives at the expense of the deposits of albuminoid substance in the cells of the intestinal gland, and these, during prolonged fasting, disappear completely, and are replaced by uric calculi. The excretions seem to consist of guanin, but some of the crystals inside the cells suggest uric acid.

Arachnoids from Pacific Islands.‡ — Herr E. Simon describes the Arachnoids of Schauinsland's Expedition. They were collected at Laysan, the Sandwich Islands, New Zealand, and the Chatham Islands. The collection includes many new species.

Completion of Monograph on Hydrachnids.§ — Dr. R. Piersig has now completed his monograph on German Hydrachnids, instalments of which we have briefly noticed from time to time. It deals with 30 genera, referred to 4 sub-families—Hygrobatinæ, Hydryphantinæ, Eylaïnæ, and Hydrachninæ—and is a monumental piece of work devoted to an interesting family which has found comparatively few students in this country, though we are glad to see that the observations of C. J. George and C. D. Soar figure prominently in the bibliography.

New Hydrachnids.‖—Herr Karl Thon describes a number of new species from Bohemian ponds belonging to the genera *Hydrachna* and *Arrenurus*.

* Proc. Linn. Soc. N.S. Wales, xxiv. (1899) pp. 304–21 (2 pls.).
† Riv. Patol. Veg., vii. (1898, received 1899) pp. 226–51 (3 pls.).
‡ Zool. Jahrb. (Abt. Syst.), xii. (1899) pp. 411–37.
§ Bibliotheca Zoologica (Leuckart and Chun), Heft 22 (1897–1900) 601 pp. (51 pls.).
‖ Zool. Anzeig., xxii. (1899) pp. 496–9 (3 figs.).

Norneria gigas.*—Herr F. Nordenskiöld describes this Hydrachnid, and compares it with *Linopodes* and *Penthaleus*. It seems to be intermediate between the lower Acarids and the higher Prostigmata. The high development of the digestive organs, the complex structure of the oral glands, the nature of the mouth-appendages, the marked differentiation of the muscular and tracheal systems, relate it to the higher forms, while in other features, e.g. the character of the mandibles, it resembles the lower acarids. The skin seems to have no glands. As in Trombididæ and Bdellidæ, there is no hind-gut. The nervous system approximates to that of *Bdella*; there are no eyes, though they have been reported to be present, but there are two peculiar refractive chitinous corpuscles on the anterior part of the dorsal surface. A peculiar appendage projects from the pseudocapitulum between the basal joints of the mandibles, and may be comparable to the sensory structure described by Henking and Schaub between the eyes. The female has an ovipositor, and the eggs are like those of Hydrachnids.

Atax taverneri.†—Mr. C. D. Soar describes this new free-swimming species collected by Mr. H. Taverner in Highams Park. It appears to be different from any of the 34 or so recorded species, but comes nearest *A. aculeatus*.

Classification of Ticks.‡—Dr. F. Supino makes a communication of systematic interest on the Ixodidæ. There are seven well-defined genera:—*Ixodes*, *Hyalomma*, *Rhipicephalus*, *Dermacentor*, *Hæmaphysalis*, *Herpetobia*, and *Opisthodon*. He also discusses the characters on which most reliance may be placed in distinguishing species, and briefly describes a number of forms.

Thelyphonid from Africa.§—Dr. Ernst Hentschel records an interesting find in the Strasburg collection of Pedipalpi. In two different collections he has found specimens of a Thelyphonid belonging to the genus *Hypoctonus*. The interest of the find is that Thelyphonids have hitherto been described as confined to the Oriental and Neotropical regions, thus affording an example of discontinuous distribution. The collections in which the specimens occurred are respectively marked Senegal and Algeria, but all four forms belong to the same species, and all are females. The genus to which they belong is Oriental, and the species, *Hypoctonus africanus* sp. n. ♀, is intermediate in characters between the Burmese species and *H. gastrostictus* Kraep. from Borneo.

ε. Crustacea.

Story of Artemia retold.—In 1875, W. Schmankewitsch published in the *Zeitschrift für wissenschaftliche Zoologie* a famous paper, giving an account of his observations on the brine-shrimp, *Artemia salina*, from the Bay of Odessa. He stated that by altering the salinity of the water he could transform *A. salina* into another species *A. mühlhausenii*, and, more than this, that by addition of fresh-water to the habitat in which *A. salina* lived, he could induce a resemblance to the genus *Branchipus*

* Acta Soc. Sci. Fennica, xxvi. (1899) 23 pp. and 1 pl. See Zool. Centralbl., vi. (1899) pp. 795-7. † Journ. Quekett Micr. Club, vii. (1899) pp. 219-21 (1 pl.).
‡ Atti Soc. Veneto-Trentina Sci. Nat. Padova, iii. (1899) pp. 241-52 (2 pls.).
§ Zool. Anzeig., xxii. (1899) pp. 429-31.

almost amounting to identity. Both results have been repeatedly criticised, the second has been proved inaccurate, and much doubt has arisen in regard to the first. The most thoroughgoing criticism, however, has been that of W. P. Anikin,* published in Russian, but now made available to the unlearned by a summary by N. von Adelung.†

Anikin points out that the various species of *Artemia* which have been described do not rest on a satisfactory basis (not that they are alone in that), and that some of them are merely cripple-modifications of *A. salina*, induced by sudden alterations in the salinity of the water. His experiments showed that if the degree of concentration was slowly and gradually increased, no structural changes of moment ensued. Some slight changes were indeed observed, but they were only "modifications,"—not transmissible to the progeny, and disappearing when normal conditions were restored. Moreover, these slightly different individuals were sometimes found together in the same water.

Unlike previous breeders of *Artemia* (Joly, Siebold, Vogt, Schmankewitsch), who only observed parthenogenetic females, Anikin found males several times in his aquarium, and he associates their appearance theoretically with altered nutritive conditions, in fact with starving. But these males which he reared (probably from unfertilised ova) were remarkable in their behaviour when the salinity was altered; they retained their characteristic features persistently in contrast to the females who changed.

It is to be hoped that no one will imagine that the question is closed; but that we shall have still more experiments on *Artemia*; in the mean time, however, Anikin's four general conclusions will be read with interest.

The representatives of the genus *Artemia* show a marked tendency to change, as regards almost all the organs of their body.

The form-changes depend mainly on the physico-chemical character of the medium.

The changes in individuals which live in salt-solutions subject to constant dilution with fresh-water do not indicate any transformation of *Artemia* into *Branchipus*; even those in the least salt solutions retain unchanged the characteristics of their genus, especially in the male sex.

The concentration of the salt solution has certainly an influence on the length of the post-abdomen; for in dense solutions those with long post-abdomens predominate, in weak solutions those with short post-abdomens.

Innervation of Vascular System in Higher Crustaceans.‡ — Prof. J. Nusbaum has used the *intra vitam* methylen-blue injection method in his study of the innervation of the vascular system of *Palæmon*, *Squilla*, &c. He shows, for instance, on the heart of *Palæmon*, very large multipolar much branched ganglion-cells, and the breaking up of the entrant nerve-strands into a very fine network connecting different fibres. Pericardium and arteries are likewise very richly innervated. Nusbaum notes *inter alia* his agreement with Holmgren, that although there are certainly subepidermic multipolar cells connected with nerves (as

* Mitth. Univ. Tomsk, xiv. (1898) 103 pp. (3 pls.).
† Zool. Centralbl., vi. (1899) pp. 757–60.
‡ Biol. Centralbl., xix. (1899) pp. 700–11 (7 figs.).

Nusbaum and Schreiber described), "Bethe's cells" (which are somewhat similar and much more abundant) are really mesenchymatous.

Carcinological Fauna of India.*—Dr. A. Alcock gives a statement of his views as to the classification of the Cyclometopa. The tribe includes:—(1) Telphusidæ, the highest Cyclometopa, approaching Catometopa, derivatives of Oxiine or Eriphiine stocks, now inhabitants of fresh-water or damp jungle; (2) Xanthidæ, with seven sub-families, of which the Oxiinæ and Eriphiinæ approach the Telphusidæ, while the Pilumninæ and Xanthinæ link the family to the Carcininæ section of the Portunidæ, and through these to the Cancridæ; (3) Portunidæ, with four sub-families, of which the Carcininæ by way of *Carcinus*, approach the Xanthidæ by way of *Hoploxanthus*; (4) Cancridæ, with six sub-families, of which the Pirimilinæ and Thiinæ link the family to Carcininæ, and the Atelecyclinæ to the Corystidæ; (5) Corystidæ, the lowest Cyclometopa, having much the same relative position to the higher families of Cyclometopes that the Raninidæ have to the higher families of Oxystomes. Then follow diagnoses of the Indian genera and species of Portunidæ, Cancridæ, and Corystidæ.

Bathynella.†—Mr. W. T. Calman points out the interest of *Bathynella natans*, a minute Crustacean from a well in Prague, described by Vejdovsky in 1882. No additional specimens have been obtained; but Calman has re-examined the unique existing specimen. In spite of its minute size, *Bathynella* must be referred to the Malacostraca. The number of the somites, the position of the genital apertures, the characters of the thoracic limbs, and the presence of appendages on the terminal somite of the abdomen, appear to afford conclusive evidence on this point. The possibility that it may be larval, as Moniez has suggested, is excluded if the identification of the genital apparatus be correct. Calman shows that it cannot be received into any of the divisions of the Malacostraca as commonly defined, but he compares it with the anomalous "Schizopod" *Anaspides tasmanica* of G. M. Thomson, and shows that many of the characters in which *Anaspides* agrees with the Palæozoic Gampsonychidæ are also shared by *Bathynella*.

New Subterranean Isopod.‡—Mr. W. P. Hay describes an interesting and apparently new species of Isopod (*Haplophthalmus puteus*) forty or fifty specimens of which were obtained from an old well in Irvington, Marion County, Indiana. They were evidently strictly aquatic, and lived for some hours in a jar of water, crawling about very much after the manner of *Asellus*. While in the water the pleopods were gently moved up and down with a fan-like motion. Several of the females carried eggs, six or eight of which were sufficient to fill the brood-pouch. The nearest relatives are *Haplophthalmus mengii* Zaddach and *H. daniers* Budde-Lund, inhabitants of moist situations, such as decaying leaves and wood, in various localities in Europe. It is also closely related to *Scyphacella* (*Haplophthalmus*) *arenicola* S. Smith, found burrowing in the sand in various places along the North American Atlantic coast.

* Journ. Asiatic Soc. Bengal, lxviii. (1899) pp. 1–104.
† Journ. Linn. Soc. (Zool.), xxvii. (1899) pp. 338–44 (1 pl.).
‡ Proc. U.S. Nat. Mus., xxi. (1899) pp. 871–2 (1 pl.).

Tanganyika Crustaceans.*—Mr. W. T. Calman describes two species of macrurous crustaceans collected in Lake Tanganyika by Mr. J. E. S. Moore. One forms the type of a new genus (*Limnocaridina*) allied to *Caridina*, the other is probably a new species of *Palæmon*. The most striking and important character of the new genus is the reduction of the branchial system; there are only four gills, and no epipods at all.

North American Caridea.†—Prof. J. S. Kingsley gives a key for the identification of the shrimps and prawns reported from the waters of North America, north of the southern boundary of the United States and within the 100-fathom line. It is believed that this key will serve for the identification of any species (except in the genera *Hippolyte* and *Pandalus*) now known to inhabit American waters; but the student may reasonably expect that several tropical species may later be found within these limits. The genera most likely to furnish additions of this character are *Alpheus*, *Palæmon*, *Peneus*, *Atya*, and *Caridina*.

North American Astacoid and Thalassinoid Crustacea.‡—Prof. J. S. Kingsley contributes on this subject one of the useful synopses of North American Invertebrates which are appearing in the *American Naturalist*.

North American Fresh-water Ostracods.§—Mr. C. H. Turner contributes to the series of synopses of North American Invertebrates a key to the fresh-water Ostracods. The key includes all fresh-water genera known to the author, whether represented in America or not, and it aims at including all the known American species.

Eyes of Polyphemidæ.‖—Dr. Otto Miltz publishes an elaborate memoir on this subject, having for its special object the manifestation of the connection between the structure and special function of the remarkable eyes of this family. Their special peculiarity, as already known, lies in the fact that they are divided into dorsal and ventral halves of very different structure. The details of structure are described for a number of genera, the most general result being to show that it is in the genus *Polyphemus* that the nearest approach is made to the typical Daphnid condition. This is shown by the fact that at the posterior border of the eye short thick crystalline cones and rhabdomes, with extensive pigmentation, are present as in a typical Daphnid, while the special Polyphemid modification, consisting in the elongation of cones and rhabdomes, and the limitation of pigment to the vicinity of the retina, only appears gradually on the ventral surface. From the conditions seen in *Polyphemus*, those found in the genera *Podon* and *Evadne* can be derived; but the eye of *Leptodora* seems to have had an independent Daphnid origin.

As to the value of the Polyphemid condition, an increase in the size of the eye and of the number of cones increases the power of sight, as does also a diminished divergence of the cones. As increase in absolute size has obvious limits; the end is better attained by diminished divergence. For physical reasons this is best confined to a certain number

* Proc. Zool. Soc. London, 1899, pp. 704–12 (2 pls.).
† Amer. Nat., xxxiii. (1899) pp. 709–20 (57 figs.).
‡ Tom. cit., pp. 819–24 (8 figs.).
§ Tom. cit., pp. 877–88.
‖ Biblioth. Zool. (Leuckart and Chun), xi. Heft 28 (1899) pp. 1–60 (4 pls.).

of the cones; hence the beginning of the division of the eye into two parts. The diminution in the amount of pigment again has the result of making the eye more susceptible to movements. The reason for the modification in the Polyphemidæ is to be sought in their adaptation to a predatory life, and to their existence in water of considerable depth. Their eyes are adapted less for the perception of form than for the perception of movement in dim light.

Arctic Amphipods.*—Ed. Chevreux gives an account of some interesting Amphipods found during the last voyage of the 'Princess Alice.' Good results were obtained by the use of the tow-net at great depths. Among other forms one specimen of *Euryporeia gryllus* was obtained from a petrel. This interesting giant Amphipod has been taken on many occasions by the 'Princess Alice,' and at all depths from the surface to one of 5310 metres. A new giant form reaching a length of 140 mm., was found at a depth of 5285 metres, and is described as *Alicella gigantea* g. et sp. n. A full account of the characteristics of this new form are given. Two specimens only were found, both females, but of very unequal size.

Distribution of Cirripedia.†—Dr. W. Weltner gives an account of the Cirripedes taken by Schauinsland's Expedition. None of the species are new, but in some cases new localities are noted for already described species. Weltner finds that, apart from pelagic species, only two Cirripedes are common to the Arctic and Antarctic regions, and are yet absent from intervening regions. Of these, one (*Scalpellulum velutinum*) is a deep-sea form, the other (*Balanus porcatus*) lives from low-tide mark down to the greatest depths. On the whole the Cirripedes offer no support to the bipolar hypothesis.

Fresh-water Copepoda.‡—Herr Carl van Douwe records *Diaptomus denticornis* Wierzejskii in the neighbourhood of Peissenberg, Bavaria, in upland ponds. This is the first German record of this brilliantly coloured Crustacean, and confirms the previously expressed opinion that it is confined to ponds at a considerable height above the sea-level (about 740 m. in this case). In the Bavarian ponds the number of individuals was large, and they constituted almost exclusively the limnoplankton of the area.

Harpacticid Appendages.§—Herr C. van Douwe has some notes on the fifth pair of appendages in Copepods, which, especially in their rudimentary form in Harpacticidæ, are credited with great specific constancy and consequent taxonomic value. He cites in illustration the differences in the number of spines on this appendage in *Canthocamptus northumbricus* Brady, and refers to other cases.

New Harpacticidæ.‖—A. Graeter notes that, while further research tends to reduce the number of species of *Cyclops* (from 150 to about 29), the reverse is true of Harpacticidæ. He records from the Val Piora *Canthocamptus cuspidatus*, also known from the Rhæticon, and

* Bull. Soc. Zool. France, xxiv. (1899) pp. 147–58 (11 figs.).
† Zool. Jahrb., xii. (1899) pp. 441–7. ‡ Zool. Anzeig., xxii. (1899) pp. 387–8.
§ Tom. cit., pp. 447–50. ‖ Rev. Suisse Zool., vi. (1899) pp. 365–7 (1 pl.).

C. unisetiger sp. n. He likewise describes an abnormality in the furca of females of *Cyclops affinis* Sars.

Hemioniscus Balani.* — M. Caullery and F. Mesnil have studied this peculiar Cryptoniscid previously described by Buchholz and by Kossmann. It is a parasite of *Balanus balanoides*. The male retains many of the characters of a free Isopod. The female arises from a similar larva; in its head and the first four thoracic segments it exhibits no peculiar feature, but the rest of the body loses its appendages, and becomes a huge sac resulting especially from the hypertrophy of the three last thoracic somites, and prolonged in seven lobes (six lateral thoracic lobes and the posterior abdomen); in the adult this sac is full of developing embryos. Kossmann concluded that the female forms arise from the transformation of the male forms, or, in other words, that the animals are protandrous hermaphrodites.

The authors point out that what Buchholz called cement-glands and Kossmann regarded as testicular, are glandular organs probably digestive. None the less is it true that the male forms show degeneration of the testes; that these organs are replaced by the ovaries; that oviducts appear as ectodermic invaginations on forms still recognisably male; and that the female features are gradually assumed.

In *Hemioniscus* the incubatory chamber arises as a solid ectodermic plastron which embraces the oviductal apertures, and is hollowed out by delamination. The ova are fertilised within the oviducts where spermatozoa have been accumulated, and they pass into the *closed* incubatory chambers without any contact with the outer world. As the embryos grow, the chamber enlarges and encroaches more and more on the cavity of the body. The eggs are peculiar in being very slightly pigmented and almost quite alecithal. The blastula is followed by a hollow spherical embryo, bearing the same relation to that of other Epicarids as the mammalian to the Sauropsidan. It is an adaptation to viviparity.

Is there a Cavernicolous Species of Asellus? †—Herr C. Miethe gives a detailed description of *Asellus cavaticus* Schiödte, and comes emphatically to the conclusion that it is a distinct species, and not, as some have supposed, a variety of *A. aquaticus*. The two species have diverged in different directions from a common ancestral stock.

Annulata.

Phagocytosis and Excretion in Annelida.‡—Herr Guido Schneider has made an extended series of observations on this subject by means of physiological injections of coloured fluids, salts of various metals, and particles in suspension. He finds that frequently, though not invariably, the nephridial cells in Annelids are phagocytic. Of the nephridial cells, those which take the most active part in phagocytosis are those which are most actively excretory, that is, are those of the inner loop of the nephridium in Polychætes, and those of the analogous structure in Oligochætes. Further, the cells which act as phagocytes in taking up

* Comptes Rendus, cxxix. (1899) pp. 770–3.
† Rev. Suisse Zool., vii. (1899) pp. 273–319 (3 pls.).
‡ Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 497–520 (1 pl.).

foreign particles, and which excrete solid and fluid waste products, also allow dissolved carmine to pass through them. Ammoniated carmine is taken up by all phagocytes; but iron salts do not seem to be so taken up; for after injections the iron may occur only in traces in the nephridia, but in abundance in the heart-body (*Terebellides*, *Pectinaria*).

In regard to the mechanism of excretion, the author finds that the excretory particle forms in the cell-body, and is ejected, probably in company with a little protoplasm, but without the direct participation of the nucleus. In this he agrees with Schoppe, but he finds that the actual expulsion of the excretory particle from the cell is a very complicated process, an active process of exchange going on between the cells and the lumen of the nephridial canal.

The lymphoid organs of Polychætes and Oligochætes resemble each other in arising from modified peritoneal epithelium, but otherwise they are not homologous organs. The true chloragogenous cells of Oligochætes appear to be never phagocytes; but in *Travisia* and *Arenicola* among Polychætes the chloragogenous cells are capable of becoming true wandering phagocytes. The chloragogenous cells of Oligochætes appear to have their nearest analogue in the cells of the heart-body of Polychætes; but the latter may be yet proved to be true phagocytes.

Note on the Opheliaceæ.*—Dr. Maurice Philippson publishes a brief but interesting paper on this aberrant family of Polychætes. He rejects the hypothesis of Oligochæte affinities, and relates the family to typical Polychætes through the Ariciidæ, to which the Maldanidæ are also related. Within the family of Opheliaceæ there is clear evidence of the existence of two distinct types of sedentary forms, the one represented by *Travisia*, the other by *Ophelia*. Both are independently derived from errant members of the family, and are not related to other sedentary Polychætes except through errant forms. They thus confirm the theory of the polygenetic origin of the Sedentaria. The author believes that the nervous system is relatively simple and quite typical, being readily reduced to Racovitza's scheme. The palps are probably represented by the frontal papilla, the antennæ by the sensitive area of the sincipital region, the nuchal organs exist as such; so that all the typical sense-organs of the cephalic regions are present.

Regeneration in Polychætes.†—Herr Eugen Schultz has experimented on the regeneration of the posterior end of the body in various worms, chiefly in species of *Harmothoë*. In regard to the regeneration of the hind-gut there is much difference of opinion among investigators. The present author finds that in the early stages there is considerable variation. In some cases the cut walls of the gut draw together and unite, and the epithelium of the body closes over the united portion. A day or two later the closed gut once more opens, and its walls unite with the epithelium of the body. In other cases the walls of the gut unite directly with the body epithelium, without a preliminary closed stage. As the regeneration of the posterior end of the body proceeds, the *mid-gut* increases in length and extends into the regenerating area of the body. There is no regeneration of ectodermic hind-gut, but its place is taken by this elongated mid-gut.

* Zool. Anzeig., xxii. (1899) pp. 417–22.
† Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 605–24 (2 pls.).

The ventral nerve-chain is very speedily regenerated; a fact which is to be correlated with its superficial position in the posterior region of Annelids. The regeneration does not proceed from any one point, but occurs along the whole ventral surface by the proliferation of the ectoderm-cells. The proliferating cells are of two kinds—neuroglia-cells and ganglion-cells. The cœlom arises from immigrating ectoderm-cells, which the author regards as probably the primitive condition, the embryonic origin from two mesoblasts being probably a cænogenetic phenomenon. The primary mesoderm of Meyer, that is the mesoderm which forms muscles and connective-tissue, also arises from ectoderm, in part directly and in part from the "neuro-muscular primordia," whose origin is obscure. The parapodia have a double origin, the chætæ-sacs arise from ectodermic invaginations, the cirri from the neuro-muscular primordia.

In general, in regeneration, while the ectoderm and endoderm retain their characters as typical germ-layers, the mesoderm loses this character and originates anew from the ectoderm. The great regenerative activity of the ventral ectoderm in Polychætes is to be associated with the fact that its cells display little specialisation. These ventral cells are arranged in bands, each of which has the power of regenerating special structures, such as ventral nerve-cord, cœlom, lateral cirri, &c. In other words, in each segment-cells occur with the power of regenerating the organs of that segment.

Regeneration in Earthworms.*—Annah Putnam Hazen has made some interesting experiments. It has been shown by Spallanzani, Morgan, and Hescheler, that a short piece cut from the anterior end of an earthworm dies without regenerating the posterior end, although such a piece often lives for several weeks or even months. It was not known, however, whether, if such pieces could be kept alive for a longer time, they would regenerate, or whether, if regeneration did occur, a head or a tail would develope. By grafting, in a reversed direction, the small anterior end of one worm upon a large posterior piece of another worm, the small piece can be kept alive for a much longer time. The results showed that a head may regenerate from the posterior end of the seventh segment, if it is kept alive for some months by grafting. It seems, comparing this with other experiments, that the part of the body of the normal worm from which the segments are taken determines what will be regenerated, rather than the direction in which regeneration takes place.

Phosphorescence in Earthworms.† — Prof. W. Blaxland Benham notes that the large white earthworm (*Octochætus multiporus*) of New Zealand has a milk-coloured cœlomic fluid of very great tenacity, which can be drawn out in strands, and soon hardens on exposure to air. In the dark, when the worm is handled, this fluid is discharged abundantly from the dorsal pores and from the mouth, which it reaches through the "peptonephridia" opening into the buccal cavity. The fluid is brilliantly phosphorescent when freshly discharged; it contains numbers of colourless "elæocytes," and a remarkable kind of corpuscle containing a thread-like structure not unlike those described by Goodrich in an Enchytræid a few years ago. Benham suggests the need for a fresh

* Anat. Anzeig., xvi. (1899) pp. 536–41 (6 figs). † Nature, lx. (1899) p. 591.

study of *Allolobophora fœtida*, in which Beddard refers the luminosity to the slime secreted by the epidermis.

Cocoons of Allolobophora fœtida.*—Miss K. Foot has been able to watch the processes of cocoon formation and copulation in this worm, and has obtained some most interesting results. As already noticed by other observers, the copulating worms have their anterior segments encased in a slimy substance, but Miss Foot finds that *two* cocoons are formed during copulation within the slimy substance, which forms a definite slime-tube. Within this slime-tube, during the early stages of cocoon formation, there is found the seminal fluid, containing free spermatozoa and spermatophores. Part of the function of the slime-tube is no doubt to enclose the seminal fluid until the cocoon is formed; but it also serves to protect the cocoon in the early stages while this is still soft. When the two cocoons are deposited, each is invested by a part of the slime-tube, and is perfectly white; as the cocoon hardens and darkens on exposure to air, the slime-tube disintegrates. The author describes in detail the breeding season and breeding habits of the species at Evanston and Wood's Holl, and the methods employed by her in obtaining eggs and cocoons, and in studying living eggs. In studying the process of copulation many observations were made to try to determine the exact function of the spermathecæ. Though the results are not quite decisive, it would seem possible that there are two copulations, during the course of the first of which the spermathecæ are filled, while in the second the cocoons are formed. There is at least no doubt that both cocoons are formed during copulation. The spermatophores are formed by the aggregation of numerous spermatozoa round minute masses of white granular substance secreted by minute integumental glands placed on segments 9–11. The substance is probably nutritive, and the sperms cluster round it after leaving the spermathecæ. Many of the minute phenomena of maturation and fertilisation were observed in the living eggs.

In regard to the figures, special mention should be made of a singularly clear and beautiful drawing of two worms *in copulo*.

Swiss Oligochæta.†—K. Bretscher records a number of new forms, and makes some interesting faunistic notes. The greatest novelty is *Aulodrilus limnobius* g. et sp. n., which cannot at present be ranked either with the Lumbriculidæ or with the Tubificidæ, though perhaps it is near the latter. The list includes six new species of *Allolobophora*, four of *Fridericia*, two of *Enchytræus*, and so on.

Valvular Apparatus in Dorsal Vessel of Enchytræids.‡—Sig. L. Cognetti notes Beddard's statement "nella sua splendida Monograph of Oligochæta" that valves do not appear to occur in the lower Oligochæta, except in *Phreoryctes*. He has found a true valvular apparatus in the dorsal vessel of *Anachæta camerani*, *Fridericia bichæta* subsp. *tenuis*, *Fr. ratzelii*, and *Enchytræus buchholzii*. He also concludes that the parietal *Blutzellen* or *Drusenzellen* of Nussbaum represent a less differentiated form of valvular apparatus.

* Journ. Morphol., xiv. (1898) pp. 481–506 (1 pl. and 4 figs.).
† Rev. Suisse Zool., vi. (1899) pp. 369–426 (7 figs.).
‡ Atti Accad. Torino, xxxiv. (1899) pp. 1028–34 (1 pl.).

Epidermis of Tubifex.*—Mr. Lewis Atheston has investigated this subject, with special reference to the nervous structures connected with the epidermis. He finds that, except at the caudal end, the epidermis consists of a single layer of cells. The caudal end is the region where the epidermic cells originate, and in it there is an incomplete layer of basal cells beneath the other cells. From these basal cells gland-cells originate. In addition to basal cells and gland-cells, the epidermis contains supporting cells and sensory cells. The latter may occur (1) singly, (2) in indefinite groups, or (3) aggregated into distinct sense-organs; all are connected with the central nervous system by nerve-fibres, and externally bear sensory hairs. Of the three types of sensory structures, the first (the isolated cells) occur over the whole body, the second (the groups) are present everywhere except at the extreme anterior end of the body, while the definite sense-organs are confined to this extreme anterior region, being especially abundant on the prostomium.

New Leeches.†—Mr. J. Percy Moore has descriptive notes on the collection of leeches in the U.S. National Museum—a small collection of 29 species, of which 6 are new. The most interesting is *Protoclepsine sexoculata* g. et sp. n., which exhibits primitive external characters in the retention of the full number (3) of annuli in all of the anterior somites, and in the elevation of the eyes upon papillæ which stand in serial relation to the dorsal median segmental papillæ of the succeeding somites.

Agreeing with Whitman, but not with Apáthy, Moore regards the primitive typical leech somite as consisting of three annuli. When the primitive tri-annulate character of the somite is lost, this may take place:—(*a*) by reduction, which has occurred as a result of the coalescence of the primary rings at the anterior and posterior ends of nearly all leeches and in the genital regions of some; or (*b*) by elaboration, which has taken place in the somites of the middle body region, especially of the Gnathobdellidæ, Herpobdellidæ, and Ichthyobdellidæ. The increase in the number of annuli by which this elaboration is expressed seldom or never occurs by the actual intercalation of new rings, but only by the growth and lesser or greater subdivision of the three primary rings.

Australian Land Leeches.‡—Miss Ada Lambert describes two new leeches, one of which is apparently identical with a form sent by Prof. Haswell to Prof. Whitman, and referred by him to a new genus *Geobdella*. This species is now described by Miss Lambert as *G. whitmani*, while the other species is referred to the same genus as *G. australiensis*. Both agree with ***Philæmon pungens*** previously § described by Miss Lambert, and differ from all other known land leeches in possessing two jaws only, the median dorsal jaw being absent. The anatomy of the new forms is briefly described.

Abnormality in a Leech.‖—Émile André describes a variation in the male reproductive apparatus of *Hirudo*. The two sides were separate

* Anat. Anzeig., xvi. (1899) pp. 497–509 (5 figs.).
† Proc. U.S. Nat. Mus., xxi. (1899) pp. 543–63 (1 pl.).
‡ Proc. Roy. Soc. Victoria, xi. (1899) pp. 156–63 (2 pls.).
§ Cf. this Journal, 1898, p. 629.
‖ Rev. Suisse Zool., vi. (1899) pp. 427–8 (1 fig.).

anteriorly, and there was a penis on each side. The right half was normal in structure, but was shunted forward by one segment; the left half was normal in position, but divergent in structure. The female organs were practically normal.

Nematohelminthes.

Cuticle of Ascaris.*—Herr C. Toldt has made a minute study of the cuticle of *Ascaris megalocephala*. There are eight different layers, and the author has some corrections to make on previous (e.g. van Bömmel's) descriptions of these. Thus the three so-called fibrous layers are not composed of fibres, but are membranes perforated by elongated parallel gaps. But the most important new result is that the cuticle is traversed by a complicated system of spaces containing jelly-like threads (probably protoplasmic), which arise from the sub-cuticula, and have to do with the sustenance and growth of the cuticle.

Uncinaria perniciosa.†—Herr L. Cohn found this parasite in nodules projecting from the intestinal wall of a panther, with larval forms in the lumen of the gut and in the lungs. He replaces the generic name *Ankylostomum* Dubini (1843) by *Uncinaria* Frölich (1789). He notes the differences between the three species which occur in cats—*U. tubæformis* Molin nec Schneider, *U. perniciosa* v. Linstow = *U. tubæformis* Schneider, and *U. balsami* Parona and Grassi. The nematodes migrate through the mucous membrane into the wall, and the aperture persists.

Parasitic Nematodes.‡—Dr. O. von Linstow describes 49 species from the Berlin Zoological Museum, of which 38 are new. A striking form is *Pterocephalus*, from the intestine of the zebra in East Africa. The head of the adult has six conical spines, six hooks, and six deeply serrated leaf-like appendages, which are attached only at their constricted bases. Noteworthy is the occurrence, in a fresh-water Australian fish, of *Spiroptera* (*Filaria*) *bicolor* previously reported by von Linstow from a German cat-fish. A new species of the gape-worm (*Syngamus*) was found in the choana of a deer from Rio Grande de Sul, and in the nasal cavity of a goat from Cameroon. Only one other species of this genus occurs in Mammalia, namely, *Syngamus dispar*, in the trachea of *Felis concolor*.

Platyhelminthes.

Studies on Tetrarhynchi.§—A. Vaullegeard gives an account of this family, describing the known species, with special reference to their life-histories. The egg of a given species may find suitable conditions in various hosts; thus *Tetrarhynchus bisulcatus* occurs in both Cephalopods and Teleosts; *T. benedeni*, *T. erinaceus*, *T. minutus*, occur in various Teleosts; and *T. ruficollis* in numerous Crustaceans. The embryo bores from the intestine into its annexes, and forms a vesicle in the walls; but in some cases, e.g. those of the type *T. lingualis*, the vesicular stage

* Arbeit. Zool. Inst. Univ. Wien, xi. (1899) pp. 289–326 (1 pl. and 2 figs.).

† Arch. Parasitol., ii. (1899) pp. 5–22 (4 figs.). See Zool. Centralbl., vi. (1899) p. 789.

‡ MT. Zool. Sammlung Mus. Naturkunde Berlin, i. (1899) 28 pp. and 6 pls. See Amer. Nat., xxxiii. (1899) pp. 902–3.

§ Thèse: Faculté des Sciences Paris, Caen, 1899, 4to, 193 pp. and 9 pls.

seems to be skipped over. The vesicle appears to be protective, like an amnion, and encloses the scolex in a *receptaculum capitis*; it has great vitality, and was seen to be mobile in *T. ruficollis*. Sometimes there is a false jointing, like precocious assumption of the adult form, though the results are not utilised in the subsequent development. If the first host be devoured by one unsuited to the further development of the parasite, the larva is usually digested; but in some cases it seems to continue to live without developing, as in *T. mulli-barbati* in *Mullus barbatus*. If the second host be suitable, the scolex developes into a strobila, usually fixed to the walls of the intestine by its proboscis-organs, but sometimes remaining in the pyloric region. The larval form does considerable damage, e.g. *T. gigas* in the liver of *Mola*; but the adult does little if any harm. In fact, as Van Beneden remarked, the finest fish often have most parasites.

Vaullegeard groups the species around the following types:—*T. lingualis*, *T. megacephalus*, *T. tetrabothrius*, *T. tenuis*, *T. erinaceus*, *T. ruficollis*, and *T. minutus*, but there remain many doubtful species. He discusses the affinities of Cestodes, and places the Tetrarhynchi nearest the Phyllobothriæ. It should be noted that this useful memoir, which brings together what has been established in regard to these remarkable Cestodes, also adds much in regard to the minute structure and the life-history of particular species.

Two New Bird Tapeworms.*—O. Fuhrmann has added two strange forms to the number of remarkable tapeworms found in birds. The first, *Gyrocœlia perversus* g. et sp. n., is characterised by the disposition of the musculature in the parenchyma—two layers of longitudinal muscles alternating with three layers of transverse muscles—by the absence of a vagina, and by the annular uterus with a ventral and a dorsal opening. The second, *Acoleus armatus* g. et sp. n., is also remarkable in its musculature, and in having an enormous seminal sac and no vagina. Perhaps, along with *Tænia polymorpha* Rud., they should be referred to a new family, Acoleïnæ. All three were got in hosts belonging to the order of "Waders" (*Limosa*, *Himantopus*, &c.).

Cestodes from Birds.†—Dr. Ludwig Cohn publishes a note on certain disputed points in regard to the classification of Avian Cestodes. The points discussed are especially the taxonomic value of the number of hooks as contrasted with the value of their variations in form, and the question as to whether the rule of priority applies to sub-generic names. Cohn strongly maintains the affirmative position in regard to the latter question, but is not prepared to accept the British Association Code in its ruling as to sub-genera. He accepts, however, the ruling of the International Commission that "the name of the typical sub-genus is the name of the genus."

Clinostomum.‡—Prof. M. Braun discusses the value of this genus, and accepts it as based on the structure of the anterior end of the body, of the excretory system, and of the sexual organs. All the species, when sexually mature, live in the mouth-cavity or throat of the Ardeidæ and Ciconiidæ, while the encysted young forms live in fresh-water bony fish.

* Rev. Suisse Zool., vii. (1899) pp. 341–51 (1 pl.).
† Zool. Anzeig., xxii. (1899) pp. 405–8. ‡ Tom. cit., pp. 484–8, 489–93.

The food invariably consists of blood. The characters of the genus are given in detail, with some account of species. The encysted forms have not as yet been observed in Europe.

Distomum cucumerinum Rud.*—Herr M. Braun has had an opportunity of studying Rudolphi's collection, and finds that this form is really a *Monostomum*, the ventral sucker being absent. The structure of the internal organs entirely confirms this view. As to the species, though nearly related to *Mon. sarcidiornicola* Megn., it seems probable that Rudolphi's species is distinct, and must stand as *Monostomum cucumerinum* Rud.

Trematodes from Snakes.†—Herr Walter Volz describes, under the name of *Distomum zschokkei*, a new Trematode found in the lung of *Heterodon platyrhinus*. He also notes briefly the occurrence of other species of flukes in various snakes.

New Species of Plectanocotyle.‡—Dr. F. S. Monticelli describes *Pl. lorenzii* from the gills of a species of *Trigla*, adjacent to but readily distinguishable from Diesing's *Pl. elliptica*. He suggests that it may be found convenient to establish for the genus a distinct sub-family (Exacotylinæ) of Polystomidæ.

Development of Rhabdocœla.§—Herr Ernst Bresslau publishes a preliminary account of the observations made by him on the eggs of *Mesostomum ehrenbergi* O. Schm., *M. productum* Leuck., and *Bothromesostomum personatum* O. Schm. The observations were made on summer eggs, but winter eggs showed no striking differences. In *M. productum* and *B. personatum* the egg contains a small germ-cell and a mass of very numerous yolk-cells. The division of the germ-cell results in the formation of a mass of similar blastomeres lying in the future ventral half of the egg, beneath a dorsal mass of disintegrated yolk-cells. In *M. ehrenbergi* the eggs are very small, and there are not more than 40–50 yolk-cells. These are very speedily used up; but from an early stage the egg shows, in addition, large vacuolated cells which take no direct part in the formation of the embryo. In this species also there is a protective investment not present in the other forms. The next change in all three forms is the formation of the rudiments of the future organs. The cells arrange themselves into a plate-like structure with a central spherical mass of cells. This spherical mass is the primordium of the pharyngeal musculature, while from the disc of cells the nervous system originates. In *M. ehrenbergi* the ectoderm is rapidly differentiated from the ventral surface of the disc. It sends a solid outgrowth of cells into the primordium of the pharynx, and this outgrowth becomes the epithelium of the pharynx, which is thus truly ectodermic in origin. In *B. personatum* the formation of ectoderm takes place much more slowly, and the pharyngeal epithelium originates *in situ* from the inner cells of the pharyngeal primordium. In *M. productum* the development takes place in a fashion intermediate between these two extremes. The further development is similar in all three forms. The

* Zool. Anzeig., xxii. (1899) pp. 465–8.
† Arch. Naturgesch., lxv. (1899) pp. 331–40 (1 pl.).
‡ Atti Accad. Torino, xxxiv. (1899) pp. 1045–53 (1 pl.).
§ Zool. Anzeig., xxii. (1899) pp. 422–9 (4 figs.).

ectoderm gradually grows round the embryo, but the pharynx remains closed until the time of hatching.

Development of Planarians.* — Mr. W. G. Van Name has obtained numerous eggs of *Eustylochus ellipticus* and *Planocera nebulosa*, and has been able to make a series of observations on their maturation, fertilisation, and early development. In *Eustylochus* the sperm-centrosome and sperm-aster could not be made out, but otherwise the observations made on the two forms were practically identical.

The germinal vesicle is large, and contains a nucleolus and a network of chromatin-threads. The entrance of the spermatozoon into the egg occurs at the time when the first polar spindle begins to form. The two centrosomes appear at once, but their exact point of origin was not made out. They are surrounded each by a centrosphere which at first has only few rays. These early stages take place before the egg is laid. Usually also, before it is laid, the centrosomes have divided. In the formation of the first polar body a true case of heterotypical mitosis (Flemming) occurs. After the extrusion of the first polar body, the remains of the old centrosphere surrounding the separating centrosomes rounds itself off in each case, and forms a new centrosphere about each, so that the entire mitotic figure of the second polar body, with the exception of the chromosomes and part of the aster rays, is formed from the centrosphere of the inner pole of the preceding spindle. The outer part of the aster-rays appears to arise from the granules of the cytoplasm. The chromosomes of the second polar spindle are much smaller than the first. It is probable, but not certain, that their division is a transverse and reducing one. After the extrusion of the second polar body, the aster degenerates, and centrosphere and centrosome disappear. Though the spermatozoon penetrates the egg while it remains in the uterus, fertilisation in the strict sense does not occur till the egg is laid. In *Planocera* the sperm-centrosome is not distinct till the late stages of the first polar spindle, and is then surrounded by short rays made up of microsomes. Later it divides into two. The relation of these sperm-centrosomes to the cleavage-centrosomes was not demonstrated, nor could the origin of the cleavage-centrosomes be made out in either *Planocera* or *Eustylochus*. Similarly, it was found impossible to trace the relation between the centrosomes of successive cleavages, or to work out the cell-lineage.

Development of Convoluta.†—Prof. J. Georgévitch has studied the early stages in the development of *Convoluta roscoffensis*. Maturation and fertilisation occur within the body; each ovum has a transparent capsule, within which the development may be seen in progress on to the gastrula stage. The first cleavage forms two almost equal blastomeres; then two smaller cells are formed; a minute segmentation cavity, present at the 4-cell stage, disappears after the 8-cell stage. The two small blastomeres (ectoderm) indicate the dorsal portion of the future animal; the two larger blastomeres (endoderm) indicate the ventral side. After a brief quiescence the endoderm cells divide laterally and form the initial cells of the mesoderm; the two ectoderm-cells also divide, and an 8-celled blastula results with marked bilateral symmetry.

* Trans. Connecticut Acad., x. (1899) pp. 263–300 (5 pls.).
† Arch. Zool. Expér., vii. (1899) pp. 343–61 (1 pl.).

The endoderm-cells are partly invaginated in gastrulation, but the gastrula is finished by epibole. Indeed, the ectoderm wholly surrounds the embryo, and no blastopore can be detected. Nor is there any archenteron; the gastrula is solid, as Gardiner noted also in *Polychœrus caudatus*. Then follows a remarkable process wherein the endoderm-cells, after dividing repeatedly, undergo degeneration. Their cytoplasm becomes finely granular and gathers round the nucleus, which is somewhat similarly affected. Thus results part of what is unfortunately called the parenchyma of the Acœla.

The ciliated ectoderm begins to move the embryo; the nervous system and sense-organs appear; no trace of solid food is to be seen in the parenchyma; the endodermic material is at first the only source of nutritive supply; the zoochlorellæ suddenly appear in the peripheral parenchyma; they probably penetrate from the outside in time to save the animals from dying of inanition.

The term parenchyma covers two sets of elements:—(*a*) the peripheral parenchyma, which is formed solely from mesoderm cells; and (*b*) the central parenchyma of degenerate endoderm-cells corresponding to the gut of other Turbellarians.

Regeneration in Turbellaria.*—Prof. W. Voigt seeks to distinguish between normal regeneration, which is acknowledged to be frequent in Turbellarians, and the occurrence of heteromorphosis (where the lost part is replaced by one which is different in form and function).

If the anterior part of the body of a Turbellarian be split in the median plane and hindered from coalescing, each of the anterior halves regenerates its missing side, and a Y-shaped form results, double anteriorly, single posteriorly.

But if, after the median cut, a transverse one be made, say to the right, so that the right anterior half is connected with the posterior portion of the body only by a narrow isthmus, and if the healing of the wound be hindered, a new tail is formed at the posterior end of the anterior right half, necessarily almost at right angles to the longitudinal axis.

If the worm be cut obliquely almost across, so that the edges of the wound may be made to gape more than is possible if the cut be straight, then a new head may be regenerated from the posterior half, and a new tail from the anterior half.

If the oblique cut do not reach the middle line, the margin of the wound towards the median plane heals, and the protruding knob regenerates a head or a tail according to the direction of the cut, provided that the projecting portion be not too small. When it is very small, there is either no regeneration of head or tail, or else the incipient regeneration is interrupted by subsequent coalescence of the cut edges.

The author goes on to show that various circumstances may bring about that the regenerated head is directed backwards; but he doubts whether any case of genuine heteromorphosis, with poles reversed, has yet been made out. He does not deny the possibility, but he shows how readily an apparent heteromorphosis may result, especially in organisms which contort themselves so much as Turbellarians do.

* SB. Niederrhein. Ges. Bonn, 1899, pp. 25–31 (3 figs.).

Polyclads of the Pacific Expedition.* — Dr. Marianne Plehn describes the Polyclads collected by Prof. Schauinsland. From Tasmania came a form for which a new genus is erected, called *Microcelis* on account of the small eyes. The species, *M. schauinslandi*, is described in detail; it is characterised by the extraordinary number of minute eyes in the anterior region.

Development of Nemertea.† — Mr. W. R. Coe has studied the development of the pilidium in *Cerebratulus leidyi*, *C. marginatus*, and *Micrura cœca*. In the last named there is little yolk, and the eggs are transparent. They "furnish an almost ideal example of the regular spiral type of cleavage," and the blastomeres are almost equal in size. Gastrulation occurs by invagination; but before it begins the larval mesoderm originates from the endoderm. From a comparison of the three species it appears that the mesoderm arises both from the division of a posterior pole-cell, and from the pushing in of certain endoderm-cells into the segmentation-cavity. By the end of the first day the dorsal surface of the embryo becomes flattened, and the down-growth of ectoderm forms the side-lobes of the pilidium. The apical plate with its long flagella arises at the extreme upper end of the embryo where flattening does not occur. The pilidium swims freely near the surface of the water with the flagella directed upwards. It feeds on small pelagic larvæ, diatoms, &c. The enteron is divided into two regions, an anterior buccal cavity and a posterior blind intestine, the two being separated by amœboid cell-processes which form a valve. The two regions are formed of histologically distinct elements, and probably the anterior is ectodermic and the posterior endodermic, but the two originate by an "almost continuous invagination."

In the apical plate, as already shown by Bütschli, originally separate flagella fuse to form a single thickened flagellum. As in Annelid trochophores, the apical plate is connected by muscles with the digestive tract and the sides of the body. The pilidia studied showed no trace of the complex nervous system described by Salensky. The muscles originate from the mesenchymatous cells, which multiply rapidly during gastrulation. Owing to the extreme transparency of the larvæ, the gradual transformation of amœboid mesenchyme cells into definite muscle-fibres can be watched in the living larva. The fibres ultimately anastomose with one another to constitute a complicated system of interdependent muscles.

The transformation of the pilidium into the young Nemertean was not observed.

Breeding-times of Nemerteans.‡—Mr. W. R. Coe notes that the eggs of some New England Nemerteans can be obtained in abundance at almost any season of the year, and that they afford most useful objects for embryological and cytological investigation. He states the breeding-time for 17 species. Nearly all the common species become sexually mature on the southern coast of New England during the summer months. Only one lays its eggs in mid-winter, and only two in the very early spring.

* Zool. Jahrb., xii. (1899) pp. 448–52 (2 figs.).
† Trans. Connecticut Acad., x. (1899) pp. 235–62 (5 pls.).
‡ Science, ix. (1899) pp. 167–9.

Incertæ Sedis.

Trichoplax adhærens.*—Dr. T. Garbowski has made a study of this peculiar animal. Through a cuticle of several layers there project the cilia, which are not continuous with the cytoplasm, but are merely outer processes of the epithelial cells. The ventral epithelium has no digestive power, this being the function of certain cells of the loose body parenchyma. The food is liquid, chiefly organic decomposition products. Other parenchyma cells, fibrous in character, are disposed dorso-ventrally and act as muscles. The so-called muscles of von Graff are artefacts. In the parenchyma there are large spheres, usually described as fat-bodies, which seem to be intercellular excretory products. The yellowish-brown globules, which have been variously interpreted, are probably symbiotic Algæ (*Zooxanthella*). Two individuals may fuse in conjugation, and this is preparatory (necessarily?) to fission or "architomy." The animal is not a flattened gastrula, nor a Platyhelminth, but it may be one of the various simple types from which higher Metazoa have arisen.

Rotatoria.

New Rotifer: Lacinularia striolata.†—Mr. J. Shephard gives a very complete and elaborate account of this interesting new species, which has much resemblance to *L. pedunculata*, and, like that species, forms spherical colonies anchored to submerged plants by a peduncle 10 to 12 mm. long. The colonies may attain a diameter of 5 mm., and the estimated number of rotifers in such a colony, calculated from those counted in a given area of its surface, gave a total of 3681 for the whole sphere. *L. striolata* has a very long foot, four-fifths the total length, and the corona is not wider than the body; it differs from *L. pedunculata* mainly in these particulars. It has been found in various places in Victoria, often in great profusion.

New Rotifer: Melicerta fimbriata.‡—Messrs. J. Shephard and W. Stickland figure and describe this new species found in the Botanical Gardens of Melbourne. It has much resemblance to *M. tubicolaria*, but builds its tube of light brown fibres, each possessing a granular structure, arranged so as to radiate somewhat irregularly from a thin gelatinous tube which fits closely to the body.

Echinoderma.

Plutei from Unfertilised Eggs.§—Prof. J. Loeb has been led by his experiments to believe that the only reason why the eggs of marine animals do not develope parthenogenetically is that something in the sea-water prevents it, namely the presence or absence of ions of sodium, calcium, potassium, and magnesium. The two former require to be reduced, the two latter to be increased. Experimenting on the eggs of *Arbacia*, he found that the mixture of about 50 per cent. $\frac{10}{8}n$ $MgCl_2$ with about

* Bull. Acad. Sci. Cracovie, 1899, pp. 87–98. See Amer. Nat., xxxiii. (1899) pp. 747–8. † Proc. Roy. Soc. Victoria, xii. (1899) pp. 20–35 (3 pls.).
‡ Vict. Naturalist, xvi. (1899) pp. 38–40 (1 pl.).
§ Amer. Journ. Physiol., iii. (1899) pp. 135–8.

50 per cent. of sea-water suffices to bring about the same result as the entrance of a spermatozoon. The eggs were left in the solution for about two hours, and then returned to normal sea-water. They segmented, formed blastulæ, gastrulæ, and plutei, normal in every respect, except that fewer eggs developed, and that the development was slower than the normal. With each experiment a series of control experiments was made to guard against the possible presence of spermatozoa in the sea-water.

The unfertilised egg of the sea-urchin contains all the essential elements for the production of a perfect pluteus. All the spermatozoon *needs* to carry into the egg for the process of fertilisation are ions to supplement the lack of favourable ions in the water, or to counteract the effects of the other class of ions, or both. "The spermatozoon *may*, however, carry in addition a number of enzymes or other material. The ions and not the nucleins in the spermatozoon are essential to the process of fertilisation." He suggests that in mammals the ions in the blood prevent parthenogenesis, and that a transitory change in these might allow of it. At present it seems hardly safe to say more than that these are very remarkable experiments.

Staleness of Sexual Cells and its Influence on Development.*—Dr. H. M. Vernon notes that the effect of varying degrees of staleness of the ova and sperms of an organism upon subsequent development appears to have been little studied, though such a condition must be a factor of frequent occurrence under natural conditions. He finds:—(1) If the ova and sperms of the Echinoid *Strongylocentrotus lividus* be kept for various times in sea-water before fertilisation, then, for about the first twenty to twenty-seven hours, the number of normal blastulæ formed diminishes only about 1 per cent. per hour. After this, abnormal development sets in rapidly, so that generally, after a further nine hours or so, no blastulæ at all are obtained. The rate of falling off in the number of normal blastulæ may increase to as much as 18·9 per cent. per hour. (2) If ova not more than twenty-seven hours stale be fertilised with equally stale sperm, practically as many blastulæ are obtained as when stale ova are fertilised by fresh sperm, or fresh ova by stale sperm. After twenty-seven hours, however, the number of blastulæ obtained with both products stale falls off more rapidly. (3) Larvæ obtained from stale ova and stale sperm are practically normal in size; those from fresh ova and stale sperm are distinctly larger than the normal; those from stale ova and fresh sperm are distinctly smaller.

Analysis of the Genus Micraster.†—Dr. A. W. Rowe has done a fine piece of work in this analysis of the genus *Micraster*, as determined by rigid zonal collecting from the zone of *Rhynchonella cuvieri* (low-zonal) to that of *Micraster cor-anguinum* (high-zonal) in the Chalk. Two thousand examples have been measured and analysed, and no specimen has been included in the summary unless its zonal position was accurately determined. Six hundred photomicrographic negatives of the special features of the test were made, in order that mere conjecture might play no part in the inquiry, and that these important aids to

* Proc. Roy. Soc., lxv. (1899) pp. 350–60.
† Quart. Journ. Geol. Soc., lv. (1899) pp. 494–547 (5 pls.).

specific and zonal determination might be placed on a permanent and scientific footing.

The result of the paper is to show, from the beginning of the low-zonal series to the beginning of the high-zonal series, an unbroken continuity in the evolution of *Micraster*; "so that as we mount up, zone by zone, fresh features are added to the test, simply owing to the progressive elaboration of the epistroma; and in each zone the special features of the test are so marked that one can tell by their aid from what zone a *Micraster* is derived."

Dr. Rowe divides the genus into four groups:—of *M. cor-bovis*, of *M. leskei*, of *M. præcursor*, and of *M. cor-anguinum* auctorum. "True species, and even prominent varietal types, are rare, and passage-forms and trivial variants are the rule. Nothing but a *group* will embrace them all, and give to each series its correlative value." Unless the passage-forms and mutations be united into a group which will admit of the zoological continuity being exemplified, and the zonal peculiarities noted, a species must be made for each variation, and that in each zone. "The one plan is sufficient for all purposes of nomenclature, and at the same time it marks the evolution of the genus, zone by zone; the other is mere ticketing, and meaningless ticketing to boot."

Revision of Genera and Species of Starfishes.*—Mr. A. E. Verrill describes various collections of starfishes, made by the 'Blake,' the 'Albatross,' and other expeditions, giving descriptions of new species, and a revision of old species and genera. The paper is illustrated by numerous figures of structural points.

Zanzibar Echinoderms.†—Prof. H. Ludwig gives an account of a collection from the Zanzibar region, and a list of the known forms (127 in all, as compared with 77 in 1869). His list includes 4 crinoids, 29 asteroids, 21 ophiuroids, 36 echinoids, and 37 holothuroids.

New Holothurians.‡—E. Hérouard publishes a revision of the Elpidiinæ, with descriptions of some new species based on specimens taken by the 'Princess Alice.' His revision of the sub-family takes into account four structural characters which vary in concert. These are:—the orientation of the tentacular disc, the distribution of the dorsal papillæ, the position of the ventral ambulacral tube-feet, the degree of flattening of the body. The variations of these structures are briefly considered, and the results embodied in a synoptic table of the known genera with lists of species.

Cœlentera.

New Hydroid from Long Island Sound.§—Mr. C. F. Sigerfoos describes *Stylactis hooperi* sp. n., growing on the shells of living specimens of *Ilyanassa obsoleta*, as one of the most beautiful and graceful of Hydroids. The delicacy of the individuals seems correlated with the protection afforded through association with the mollusc and the habitat in a locality free from high winds.

The diagnosis runs:—Hydrocaulus absent; hydrorhiza a network of

* Trans. Connecticut Acad., x. (1899) pp. 145–234 (8 pls.).
† Abh. Senckenberg. Nat. Ges., xxi. (1899) pp. 537–63.
‡ Bull. Soc. Zool. France, xxiv. (1899) pp. 170–5 (4 figs.).
§ Amer. Nat., xxxiii. (1899) pp. 801–7 (5 figs.).

tubes lying in one plane, from which arise small simple spines and the sessile hydranths, which are of two kinds, nutritive and reproductive; they are similar to each other and extremely elongate. The nutritive hydranths may attain a length of two to two and a half centimetres, and bear usually about twenty tentacles arranged in a single circle. The reproductive hydranths are slightly smaller, and bear usually six to ten tentacles, and four or five reproductive buds. Medusa becomes free, though degenerate; the sexual products are mature when the medusa is liberated. The medusa has four radial canals, eight equal rudimentary tentacles, mouth-opening and mouth-parts absent, velum developed.

Pennaria tiarella.*—Mr. M. Smallwood describes the main structural features of this hydroid, and the development of the medusoid. There is in the latter no apparent mouth or circumference-canal. The chymiferous tubes, which appear by a splitting of four endodermic thickenings, entirely degenerate except where the sense-organs occur. Thus the medusoid of *Pennaria* appears to be in a degenerate condition, and, in a sense, intermediate between free-swimming forms and those which have lost all resemblance to this stage. Cells originating from the ectoderm, and filling up the cavity between the manubrium and the bell, form the reproductive elements, but only a few of the primitive ova become effective. Many are absorbed by the few successful cells which become mature ova; others remain simply unused.

Margelopsis and Nemopsis.†—Dr. C. Hartlaub found, four years ago, an interesting medusoid—*Margelopsis haeckelii*—which appeared at Heligoland in great abundance in 1899. It bears on its manubrium numerous "*Nemopsis*" polyps (once seen by McCrady in 1857, but never since), which are strikingly Actinula-like. There is no doubt that *Margelopsis* belongs to the Codonidæ, and that the polyps must be placed beside the medusoid-bearing Tubularians. McCrady's polyp, which he referred to a *Nemopsis* medusoid (*N. gibbesii* = *N. bachei* Agassiz), should be ranked as a stage of *Margelopsis gibbesii*, Hartlaub's *M. haeckelii* being apparently distinct.

Fossil Medusæ.‡—Mr. C. D. Walcott has published a monograph on the known fossil forms and markings referable to Medusæ. As a reviewer notes, "a few years ago no one would have suspected that the rocks of the world could ever yield fossil jelly-fish sufficient in quantity to warrant the publication of a large quarto monograph. Equally unlooked for would have been the fact that the oldest known fauna, the Cambrian, was to furnish a large part of the species, together with a great abundance of specimens." All the undoubted species are classed with Discomedusæ, which shows that the differentiation of the Acraspeda must have taken place in pre-Cambrian times.

Vertical Distribution of Medusæ.§—Dr. Otto Maas publishes a brief note on the Medusæ of the voyages of the 'Princess Alice.' They include a number of species which are apparently true abyssal forms, and

* Amer. Nat., xxxiii. (1899) pp. 861–70 (7 figs.).
† Nachr. Ges. Wiss. Göttingen, 1899, pp. 219–24 (4 figs.).
‡ Monographs U.S. Geol. Survey, xxx. (1898) x. and 201 pp. and 47 pls. See Amer. Nat., xxxiii. (1899) pp. 910–1.
§ Bull. Soc. Zool. France, xxiv. (1899) pp. 165–6.

these are all characterised by a remarkable purple tint, which the author regards as of protective value. It is the complementary colour of the characteristic green of the luminous animals of the abyss, and probably renders the possessors invisible.

Development of Lebrunia.*—Mr. J. E. Duerden gives an interesting account of the *Edwardsia*-stage of the Actinian *Lebrunia*, which is in several ways very remarkable. It seems that *Lebrunia coralligens* retains to a late period certain ancestral characters, which in other forms are either passed over or disappear very early. The early tetrameral symmetry, followed by a bilateral phase, and that again by the hexamerous adult; the system of ciliated cœlomic spaces connected with a closed archenteron, all imbedded in a mass of undifferentiated tissue; the formation of the œsophagus by the breaking down of the floor of an ectodermic invagination in association with an archenteric tube; and the origin of the adult gastrocœlomic cavity from a primary cœlome and disintegration of the tissues, are all unique characteristics.

Cleavage of Ctenophore Ovum.†—Herr L. Rhumbler has tried to analyse the factors operative in the peculiar cleavage of the Ctenophore egg, and finds one of these in a secondary attraction-centre with radiating rays, which forms the plasmic thickening of the *Furchenkopf*.

Porifera.

Sponges from Celebes.‡—Dr. Johannes Thiele describes a collection of sponges made by the Sarasins. A considerable number of new species are described and figured.

New Euplectellid.§—Mr. J. Percy Moore describes *Hyalodendron navalium* g. et sp. n., from Japan, which would appear to be a type of a new sub-family of Euplectellidæ.

Protozoa.

Amœbæ in Sheep's Lung.‖—M. Louis Blanc notes some of the cases in which amœboid organisms have been reported as parasites in mammals, e.g. *Amœba coli* from the large intestine, various species from the vagina, &c. Hitherto none have been detected in the lung, but Blanc found a colony in the sheep, associated with nodules like those caused by *Strongylus filaria*. The parasite bore a close resemblance to *Hyalodiscus limax* or to *Amœba coli*, and had doubtless found its way to the lung by some accident in deglutition.

Coccospheres.¶—Herr C. Ostenfeld has studied some of these much discussed minute organisms from North Atlantic plankton. He has no doubt that *Coccosphæra* is a living organism, though the dead forms look very inorganic. Adopting Haeckel's title, Calcocyteæ, he suggests the following provisional diagnoses:—

Unicellular pelagic organisms (probably Rhizopods related to the

* Journ. Linn. Soc. (Zool.), xxvii. (1899) pp. 269–316 (2 pls.).

† Arch. Entwickmech., viii. (1899) pp. 187–238 (28 figs.). See Zool. Centralbl., vi. (1899) pp. 885–6 (1 fig.).

‡ Zoologica, xxiv. (1899) pp. 1–33 (5 pls.).

§ Proc. Acad. Philadelphia, 1898 (published 1899) pp. 430–4 (2 pls.).

‖ Ann. Soc. Linn. Lyon, xlv. (1899) pp. 87–9.

¶ Zool. Anzeig., xxii. (1899) pp. 433–9 (2 figs.). Cf. this Journal, 1899, p. 419.

Foraminifera), with a shell of regularly arranged peculiarly formed calcareous plates, a large nucleus in granular plasm, and without chromatophores; locomotion unknown; form spherical or ellipsoidal.

Fam. 1. Coccosphærales Haeck. Calcareous plates like a stud, without long radiating outgrowths; with the single genus *Coccosphæra* Wallich (including Haeckel's *Cyathosphæra*), with *C. pelagica* and *C. atlantica* as species.

Fam. 2. Rhabdosphærales Haeck. Calcareous plates provided with long outgrowths, pelagic in the tropical Atlantic, including *Rhabdosphæra* Murray, in which the outgrowths are terminally rounded without discs, and *Discosphæra* Haeck., in which the outgrowths bear a distal disc.

In the same paper the author discusses new species of *Cyttarocylis* and *Tintinnus*, which he has been able to add to the known Tintinnidæ.

Digestion in Ciliata.*—Dr. S. Costamagna has made some experiments in *intra vitam* staining of Ciliata with neutral-red (rectif. Ehrlich). The stainable granules, described by Prowazek in the endoplasm of certain Ciliata, arise within the food-vacuoles during the process of digestion. The granules, regularly scattered through the cell-substance, and stainable with neutral-red, gradually move to the more superficial parts of the endoplasm, whence they may pass to form in some way the external excretory droplets.

Psychology of Paramæcium.†—Mr. H. S. Jennings sums up from the psychological standpoint the results of his numerous experiments on the vital phenomena of this Protozoon. The special interest of his results is that, while *Paramæcium* presents not a few phenomena which appear to demand a psychical explanation, yet in point of fact, all these can be reduced to simple protoplasmic irritability. Thus *Paramæcium* in its natural conditions feeds on bacteria, and if a fragment of bacterial zooglœa be placed in a drop of water containing *Paramæcia*, these at once collect round it, even if they are so numerous that only a proportion are actually in contact with the zooglœa. Further, the *Paramæcia* are social, collecting in large masses both in the culture-jars and in isolated drops of water beneath the Microscope; they are also strongly attracted by certain fluids such as dilute acid, and strongly repelled by others, especially alkalis. Such characteristics might be (as indeed they have been) explained by the use of the ordinary psychological terms, but careful observation shows that all are purely automatic. Thus food-taking is the mechanical result of the movement of the cilia; these sweep particles into the mouth without regard to the nutritive value of the particles. Further, the remarkable swarming movement about bacterial zooglœa occurs also with any solid substance introduced into the water, and is due to the fact that when the organism hits against a solid particle all its cilia come to rest except those lining the oral cavity. Again, the "sociality" can be explained in the following way. The *Paramæcia* are roving animals which wander about in all directions; but if in the course of their wanderings they strike against some minute particle, or even a mere roughness in the glass, they then come to rest,

* Atti Accad. Torino, xxxiv. (1899) pp. 1035–44 (1 pl.).
† Amer. Journ. Psychol., x. (1899) pp. 1–13.

and as a result, the particle becomes a centre of carbonic acid secreted by the resting animals. Carbonic acid exerts a strongly attractive influence on organisms in general; and these, during the course of their random wanderings, are likely to come within the acidulated area, and are then retained there by the negative reaction of the surrounding water. The same phenomenon explains the swarming of individuals round a solid particle which is already covered by others. There is thus no action at a distance, the swarming is an accidental result of the active movements of the unstimulated animal. Quite similarly there is no directly attractive agent, the swarming in any particular area being due to the repellent effect of the surrounding area. The mechanism of repulsion is, that contact with the repellent substance causes the animal to reverse its cilia, move backwards, make a half turn, and then move forwards again. Under ordinary circumstances the result is to cause the animal to move away from the repellent substance; but the absence of any "intelligence" in the process is shown by the repetition of the same movements when the *Paramæcia* are placed in water impregnated throughout with the noxious reagent. The result is that, strictly speaking, it is as untrue to say that *Paramæcium* is repelled by any agent or condition as it is to say that it is attracted. It is rather true that certain agents produce a reaction which is not directly related to the position of the source of stimulus, but which is determined by the structure of the organism.

Conjugation in Infusoria.*—S. Prowazek has studied the structure and life-history of *Bursaria truncatella* (O. F. M.) Clap. et L. The macronucleus is a long ribbon-shaped structure tapering towards the ends. It possesses an alveolar structure with a central denser band. The micronuclei are numerous and are not always easy to see. Conjugation follows a period of rapid division, and is heralded by restless swimming movements. In the first period the most marked alteration is seen in the macronucleus, which increases in length and becomes coiled. Later it takes on a rosary-like form, and ultimately breaks up into some 6–12 segments, each containing one or more rounded masses of chromatin. These undergo degeneration later. Meanwhile the micronuclei increase in size and divide by means of spindles. One of the nuclei produced forms the fertilisation-spindle, the others are to be regarded as analogous to reducing divisions. The fertilisation-spindle divides into a stationary and a wandering nucleus. After the fusion the new nucleus divides up to form the numerous micronuclei of the normal organism. These micronuclei separate from one another, and ultimately a varying number of them fuse together to form the new macronucleus.

The author has also studied the structure and life-history of *Stylonychia pustulata*, and gives a detailed account of his observations, with some notes on habits.

New Myxosporidium.†—Mr. Hagenmuller describes *Nosema stephani* sp. n. (genus *Glugea* Thélohan) from *Flesus passer* Moreau. This is interesting, since Thélohan regarded Pleuronectid fishes as refractory to myxosporidial infection, though the conditions of their life seem such

* Arbeit. Zool. Inst. Univ. Wien, xi. (1899) pp. 195–268 (4 pls. and 4 figs.).
† Comptes Rendus, cxxix. (1899) pp. 836–9.

as should render them very liable. In the above-named flat-fish characteristic of the littoral marshes, the parasite is very abundant—in 18 cases out of 30 specimens. It occurs diffusely or in cysts on the walls of the digestive tract. The only Myxosporidia hitherto observed in these conditions have been species of *Myxobolus*.

Ætiology of Kedani Disease.* —According to Dr. K. Tanaka, Kedani disease is caused by a species of *Proteus* which gains entrance to the body through bites caused by a small tick. No distinct proof of this connection is adduced, but the assumption is based on the coincidence of the simultaneous appearance and disappearance of the ticks and the disease. The *Proteus* was not discovered in the ticks, but was isolated from the body post-mortem and from urinary sediment during life. In sections it resembles anthrax or the œdema bacillus, but in cultures its form is very variable and frequently coccoid. It was cultivated on the usual media; the colour of the growth was usually whitish, but on potato yellowish-white. It produces indol, causes an acid reaction, coagulates milk, and in saccharated media forms gas. It grows equally well in air or in hydrogen When young it liquefies gelatin, but loses the power in a few months. In sections it is best stained with methylen-blue, but cover-glass preparations stain easily with all basic anilin pigments. Its behaviour to Gram's method is inconstant. It is pathogenic to mice, guinea-pigs, and rabbits. It closely resembles, morphologically and biologically, *Proteus hauseri*, but stains like *Bacillus capsulatus septicus*.

* Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 432–9 (2 pls.).

BOTANY.

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

α. Anatomy.

(1) Cell-Structure and Protoplasm.

Structure of the Cell.*—Dr. L. Buscalioni has collected his recent observations (1892–97) on the structure of the cell and cell-nucleus, together with the results of some more recent researches. The treatise comprises the following subjects:—Development of the endosperm and embryo of *Vicia Faba*; Development of the pseudo-cells (*Scheinzellen*) and endosperm in *Lupinus*; Endosperm of *Fritillaria imperialis* and *Leucojum vernum*; Latex-cells of *Urtica dioica*, *U. urens*, and *Euphorbia Cyparissias*; Cyanophily and erythrophily of the nucleus; Structure and function of the nucleoles.

In *Vicia Faba* the suspensor does not entirely disappear, but persists throughout the development of the seed, and contributes to the formation of the peculiar bodies termed by the author "pseudo-cells." A portion of the endosperm also persists, and is organised into an intercotyledonary tissue. The cotyledons finally occupy the whole of the chalazal portion of the embryo-sac, while the radicle and the hypocotyledonary axis penetrate into the micropylar portion, almost completely closing it. The pseudo-cells contain a number of large oval or irregular nuclei, which multiply by typical fragmentation. They probably assist in the carriage of nutriment to the embryo. In several species of *Lupinus* similar pseudo-cells were observed. No centrosomes were at any time observed.

In the latex-idioblasts of *Urtica*, which are only of one kind, three modes of cell-multiplication take place; karyokinesis, ordinary fragmentation, and karyokinetic fragmentation; in *Euphorbia Cyparissias* apparently karyokinesis only.

In a great majority of the endosperm-nuclei of *Vicia Faba* there is a strong tendency, during the entire development of the seed, to take up green pigments, while the nucleoles are stained red. During karyokinesis the nuclei are typically cyanophilous.

The nucleoles are either homogeneous or contain vacuoles, according to the species and the state of development of the seed. They are almost always separated from the framework of the nucleus by a colourless border.

There is no connection (in *Vicia Faba*) between the formation or nutrition of the chromosomes and the disappearance of the nucleoles; nor is there any connection (in *Vicia*, *Fritillaria*, and *Leucojum*) between the nucleoles and the chromosomes [centrosomes in *Bot. Centralbl.*]; while there is a connection between the achromatic threads and the cytoplasm. In *Vicia* and *Fritillaria* the nucleoles take no part in the formation of the membrane.

* Ann. r. Ist. Bot. Roma, vii. (1898) pp. 255–316 (8 pls.). See Bot. Centralbl., lxxix. (1899) p. 360.

Division of the Nucleus in Vegetative Cells.*—Prof. D. M. Mottier states that, in the process of karyokinesis in the vegetative cells of *Lilium*, during the formation of the spindle, the kinoplasm is present in a much smaller quantity than in the sexual cells of the same plant. As a rule, it is not at first arranged radially about the nucleus, but forms a delicate weft which may be closely applied to the nuclear membrane. The kinoplastic fibres of the weft form a multipolar spindle which is readily transformed into the ordinary bipolar type. These accumulations of kinoplastic fibres are characteristic of a definite phase in the development of the spindle in certain vegetable cells. The author considers that the development of the karyokinetic spindle proves conclusively that centrosomes do not exist in the higher plants.

Fusion of Nuclei.†—Mr. P. Groom reviews the recorded cases of a non-sexual union of nuclei in Fungi, Florideæ, and Phanerogams, and suggests the following hypothesis:—The nuclear union does not, in these cases, represent a true sexual act; it is an interpolation. It takes place in a small generation which is fructificative in development. The generation in which the nuclear fusion occurs is probably in all cases degenerate; and it is natural to suppose that the fusion is correlated with the vegetative degeneracy. The theory that the object of the nuclear union is to double the chromosomes is negatived by the occurrence of a double union in the Ascomycetes, and by the fact that in Angiosperms the chromosomes in the endosperm sometimes preserve the half number. For these pseudo-sexual unions the author proposes the term "deuterogamy."

Dependence of the Streaming of Protoplasm and the Movements of Vibratile Cilia on Free Oxygen.‡—Herr G. Ritter records the results of a series of experiments for determining this question, made mostly on aerobic and anaerobic bacteria and on the movements of protoplasm in *Chara* and *Nitella*. The following are some of the chief results reached. With the facultative anaerobic bacteria, the duration of the anaerobic movements depends greatly on the nature of the nutritive medium, lasting from three to seven times as long with some as with others. The absence of oxygen has a tendency to produce motionless rather than motile forms. In the Characeæ the experiments determined also the capacity for anaerobic existence, and even growth, to a limited extent. The author concludes that the intramolecular respiration, and in consequence the anaerobic movements of protoplasm, in *Nitella*, are not dependent on stored-up oxygen, any more than are the ordinary phenomena of life. The difference between chlorophyllous and non-chlorophyllous temporary anaerobes consists in this:—that the former can themselves manufacture their food-materials out of inorganic substances, with the help of the solar energy; while the latter are dependent on already organised nutrient substances.

Effect of Centrifugal Force on the Cell.§—Prof. David M. Mottier records the result of a series of experiments on the effect on the struc-

* Proc. Indiana Acad. Sci., 1898, pp. 164–6.
† Trans. and Proc. Bot. Soc. Edinburgh, xxi. (1899) pp. 132–44.
‡ Flora, lxxxvi. (1899) pp. 329–60 (1 fig.).
§ Ann. of Bot., xiii. (1899) pp. 325–62 (1 pl.).

ture and development of the cell of a centrifugal force varying from 1700 to 1930 times that of gravity. The objects experimented on were *Cladophora*, *Spirogyra*, and other fresh-water algæ, *Chara* and *Nitella*, staminal hairs of *Tradescantia* and other trichomes, leaves of mosses, &c. In *Cladophora*, the effect of the treatment was that almost the entire contents except the parietal utricle were crowded into a dense mass at the end of the cell, and yet the vitality of the cell was in no way injured; after the lapse of a considerable time the contents again took up their normal position. With *Spirogyra* the general results were the same, but the cells were much more liable to injury in the process. Cell-division may commence, in both cases, before complete redistribution of the contents is accomplished. The author regards his results as confirmatory of the view that in both types of cell-division represented by *Cladophora* and *Spirogyra*, a close relation exists between the nucleus or nuclei and the transverse membrane in process of formation.

Plasmolysis of Growing Cells.*—From a series of experiments on a variety of plants, both cryptogamic and phanerogamic, Herr M. O. Reinhardt derives the conclusion that in the growth of the cell-wall there must be a mutual reaction between the protoplasm and the young membrane, the source of which must lie partly in the membrane, though it can be brought into action only by the co-operation of living protoplasm. The relations between membrane and protoplasm may be brought about by delicate threads of protoplasm connecting the protoplasts with the micellæ of the cell-wall. When this delicate connection is ruptured by plasmolysis, it cannot be restored, and growth must cease. The protoplasm receives the stimulus and reacts upon it, determining the form and the direction of growth; but there are also active forces in the cell-wall, which possibly act in the manner suggested by Nägeli in his theory of intussusception.

Centrifugal Growth of the Cell-wall and Extracellular Protoplasm.†—The growth on the outside of the cell-wall is very much less common, and has been much less carefully investigated, than the ordinary centripetal growth. Herr F. Schütt has studied it in the cases of the Peridinieæ (*Ceratium* and *Podolampas*), diatoms (*Cyclotella socialis*), and desmids. The bands, spines, wings, &c., which occur outside the cell-wall in the Peridinieæ, cannot be derived from the internal protoplasm, since neither intussusception nor apposition could account for their formation in this way. The explanation offered is that these structures have their origin in a portion of the protoplasm which has escaped from the interior of the cell, passing through the sieve-like pores which everywhere perforate the cell-wall. From the occurrence of this phenomenon the author groups together the three families named under the term PLACOPHYTES.

In the case of the Peridinieæ named, as well as some others, the author has detected very fine threads passing through the pores in the cell-wall to which he attributes a protoplasmic character, as well as

* Festschr. f. Schwendener, 1899, p. 124 (1 pl.). See Bot. Ztg., lvii. (1899) 2te Abth., p. 298.

† Pringsheim's Jahrb. f. wiss. Bot., xxxiii. (1899) pp. 594–690 (3 pls.).

the escape of protoplasm by the pores through which the flagella pass, this protoplasm being endowed with amœboid movements, and putting out pseudopodes. The mechanical irritation causes the formation of bladders and pustules on the outer surface of the cell. A direct communication is maintained between the internal and the external protoplasm.

Similar results were obtained with diatoms and desmids. In *Cyclotella socialis* the individual cells of a colony are connected together by countless threads; in the interior of the colony, but outside the cell-walls, is a quantity of mucilage and pseudopode-forming protoplasm. The local band-like thickenings of the cell-wall occur partially on the inner, but to a much larger extent on the outer surface of the cell-walls.

Vibrioids.*—Prof. G. Lagerheim confirms the occurrence of these bodies in vegetable cells discovered by Swingle. He finds them in the hyphæ of a fungus. *Ascoidea rubescens*, imbedded in the parietal protoplasm; in older cells they are often obscured by drops of oil. Their number varies greatly. Their motion consists of a variety of bendings in a plane parallel to the cell-wall. Their form resembles that of a bacillus of uniform thickness; their length varies between 2 and 20 μ; their thickness is about 0·5 μ; they have rounded ends. They are sharply differentiated from the cytoplasm; they are slightly refringent; not doubly refractive; with very high magnification they appear to consist of a badly defined row of granules. Their microchemical reactions are given in detail.

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

Colours of Flowers.†—Mr. P. Q. Keegan has performed a careful series of experiments for the purpose of deciding between the view of Berzelius that the original colour of anthocyan (the colouring matter of red and blue flowers) is red, and that of Wiesner that it is blue. His conclusion is, on the whole, in favour of the former hypothesis. He believes, however, that there are different stages in the development of the floral pigment. In the lower stages the natural colour is red, whatever the chromogen may be. In the higher stages, on the other hand, the natural colour of anthocyan is blue, or rather—at least with some chromogens—it becomes capable of forming blue compounds with alkalis and certain metallic acids. There also exist chromogens which, except under very exceptional conditions, are incapable of producing a blue pigment. These, in all stages, naturally develope into a red, the brilliancy of which unequivocally attests its real original and proper character.

Chemical Substances in Plants.‡—M. P. van Romburgh notes the occurrence of the following substances in the vegetable kingdom. Acetone is probably widely distributed, and was detected in *Hevea brasiliensis*, *Manihot Glaziovii* and *utilissima*, *Phaseolus lunatus*, and other plants. Methyl salicate is apparently also a substance of wide distribution in the vegetable kingdom. The presence of hydrocyanic acid was determined

* Öfv. k. Vetensk. Akad. Förhandl., lvi. (1899) pp. 557–64 (1 fig.) (German). Cf. this Journal, 1898, p. 316.
† Nature, lxi. (1899) pp. 105–6.
‡ Ann. Jard. Bot. Buitenzorg, xvi. (1899) pp. 1–16.

in *Hevea brasiliensis*, *Manihot Glaziovii*, *Phaseolus lunatus* (leaves), *Indigofera galegoides* (leaves), and, in smaller quantities, in the leaves of many other plants.

Calcium Oxalate in the Pericarp of the Umbelliferæ.* — Dr. J. Rompel gives details with regard to the presence of crystals of calcium oxalate in the pericarp of Umbelliferæ, and its value for the purpose of classification; 220 species, belonging to nearly 100 genera, having been examined.

He finds that the presence of these crystals, and still more their mode of distribution, is often characteristic of natural groups. The various modes of deposit may be classed under three types—those of *Hydrocotyle*, of *Sanicula*, and of *Scandix*. The *Hydrocotyle*-type—characterised by an endocarp composed of an inner hard layer and an outer coat containing crystals—occurs without exception in the tribes Hydrocotyleæ and Mulineæ. *Erigenia* must be excluded from, *Hermas*, *Actinotus*, and *Astrotricha* included in this section of the order. The *Sanicula*-type—in which the clusters of crystals are usually grouped at particular spots of the pericarp, and deposited in parenchymatous cells—is characteristic of the tribe Saniculeæ, from which *Arctopus* and *Lagœcia* must be excluded, while *Lichtensteinia* and other allied South African genera must be placed in it. The *Scandix*-type is characterised by the occurrence of usually single crystals in several layers of cells along the commissure and around the carpophore, and is universal in the Scandicineæ and Caucalineæ.

Calcium Oxalate in the Embryo of Papilionaceæ.†—According to Sig. J. Caldarera Castranovo, the occurrence of crystals of calcium oxalate in the embryo of the Papilionaceæ is only exceptional. It may occur either in the form of Rosanoff's crystals, or as an enclosure in the aleurone grains, as sphærites, single crystals, or clusters. They are located in the parenchyme of the cotyledons, occasionally in the aleurone grains of the epidermal cells; never in the plumule or radicle. Crystals of calcium oxalate are formed especially when there is abundance of aleurone and but little or no starch.

Alleged Digestive Enzyme of Drosera.‡ — M. Raphael Dubois reaffirms his statement that, in the tentacles of *Drosera* (*longifolia*), there is, as is the case also with the pitchers of *Nepenthes*, no zymase capable of digesting albuminoids.

(3) Structure of Tissues.

Spiral Thickenings in the Water-conducting Elements.§—Dr. M. Koernicke describes the peculiar spiral thickenings in the tracheids of *Viscum album*. They present the peculiarity that the thickening-band is not directly attached along its whole length to the wall of the vessel; but the main spiral (*Kopfspirale*) is fixed on a narrow cross-piece, the "foot-spiral," which is itself attached to the wall of the tracheid. The two portions of the spiral present different staining reactions, which are described at length.

* SB. k. Akad. Wiss. Wien, civ. (1895) pp. 417–74 (2 pls.).

† Lab. Ist. Bot. Univ. Catania, 1898, 38 pp. and 1 pl. See Bot. Centralbl., lxxix. (1899) p. 199.

‡ Ann. Soc. Linn. Lyon, xlv. (1899) pp. 79–80.

§ SB. Niederrhein. Gesell. Nat. u. Heilk. Bonn, 1899, 1te Hälfte, pp. 1–10 (1 fig.).

Secondary Thickening in the Aerial Roots of Ivy.* — Prof. R. J. Harvey Gibson notes a singular change which has taken place in the aerial roots of a plant of ivy. The number of protoxylems is greatly increased; the pericycle is much thicker; the endoderm is well marked, and is followed by a thick cortex. As the root becomes older, two cambiums make their appearance in a manner quite similar to that seen in a normal underground dicotyledonous root.

Histological Changes produced by Phytoptus.†—From an examination of the twigs of the pear infested by galls produced by *Phytoptus pyri*, M. M. Molliard draws the conclusion that the chemical irritation resulting from the action of parasites, such as the Phytoptidæ, determines the formation of a new tissue which is differentiated at the expense of cells of any kind, whatever may be their future development under ordinary conditions; this new tissue being destined for the nourishment of the parasite. In the case under discussion this new tissue consists of a number of layers, which may amount to as many as fifteen, of homogeneous cells immediately beneath the bark. The phelloderm consists of several layers of cells either entirely destitute of starch, or containing only very small grains.

Raphid-Cells.‡—Herr F. G. Kohl has investigated the structure and development of raphid-cells, chiefly in *Hyacinthus* and in the Orchideæ. The bundle of raphids is enveloped in a protoplasm-sac, not only when young, but for a considerable time. This sac is usually suspended by two strings of protoplasm lying in the direction of the axis of the bundles, and it is connected also with the parietal protoplasm by fine protoplasmic filaments. The nucleus of the raphid-cells is usually parietal. The separate crystals are for a long period enveloped in sheaths of cytoplasm, which display the same staining and micro-chemical reactions as the parietal protoplasm and that of the strings. The mucilage of the raphid-cells always fills up the vacuoles, and is permeated by strings of protoplasm. Both the parietal protoplasm of the raphid-cells of the tubers of *Orchis* and the protoplasm of the central sac have a reticulate structure on the inner or outer side. The mucilage of these cells is chiefly formed out of starch; but in the mature cells there are usually only traces of normal starch.

Oil-Cells and Oil.§ — Herr R. Biermann gives an account of the structure and development of oil-cells and the formation in them of oil, in *Cinnamomum Cassia*, *Laurus nobilis*, *Myristica fragrans*, and other plants. In their early stages there is no difference in the mode of formation of oil-cells and of mucilage-cells; the first stage in both is the formation of mucilage-membranes. The resinogenous layer resembles protoplasm in being stained yellow or brown by iodine, but differs from it in its capacity of taking up certain anilin pigments, especially methyl-green, and not giving them up again to solvents.

* Proc. and Trans. Liverpool Biol. Soc., xiii. (1899) pp. 185–7 (1 pl.).
† Comptes Rendus, cxxix (1899) pp. 841–4.
‡ Bot. Centralbl., lxxix. (1899) pp. 273–82 (1 pl. and 6 figs.).
§ Arch. d. Pharmacie, ccxxxvi. pp. 74–80. See Beih. z. Bot. Centralbl., ix. (1899) p. 15.

(4) Structure of Organs.

Anatomy of Dicotyledons.* — Herr H. Solereder has collected an immense mass of details respecting the anatomy of the stem and leaves in the various families of Dicotyledons, with a view to their systematic classification on these grounds. A synopsis is given of the chief anatomical characters of each family; and an account is then given in detail of the structure of the leaf and of the stem. Each section is accompanied by a complete bibliography.

Flowers of Alsineæ.†—A. O. Wester has investigated the morphology and anatomy of the flowers of this tribe of Caryophyllaceæ. In *Arenaria* and *Alsine* the episepalous stamens form the outer, the epipetalous stamens the inner whorl; while in *Spergula* and *Spergularia* the reverse is the case; in *Stellaria* and *Malachium* the case is doubtful. The central cylinder divides into two parts, one of which branches into the calyx, corolla, and stamens; while the bundles which proceed to the wall of the ovary and to the placenta have no connection with one another.

Floral Scales of Cuscuta.‡—Alida M. Cunningham proposes a new arrangement of the American species of this genus based on the position of the floral scales. Contrary to the view of previous observers, she has arrived at the conclusion that the scales are not epistaminal, and do not form a staminal crown, but are petaloid in their origin, being of the nature of a duplication of the petals.

Formation of Pollen in Hemerocallis.§—Mr. E. L. Fullmer thus sums up his observations on the development of the microsporanges and microspores of *Hemerocallis fulva*. Three or four hypodermal cells of each microsporange become differentiated as the archesporial cells. The wall of the sporange consists of three layers exclusive of the epiderm; the tapete is a physiological rather than a morphological structure, the peripheral part being organised from the parietal layers, and the axial part from the general tissue. The spindle appears bipolar from its first appearance, being dome-shaped in its early stages; no trace of multipolar spindles was observed. The spindles often persist for a considerable time after division is complete. Bodies having the appearance of centrosomes are frequently seen at the poles. The origin of the supernumerary microspores was not absolutely determined. In many cases, where their origin was indicated by spindles or otherwise, they appeared to arise by the indirect division of one of the tetrad nuclei. The pollen-tube nucleus frequently divides by direct division, forming sometimes as many as six or eight nuclei.

Endosperm Haustoria.‖—Prof. D. M. Mottier describes a special provision in the endosperm of *Lilium candidum* for increasing the absorbing surface in the chalazal region. At the chalaza some of the endosperm-cells send out short tubes which penetrate the tissue of the chalaza.

* 'Systematische Anatomie d. Dicotyledonen,' Stuttgart, 1899, xii. and 984 pp. and 189 figs. See Bot. Gazette, xxviii. (1899) p. 140.

† Öfv. k. Vetensk. Akad. Förhandl., lvi. (1899) pp. 341–64 (23 figs.) (German abstract).

‡ Proc. Indiana Acad. Sci., 1898, pp. 212–3.

§ Bot. Gazette, xxviii. (1899) pp. 81–8 (2 pls.). Cf. this Journal, 1898, p. 91.

‖ Proc. Indiana Acad. Sci., 1898, pp. 168–9.

By the growth of the seed the chalazal region is forced into a lateral position. The antipodals disappear, and the chalazal end of the embryo-sac formerly occupied by them is now filled with endosperm-cells projecting into the chalazal tissue. There seems to be no doubt that this is a provision for increasing the absorbing surface of the endosperm in the region of greatest food-supply. Similar arrangements have been observed in other plants.

Fruit of Œnanthe.*—M. J. Briquet has paid special attention to the fruit of this genus of Umbelliferæ. The chlorophyll disappears very early from the outer layer of the mesocarp. The conducting bundles serve chiefly for the supply, not for the elimination of assimilated substance. The oil-glands are regarded by the author as a means of protection against fructivorous or seminivorous birds. The fruit has a beautiful apparatus for allowing it to swim for weeks upon the water, in the form of groups of aeriferous cells imbedded in the mericarp.

Dehiscence of the Nutmeg.†—M. J. N. Janse attributes the bursting of the fruit of *Myristica* to the co-operation of three forces:—a mutual tension between the kernel and the shell; the development of a special portion of the pericarp into an "expansion-tissue"; and a tension within the shell itself. M. Janse supports the view that the purpose of the bright-coloured aril or mace is the attraction of birds which feed upon it, and pass the seeds unharmed in their excrement.

Biastrepsis in its relation to Cultivation.‡—Using the term "biastrepsis," as proposed by Schimper, as an equivalent for the German *Zwangsdrehung* (often rendered "twisting of the stem") M. Hugo de Vries states, as a general rule, that the phenomenon (especially in the case of *Dipsacus sylvestris*) is in a high degree dependent on the conditions which obtain during and subsequently to the germination of the seed. Conditions which favour the vigorous development of the plants promote also the size and the number of the portions of the main stem, and of the branches which show the twisting. Biastrepsis occurs only in plants the shoots of which have opposite or whorled leaves; the phyllotaxis becomes spiral instead of verticillate, the successive leaves of the spiral being connected by their bases.

Stem of Aristolochia.§—Herr H. C. Schellenberg has studied the structure of the abnormal stem of *Aristolochia sipho*, and is of opinion that the main object of the mechanical ring is the increase of its flexibility rather than the protection of the sieve-tubes. In the twining species of *Aristolochia* the pith and medullary rays are composed of unlignified thin-walled cells; while in the erect species these cells are thick-walled and lignified. *A. sipho* possesses no special climbing contrivances during its first year of growth.

Floating-Apparatus of the Leaves of Pistia.‖—Prof. T. Ito describes the peculiar floating-apparatus in the leaves of *Pistia stratiotes*, an aquatic Aroid. A little above the base the leaf is swollen into an obovate

* Bull. Herb. Boissier, vii. (1899) pp. 467-88 (11 figs.).
† Ann. Jard. Bot. Buitenzorg, xvi. (1899) pp. 17-45 (1 pl.).
‡ Ann. of Bot., xiii. (1899) pp. 395-420.
§ Festschr. f. Schwendener, 1899, p. 301 (1 pl.). See Beiheft z. Bot. Centralbl., ix. (1899) p. 16.
‖ Ann. of Bot., xiii. (1899) p. 466.

form, the swollen part being composed of spongy parenchymatous tissue containing air. Both surfaces of the leaf are densely covered with minute depressed hairs, which protect the leaves from being wetted.

Envelope of the Corpuscles of Ephedra.* — M. P. Jaccard has studied the mode in which the envelope of the corpuscles of *Ephedra* becomes disorganised, and the proteinaceous substances accumulate in the archegones. The disorganisation probably takes place under the influence of a ferment, and the transference of the proteinaceous substances by dialysis through cell-membranes and the wall of the archegone, which is connected with the envelopes of the corpuscle by numerous filaments of protoplasm. The membrane is never perforated as is the case with *Cycas*. The function of the envelope of the corpuscles appears to be analogous to that of the antipodals and of the epithelial layer of the embryo-sac of Compositæ.†

Hydathodes of Scolopia.‡—M. J. Briquet describes the hydathodes in several species of this genus belonging to the Flacourtiaceæ. They consist of two small symmetrical cylindrical-conical appendages at the apex of the leaf-stalk, containing a central tracheid-bundle surrounded by a delicate parenchyme destitute of cellulose and containing calcium oxalate and water. The epiderm possesses water-fissures. These structures are not extranuptial nectaries, since they contain no sugar.

Thallus of Rafflesia.§—Dr. F. Schaar gives the following account of the structure of the myceloid thallus of *Rafflesia Rochussenii*, and its parasitism on roots of *Cissus*. The thallus is entirely cellular, containing neither tracheids nor sieve-tubes. As a rule the cells of the parasite are sharply differentiated from those of the host-plant. The hyphæ permeate the leptome-portion of the secondary cortex, the xylem-discs, and the amylaceous medullary rays; the cells found in the cambium zone of the host have a meristematic character. In the leptome the hyphæ pass into the cavities of the sieve-tubes, and the membrane of the parasite partially coalesces with that of the host; the coalescing portions are usually very thin. Small haustorial structures are sometimes formed. The bundle-tissue which passes into the flowers of the parasite consists of about 20 bundle-rings placed in a circle, each having its own cambium-ring, which forms sieve-tubes outwardly, the centre consisting of a parenchymatous cellular tissue.

Roots of Cactiform Euphorbias.‖—M. L. Gaucher calls attention to the structure of the roots of the cactus-like species of *Euphorbia*, which are well adapted to absorb every particle of moisture out of the dry soil in which they grow. The ultimate ramifications of the root are completely covered by long root-hairs; and these rootlets themselves become detached and fall off after the absorbing hairs have completed their function. The long roots are characterised by the great development of the bark and the reduction of the cortical parenchyme and phloem. In the reduced cortex are a great number of wide laticiferous

* Arch. Sci. Phys. et Nat., viii. (1899) p. 190. † Cf. this Journal, 1899, p. 297.
‡ Bull. Lab. Bot. Univ. Genève, iii. (1899) pp. 35–6. See Bot. Centralbl., lxxix. (1899) p. 317. § SB. k. Akad. Wiss. Wien, cvii. (1899) pp. 1039–56 (3 pls.).
‖ Journ. de Bot. (Morot), xiii. (1899) pp. 173–5 (1 fig.).

tubes filled with contents. Similar tubes are also found, in great abundance, in the absorbing roots.

β. Physiology.

(1) Reproduction and Embryology.

Embryology of Corylus.*—Prof. S. Nawaschin has made a further investigation of the processes connected with the formation of the embryo and the act of impregnation in the hazel, and discusses the analogies with the corresponding processes in the Betulaceæ and the Casuarineæ. While these processes correspond, in the main features, with those in the birch, they differ in this respect, that in the hazel there is not a single sporogenous cell (the mother-cell of the embryo-sac), but a sporogenous tissue composed of a varying number of cells, up to 12, from which are derived, by further division, a number of megaspores, which may amount to 20 or more, though sometimes there is only a single one. The sister-cells of the megaspores become atrophied. The alder presents, in some respects, an intermediate condition between the birch and the hazel; while the processes in the hazel lead on to those in the Casuarineæ. The further development of the only megaspore which matures presents no special features.

Before impregnation there is, in the hazel, no typical egg-apparatus. The position of the antipodals corresponds more nearly to that of an ordinary egg-apparatus, viz. near the apex of the embryo-sac; the antipodals finally clothe themselves with cellulose-membranes. In the mature embryo-sac the egg-apparatus is replaced by a mass of protoplasm with free-lying nuclei.

Impregnation by the pollen-tube takes place chalazogamically; pollen-tubes are constantly to be met with within the nucleus in the neighbourhood of the funicle. The actual contact of the apex of the pollen-tube with the egg-apparatus is exceedingly difficult to follow.

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

Symbiosis and Saprophytism.†—Prof. D. T. MacDougal limits the term saprophyte (or holosaprophyte) to those species which derive their food-supply from organic products directly, without the intervention of the activity of chlorophyll and unaided by other organisms. If the term be thus limited, holosaprophytes include numerous fungi and bacteria, but as far as we know at present, only one seed-forming species, *Wullschlaegelia aphylla*. All species furnished with mycorhiza or tubercles, or which enter into direct mechanical or nutritive associations, must be classed as symbionts or "symbiotic saprophytes."

The degenerations of the true saprophytes are generally parallel to those of mycorhizal forms. All endotropic mycorhizas do not conform to a single physiological type. The theory of Janse, ‡ that endotropic fungi are negatively chemotropic to oxygen, and bear the same relation to the higher plants as the organism of the leguminous tubercle, is not

* Bull. Acad. Imp. Sci. St. Pétersbourg, x. (1899) pp. 375–91 (2 pls.) (German). Cf. this Journal, 1895, p. 654.

† Bull. Torrey Bot. Club, xxvi. (1899) pp. 511–30 (3 pls. and 1 fig.). Cf. this Journal, 1899, p. 505.

‡ Cf. this Journal, 1897, p. 318.

capable of general application. Two types of endotropic mycorhiza may be distinguished; one adapted for the fixation of nitrogen; the second for the absorption and modification—perhaps the oxidation—of the products of the soil before liberation in the tissues of the higher plants.

Absorption of Nitrogen by Leguminosæ.*—Herr J. Lutowslawski finds that, in the case of peas and lupins, an increase in the amount of nitrogen commences with the beginning of the independent growth of the plant, i.e. soon after the close of the period of germination; in all cases before the commencement of the formation of the inflorescence. It attains its maximum after flowering, when the pods begin to be formed, after which it gradually decreases. The period, therefore, for using these crops as manure, to increase the fertility of the soil, is at the commencement of the formation of the fruit.

Function of Sodium.†—According to Herr M. Stahl-Schröder, sodium is taken up largely by plants, in the presence of plenty of potassium, only when in combination with some acid of which the plant requires considerable amounts, such as phosphoric or nitric. The sodium remains mainly in the lower parts of the plant. Sodium cannot replace the potassium necessary for the production of the organic matter of plants.

Absorption of Iodine by Plants.‡—From a series of experiments carried on by M. P. Bourcet, the result is attained that different plants vary greatly in their power of absorbing iodine from a soil containing a given quantity of that element; some species refusing it altogether. A difference in this respect is exhibited even between different species of the same genus; but some orders appear to possess the property in a greater degree than others; as, e.g., the Liliaceæ and Chenopodiaceæ more than the Solanaceæ or Umbelliferæ.

Indirect Action of Light on the Stem and Leaves.§—From a comparison of plants grown (1) completely exposed to light; (2) completely in the dark; (3) so that the lower leafy part of the stem is in the light, while the terminal bud is in the dark; M. E. C. Teodoresco draws the following general conclusions. In the third case (with the exception of twining and climbing plants) the leaves are larger than in the second case, the difference being in some instances (*Helianthus tuberosus*) as much as 50 to one. The thickness of the leaves and that of the palisade-parenchyme may be one and a half times as great in plants partially illuminated as in those grown entirely in the dark; the walls of the epidermal cells are wavy in the former case, but not in the latter. In the stem the contrast is still greater. In a plant partially illuminated, the conducting tissue and the lignification of the walls of the mechanical tissue, approach more nearly in their development to those in a plant grown entirely in the dark. In a plant entirely deprived of light, starch is altogether wanting in the tissues of the stem; while in

* 'Beitr. z. Lehre v. d. Stickstoffernährung d. Leguminosen,' Halle a. S., 1898, 32 pp. See Beiheft z. Bot. Centralbl., ix. (1899) p. 72.

† Jahrb. Landwirth., xlvii. pp. 49–84. See Journ. Chem. Soc., 1899, Abstr. ii. p. 789.

‡ Comptes Rendus, cxxix. (1899) pp. 768–70.

§ Rev. Gén. de Bot. (Bonnier), xi. (1899) pp. 369–97, 430–5 (1 pl. and 12 figs.).

a plant partially illuminated it is present, though in smaller quantities than in a plant cultivated entirely in the light. The carbohydrates elaborated in the leaves exposed to light may accumulate in the parts of the plant which are not directly exposed to light.

Influence of the different Solar Rays on the Form and Structure of Plants.*—M. E. C. Teodoresco gives a review of the literature of this subject, and of the general conclusions that can be drawn in the present state of our knowledge. He then recounts the results of his own observations made in two different ways, by the use of coloured screens and by the spectroscope. With regard to the leaf, he finds the various coloured rays less favourable to their development than total light. The palisade- and air-tissues have a minimum development in the green; more in the red; most in the blue. The chloroleucites are smallest and least numerous in the green; the stomates are more numerous in the green than in the red, and in the red than in the blue. The results obtained in the root and in the stem confirmed the general conclusion that green light is least favourable to the development of the plant; the maximum development of all the tissues being, on the other hand, most promoted by the most refrangible rays of the spectrum, viz. the blue and the indigo.

Influence of Electricity on Plants.†—Herr H. Euler gives the results of previous investigations on this subject, and of his own observations, chiefly on *Elodea canadensis*. He states that the electrical processes in the atmosphere can only slightly change the amount of dissolved gases in water which does not contain bacteria. Atmospheric electricity can therefore have no direct action on the growth of plants or of the parts of plants in water or in damp places.

Grafting of Monocotyledons on themselves.‡—M. L. Daniel has been attempting for a long period the hitherto unsolved problem of grafting a Monocotyledon on itself, and with a large amount of success in the cases of a species of *Vanilla* and a species of *Philodendron*. The grafts are of the nature previously termed by the author "mixed grafts."

Germination of Seeds.§—From a long series of experiments on the germinative power of the seeds of a large number of American plants, mostly belonging to the order Compositæ, Prof. Stanley Coulter has arrived at the following general conclusions. The germinative percentage in the Compositæ is smaller than in the other families examined. In most cases the achenes show the highest germinating percentage if collected at about the middle of the flowering season. For the most part the central achenes of the head are not viable, and the same condition is frequently found in the outer rows. The seeds of all species of Compositæ studied were found to be particularly sensitive to changes in temperature and moisture. Cotyledons of nearly related species closely resemble each other, a resemblance often carried on to the

* Ann. Sci. Nat. (Bot.), x. (1899) pp. 141–263 (4 pls. and 18 figs.).
† Öfv. k. Vetensk. Akad. Förhandl., lvi. (1899) pp. 609–30 (1 fig.) (German).
‡ Comptes Rendus, cxxix. (1899) pp. 654–6. Cf. this Journal, 1898, p. 101.
§ Proc. Indiana Acad. Sci., 1898, pp. 215–22.

earlier true leaves. The water content of the soil does not appear to affect the germination percentage to the degree that might have been expected. A single plant of *Solanum nigrum* may produce over 2000 potentially viable seeds; in *Scrophularia* the germination percentage amounted to from 56 to 70 per cent. in the favourable conditions of the laboratory.

Influence of a very Low Temperature on the Germination of Seeds.*—Sir W. T. Thiselton-Dyer states, as the result of a series of experiments carried on by Prof. G. Dewar and himself, that immersion for upwards of six hours in liquid hydrogen (a temperature of 453° F. below melting ice) appears to produce no injurious effects whatever on their power of germinating. The seeds operated on were those of *Brassica alba*, *Pisum sativum*, *Cucurbita Pepo*, *Mimulus moschatus*, *Triticum sativum*, and *Hordeum vulgare*.

Resistance of Seeds to High Temperatures.†—M. V. Jodin states that seeds (peas and cress), when heated at once to 98° C. for 10 hours, are completely killed, but, when heated first to 60° for 24 hours, and then to 98° for 10 hours, a certain proportion (30 to 60 per cent.) retain their power of germination. Heated to 40° in sealed tubes for about 20 days, the same seeds entirely lost their power of germination; but this power was retained if a substance capable of absorbing water, like quick-lime, was introduced into the tubes.

Ascent of Sap.‡—Mr. H. W. Chamberlain gives, in great detail, the results of a long series of experiments, on a variety of plants, on the phenomena connected with the ascending sap. Among the more important are the following:—After decapitation an efflux of water was detected in some plants, but not in others. Root-pressure was stronger in herbaceous than in woody plants. The period of the year has but little effect on the root-pressure when the plant is in active growth. As regards a daily periodicity, the plants under examination could be divided into three groups:—in the first there was no trace of any daily periodicity in the flow of sap; in the second there was a daily periodicity, but the times for the maxima and mimima were uncertain; in the third group the periodicity was regular and permanent. Variations in temperature (between 5° and 6°) had no considerable influence upon the root-pressure. Moistening of the leaves greatly favours the ascent of sap; while the saturation of the soil is very unfavourable. Succulent plants are characterised by a replacement of root-pressure by an energetic aspiration. The larger and more strongly developed the roots, the stronger is the root-pressure.

Absorption of Water by Decorticated Stems.§—Mr. G. E. Ripley states, as the result of a series of experiments on different woody plants, that cut stems wither more slowly when decorticated than when entire. The difference in the period before withering varies greatly, but is often very considerable.

* Proc. Roy. Soc., lxv. (1899) pp. 361–8; Ann. of Bot., xiii. (1899) pp. 599–605.

† Comptes Rendus, cxxix. (1899) pp. 893–4.

‡ Bull. Lab. Bot. Univ. Genève, ii. (1897) 340 pp., 7 pls. and 3 figs. See Bot. Centralbl, lxxix. (1899) p. 311.

§ Proc. Indiana Acad. Sci., 1898, pp. 169–74.

Distribution of Aquatic Plants.*—Dr. G. Hochreutiner has determined experimentally that seeds of a number of aquatic plants may pass uninjured through the alimentary canal of herbivorous fish, which therefore may aid in the dissemination of aquatic plants.

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

Production of Proteids insoluble in the Gastric Juice.†—Pursuing his investigations on the connection between the production of living albumen and respiration in plants, Herr W. Palladin uses the amount of nitrogen in the undigestible residue as a rough test for the amount of living albumen, though subject to some limitations. He states that nutrition at the expense of sugar takes place much more energetically in the light than in the dark; and that this is also the case with the regeneration of the proteids. The more refrangible half of the spectrum favours the regeneration of albumen more than the less refrangible half. Undigestible proteids are abundantly formed even in the dark when sugar is present; but in still greater quantities in the light. In the blue half of the spectrum a larger quantity of undigestible proteids is formed than in the yellow half. The energy of respiration in leaves supplied with sugar is twice as great in the light as in the dark. The proportion between the carbon dioxide produced and the nitrogen of the undigestible proteids is nearly constant. The experiments were made on etiolated leaves of *Vicia Faba*.

Formation of Proteids in the Dark.‡—M. J. Goldberg states, from observations made on the germination of wheat, that proteid substances are formed in the embryo in considerable quantities. Since this phenomenon takes place at the close of the period of germination, it is clear that the formation of proteids is not effected at the expense of the decomposition of proteid substances which have passed by osmose from the endosperm.

Destruction of Chlorophyll by Oxydising Enzymes.§—Mr. A. F. Woods, after recording the results of numerous interesting experiments, thus sums up the evidence. Chlorophyll is rapidly destroyed by oxydising enzymes (oxydases and peroxydases) which are normally present, though in small quantity, in many of the higher plants. Under conditions at present ill understood, these enzymes become more active or are produced in abnormally large quantities, and are then the cause of variegation, and maladies such as the mosaic disease of tobacco, which disorder was ascribed by Beijerinck to a living fluid contagium.‖

The oxydase and peroxydase may remain in the soil for months. The peroxydase will diffuse slowly into an agar substratum, and may retain its active properties for a long time in the dried condition. In the presence of egg-albumen oxydase does not always give the guaiacum reaction. In aqueous solutions the oxydases are destroyed in five minutes at 65°–70° C., and peroxydases at 80–85° C.

* Bull. Herb. Boissier, vii. (1899) pp. 459–66.

† In Russian, Warsaw, 1898. See Bot. Centralbl., lxxix. (1899), p. 193. Cf. this Journal, 1899, p. 299.

‡ Rev. Gén. de Bot. (Bonnier), xi. (1899) pp. 337–40 (1 fig.).

§ Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 745–54.

‖ Cf. this Journal, 1899, pp. 319–20.

Symbiotic Fermentation.*—Dr. A. Macfadyen records an interesting example of symbiotic fermentation arising from the co-operation of *Amylomyces Rouxii* and yeast. *A. Rouxii* is a saccharifying mould, and though it can work alone, ferments the sugar it has formed much better when acting in combination with a yeast.

Tables are given showing the difference in the result of the single and double action.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Anatomy of Tropical Species of Lycopodium.†—After a description of several tropical species of *Lycopodium* from Java—*L. Phlegmaria*, *filiforme*, *nummularifolium*, *serratum*, *clavatum* (var. *divaricatum*), and *complanatum*—Herr K. Linsbauer makes some general remarks on their comparative anatomy.

Connected with the dorsiventral structure of the leaves, the elements of the upper surface are usually larger, and more strongly thickened and cuticularised, than those of the under surface. In contrast to the Selaginellaceæ, the stomates are hardly ever placed above a leaf-vein. The fundamental tissue is differentiated into an assimilating parenchymatous and a prosenchymatous tissue serving partly for the conduction of food-material and partly for a mechanical function, but a typical assimilating tissue is wanting in the orthotropous forms. The conducting bundles differ also in the orthotropous and the plagiotropous forms, the xylem being very much more strongly developed in the latter than in the former. The tracheids are usually furnished with roundish or scalariform pits.

Chlorophylls of Ferns.‡—M. A. Étard has isolated from ferns (*Aspidium filix-femina*) an alcohol, $C_{16}H_{32}O$, carrotin, and three forms of chlorophyll with very high formulæ to which he gives the name *aspidiophylls*.

Anatomy of the Ophioglosseæ.§—Mr. L. A. Boodle has obtained the following general results from a study of various species of *Ophioglossum* and *Botrychium*. The root of *O. vulgatum* is monarch as regards its xylem, but the phloem has an indication of the presence of two protophloems. Monarch structure also occurs at the base of diarch rootlets in *O. pendulum* and *B. Lunaria*. The root-stele of *O. vulgatum* has probably become monarch by reduction from diarch structure, viz. by the abortion of one of the xylem-groups and the fusion of the two phloem-groups. A small amount of secondary thickening takes place in the root and stem of *O. vulgatum*, xylem-elements only being added. Secondary thickening occurs also in the root-bases of *B. Lunaria*.

Helminthostachys.‖—Prof. J. B. Farmer and Mr. W. G. Freeman have studied the structure and affinities of *Helminthostachys zeylanica*, the following being among the more important results. The plant is

* Trans. Jenner (late British) Inst. Prev. Med., 1899, series ii. pp. 207–18.

† SB. k. Akad. Wiss. Wien, cvii. (1898) pp. 995–1030 (3 pls.).

‡ Ann. Agron., xxv. (1899) pp. 393–4. See Journ. Chem. Soc., 1899, Abstr., ii. p. 792.

§ Ann. of Bot., xiii. (1899) pp. 377–94 (1 pl.).

‖ Tom. cit., pp. 421–45 (3 pls.).

dorsiventral. The leaves are provided with stipular appendages which enclose the youngest leaves and pass over the apex of the stem. They more closely resemble the corresponding organs of *Botrychium* than those of *Ophioglossum*. The rhizome possesses a single stele; the vascular elements in all except the youngest stems enclose an axile pith. There is an inner irregular and an outer well-developed and regular endoderm. The xylem is mesarch. There is no secondary formation of vascular tissue. Adventitious buds may be formed on the stem. The leaf-traces are single at their origin; the bundles are collateral. The apex of both stem and root is provided with an apical cell. The vascular strand of the root varies from tetrarch to heptarch. The root branches monopodially; but as a rule the lateral roots are abortive or temporary.

Muscineæ.

Cell-membrane of Muscineæ.* — Prof. F. Czapek states that hadromal, the subject of the lignin-reaction in the higher plants, is entirely wanting in the cell-walls of both Musci and Hepaticæ. It is very rare for the cell-walls of the Muscineæ to display a cellulose reaction, except after boiling for a shorter or longer time in soda-lye. They very often respond to Millon's or to a black iron reaction. The substances causing this reaction—the material chiefly examined being *Sphagnum* and *Trichocolea tomentella*—are one of a phenol-character to which the author gives the name *sphagnol*, and a tannin-like compound *dicranum-tannin*. The author describes in detail the mode by which these substances can be extracted from the living plant, stating the part of the plant in which they are found, and giving a very long list of species of both Musci and Hepaticæ which yield them. The aromatic sphagnol probably contributes to the remarkable property possessed by *Sphagnum* of checking decay; while the dicranum-tannin serves to protect the leaves against long exposure to moisture.

Makinoa, a New Genus of Hepaticæ.†—Under the name *Makinoa crispata* g. et sp. n., Prof. K. Miyake describes a new genus of Hepaticæ from Japan, belonging to the thallose Jungermannieæ, and resembling *Pellia* in appearance. The following is the diagnosis:—Plantæ frondosæ, dichotome ramosæ, dioicæ, ventre e medio costæ rhiziferæ; archegonia numerosa, antica, in alveolo subapicali aggregata, squama dorsali dentata tecta; antheridia similiter inserta, squama humili semilunata e tergo circumplexa; spermatozoidea maxima; capsula ambitu oblongo-elliptica, longe pedunculata, fusco-brunnea, parietibus bistratis; elateres longi, apicibus longe attenuatis, bispiri, spiris uno latere incrassatim confluentibus; sporæ virescentes, parvæ, subsphæricæ, reticulatim lamellatæ; calyptra cylindrica, squama involucrali multo longior. Sterile specimens have been described under the name *Pellia crispata*.

Frullania.‡—Mr. A. W. Evans gives a general description of this genus of Hepaticæ, with a revision of the North American species. The inflorescence is treated as a character of the greatest importance in the determination of species. The 22 North American species (2 of them

* Flora, lxxxvi. (1899) pp. 361-81.
† Hedwigia, xxxviii. (1899) pp. 201-3 (1 pl.).
‡ Trans. Connecticut Acad. Arts and Sci., x. (1899) pp. 1-39 (15 pls.).

new) are classified under 4 subgenera, viz. Chonanthelia (comprising *F. arietina* only), Homotropanthe, Thiopsiella, and Diastoloba.

Spore-mother-cells of Anthoceros.*—Mr. Bradley M. Davis gives the following among the more important results of an examination of the development of the spore-mother-cells in *Anthoceros lævis.* The number of chromosomes is 8 in the sporophyte, and 4 in the gametophyte. The chloroplast appears rather suddenly in the spore-mother-cell as a differentiated region of the protoplasm containing several starch-grains. When fully developed it has a honeycomb structure, each cavity being occupied by a starch-grain. The division of the chloroplast is by simple fission. Synapsis occurs in the nucleus soon after the first division of the chloroplast. The second division of the chloroplast presents the spore-mother-cell ready for the division of the nucleus. The resting nucleus has a nucleole and a very small spirem-thread. Prophase conditions of the nucleus show the presence of a mesh of delicate fibrils (filarplasm) around the structure. The nuclear membrane is at first irregularly angular, but finally two poles of a spindle are differentiated. The metaphase presents a spindle with flattened poles, but no indication of centrospheres or centrosomes. There is a period of rest after the first mitosis, when each daughter-nucleus has a nucleole and a spirem-thread; the second mitosis agrees entirely with the first. The chromosomes are 4 in number in each mitosis; they appear to split longitudinally. All traces of the spindle become lost soon after each mitosis. The fully matured spore-mother-cell presents 4 chloroplasts, each with a single nucleus on the interior side. The protoplasm collects in these four regions of the cell, leaving spaces that are crossed by many anastomosing strands of cytoplasm. These strands cannot be traced from spindle-fibres, and appear to have no connection with the filarplasm. The walls separating the cell-contents into 4 spores are derived from films of protoplasm that appear between the chloroplasts with their respective nuclei. The films are formed by the coalescence of strands of cytoplasm that cross the spaces between the four regions of cell-contents.

Centrosomes in Marchantia.†—In certain cells of the gamophyte of *Marchantia polymorpha* (e.g. the stalk-cells of the receptacle), Prof. D. M. Mottier finds undoubted centrosomes, and they appear to be universal in the vegetative cells. By the time the chromosomes are differentiated, or even earlier, the centrospheres lie nearly diametrically opposite one another, and appear to be in all cases attached to the nuclear membrane. As soon as the chromosomes are regularly arranged in the equatorial plate, the polar radiations become faint, and soon disappear. When the daughter chromosomes have arrived at the poles, and before any trace of a nuclear membrane is visible, neither centrosome nor polar radiations are to be seen.

Structure and Development of Cryptomitrium.‡—A study of the monotypic *Cryptomitrium tenerum* leads Mr. Le Roy Abrams to place it near *Duvalia* among the Marchantiaceæ. It has minute stomates

* Bot. Gazette, xxviii. (1899) pp. 89–108 (2 pls.).
† Proc. Indiana Acad. Sci., 1898, pp. 166–8.
‡ Bot. Gazette, xxviii. (1899) pp. 110–21 (6 figs.).

surrounded by eight (occasionally seven) very systematically arranged guard-cells, and each stomate opens into a well-developed air-chamber. The peculiar oil-bodies of the Hepaticæ are scattered throughout the thallus, ventral scales, and sporogonial receptacle. It is monœcious, and the antherids form a single row just behind the sporogonial receptacle. The archegones are formed, in two rows of usually three or four each, just behind the apical cell. After fertilisation, the oosphere enlarges to nearly double its original size; the first and second division-walls are respectively transverse and longitudinal. In the development of the sporogone the spore-mother-cells and elater-mother-cells are readily distinguished; the former are nearly spherical, the latter elongated; and the nuclei of the latter are much smaller than those of the former.

Algæ.

Pyrenoids of Algæ.*—Dr. A. M. Boubier has studied these structures in the genera *Stigeoclonium*, *Spirogyra*, *Mougeotia*, and *Chætophora*. Each pyrenoid is invested by a protoplasmic membrane, perfectly differentiated and independent of the chromatophore, at least when mature. The membrane encloses a leucoplast, the centre being occupied by a crystalloid substance. In *Spirogyra* and in *Mougeotia scalaris*, a number of pyrenoid-structures are connected together, by a membrane which the author terms a *pyrenodesm*, into a compound pyrenoid, containing in its centre a *pyrenocrystal*. By fixing in absolute alcohol and then examining in Millon's reagent, the chromatophore is nearly or completely destroyed, exposing the pyrenoid; the crystalloid is surrounded by a hyaline zone formed by the dissolution of the starch.

Holdfasts of the Florideæ.†—Carrie M. Derick describes the holdfasts (hapters) in a number of genera of Florideæ, chiefly belonging to the Rhodymeniales.

The species examined of *Rhabdonia*, *Lomentaria*, and *Champia*, all agree in passing through a segmentation stage, resulting in a somewhat spherical mass of cells; in the elongation of four basal cells; and in the subsequent development of four primary rhizoids, which branch repeatedly, and finally form a large discoid holdfast composed of pseudo-parenchymatous tissue.

A different development occurs in the Rhodomelaceæ as exhibited by *Chondria tenuissima*, *Polysiphonia violacea*, and *Dasya elegans*. These three species agree in forming a primary root-cell which elongates into a rhizoid terminating in a clasping disc, and in developing secondary rhizoids, which are sent out by the root-cell, the cell adjacent to it, and the cortical cells at the base of the frond. But, while the rhizoids of *Polysiphonia* are unicellular, unbranched, and free, those of *Dasya* and *Chondria* are multicellular, branched, and aggregated into a compact cell-mass, which in section resembles parenchymatous tissue.

Among the Ceramiaceæ examined the species differ greatly both in the manner of development and in the form of the holdfast, agreeing only in the production of one primary root-cell. *Spermothamnion Turneri* forms short unicellular rhizoids with terminal discs and no

* Bull. Herb. Boissier, vii. (1899) pp. 451–8, 554–9 (26 figs.).
† Bot. Gazette, xxviii. (1899) pp. 246–63 (3 pls. and 5 figs.).

branching or cortication. *Griffithsia Bornetiana* produces a large spreading holdfast composed entirely of pseudo-parenchymatous tissue arising from the primary root-cell. *Callithamnion*, *Spyridia*, and *Ceramium* have primary root-cells, from which spring rhizoids terminating in multicellular discs. Others originate in the cell adjacent to the basal cell and in the cortications.

Melanospermeæ.*—Mr. R. A. Bastow gives, in a large sheet, a key to the tribes and genera of the Melanospermeæ (Fucaceæ and Phæosporeæ), with a somewhat rough drawing representing the salient characters of the more important genera.

Plurilocular Sporanges of Petrospongium.†— Mr. H. Hanna has found the plurilocular sporanges of *Petrospongium Berkleyi*, belonging to the Phæophyceæ. He finds a great difference in size between the different loculi in the same sporange, and a consequent inequality in size among the zoospores produced in them.

Alternation of Generations in the Cutleriaceæ.‡—After a review of the literature, and a description of the species of Cutleriaceæ found in the Gulf of Gascony, M. C. Sauvageau discusses at length the biological connection between the three genera *Cutleria*, *Zanardinia*, and *Aglaozonia*, and the phenomena of polymorphism and parthenogenesis which they exhibit.

The Cutleriaceæ have a sexual and a non-sexual thallus. The sexual plant of *Zanardinia* is monœcious, and differs from the non-sexual plant only in the nature of the reproductive organs; the sexual plant of *Cutleria* is diœcious. The oogonial and antheridial thalli of *Cutleria*, like the thallus of *Zanardinia*, are formed by the union of two layers of filaments, which subsequently increase in surface and thickness from the further division of the cells. On the other hand, the zoospore-thallus (*Aglaozonia*), is a creeping plate composed of a parenchyme, and resembling a *Zonaria* in external appearance.

M. Sauvageau considers the "alternation of generations" between *Cutleria* and *Aglaozonia* to be a facultative rather than a necessary one. While there is certainly a biological connection between *C. multifida* and *A. parvula*, that is not the case with *C. adspersa* and *A. chilosa*. The non-sexual form of *C. adspersa* appears to be *A. melanoides*; the sexual form of *A. chilosa* being at present unknown. The germination of fertilised or of parthenogenetic oospheres of a *Cutleria* may give rise to an *Aglaozonia*; while under other conditions they may produce again a *Cutleria*; and the same is the case with the zoospores of *Aglaozonia*. From whichever reproductive element an *Aglaozonia* originates, it is not a direct product of germination, but a secondary product, always formed by a pro-embryo or *colonerette*.

Growth of the Chlorophyll-bands in Spirogyra.§—Herr. R. Kolkwitz infers, from the phenomena presented in the case of *S. longata*, especially the behaviour of the pyrenoids during the growth of the

* Journ. and Proc. R. S. New South Wales (1899) pp. 169–73 (1 pl.).

† Ann. of Bot., xiii. (1899) pp. 461–4 (1 fig.).

‡ Ann. Sci. Nat. (Bot.), x. (1899) pp. 265–362 (1 pl. and 25 figs.). Comptes Rendus, cxxix. (1899) pp 555–8. Cf. this Journal, 1898, p. 565.

§ Fetschr. f. Schwendener, 1899, pp. 271–87 (5 figs.). See Hedwigia, xxxviii. (1899), Beibl., p. 204.

cell, that the chlorophyll-bands increase in length, not exclusively by apical, but also by intercalary growth. Since the growth of the bands takes place in the direction of the coils, and therefore obliquely to the surface of the cell-wall, there must be a gliding motion of the bands through the parietal protoplasm. To facilitate this movement, the bands have hollow channels, in order to make the gliding surface as small as possible. But, since the bands have a marked tendency to contraction, they are provided with vertical hooks which prevent the bands from becoming altogether detached from the parietal protoplasm.

Asterionella as a Cause of Foulness in Drinking Water.* — Mr. G. C. Whipple and Mr. D. D. Jackson have studied the biology of *Asterionella formosa*, a diatom which is a frequent cause of foulness in drinking water in America, giving to it a fishy or geranium-like odour, caused by the formation of an oil analogous to the essential oils. The diatom forms spores during periods of stagnation at the bottom of reservoirs, and increases with very great rapidity when these spores germinate, this growth taking place chiefly during the spring and autumn. The growth of the diatom is greatly favoured by light; and the best mode of preventing its increase is by storing the water in the dark.

Marine Diatoms of France.† — MM. H. and M. Peragallo have issued the first part of an important contribution to diatomic literature, an account of the marine diatoms of France. The Diatomaceæ are divided into three sections,—Raphideæ, Pseudo-raphideæ, and Anaraphideæ. The Raphideæ consist of three tribes, the Heteroïdæ, Naviculoïdæ, and Tropidoïdæ. The Heteroïdæ are characterised as having frustules with two unequal valves, the lower valve generally concave, having only one raphe and row of nodules, and comprise the single family Achnantheæ, and the 6 genera, *Cyclophora* (1 sp.), *Achnanthes* (10 sp.), *Cocconeis* (20 sp.), *Rhoicosphænia* (1 sp.), *Anorthoneis* (1 sp.), and *Campyloneis* (1 sp.). The Naviculoïdæ have frustules composed of equal valves, neither winged nor keeled, and are arranged in five groups, viz.: —the Mastigogloieæ, Naviculeæ, Pleurosigmeæ, Gomphonemeæ, and Cymbelleæ. The Naviculeæ include the 7 genera *Dictyoneis* (2 sp.), *Mastoneis* (1 sp.), *Cistula* (1 sp.), *Stenoneis* (1 sp.), *Berkeleya* (2 sp.), *Brebissonia* (1 sp.), and *Navicula*, the very numerous species of which are divided into 9 sections and 28 groups. The Pleurosigmeæ consist of 4 genera:—*Pleurosigma* (46 sp.), *Rhoicosigma* (7 sp.), *Donkinia* (3 sp.), and *Toxonidea* (3 sp.). The Tropidoïdeæ (Amphitropideæ) are made up of 3 genera, *Amphiprora* (4 sp.), *Tropidoneis* (6 sp.), and *Auricula* (7 sp.). A commencement of the Cymbelleæ is made with its two genera *Amphora* and *Cymbella*. The present part is illustrated by fifty beautiful plates.

Diatoms in Basalt.‡—Dr. A. M. Edwards records the discovery of valves of diatoms in the trap-rock of New Jersey, possibly the oldest record. Forms belonging to *Synedra* and *Meloseira* were readily distinguished.

* Journ. N. England Waterworks Ass., xiv. (1899) 25 pp., 2 pls. and 1 chart.
† 'Les Diatomées marines de France,' 1re partie, Paris, 236 pp. and 50 pls.
‡ Amer. Mon. Micr. Journ., xx. (1899) pp. 292-4.

Schmidt's Atlas der Diatomaceen-Kunde.—The latest part published of this fine work, Heft 55, consists of the four plates 217–220, with accompanying letter-press, and is entirely devoted to the genus *Rhabdonema*.

Cladophora.*—Herr F. Brand gives a detailed account of a variety of observations on the European species of *Cladophora*. Among the more important results are the following. There is much greater variation in the characters of the species than has hitherto been supposed, and the diagnoses must be enlarged. The relative length of cells of *Cladophora* is, in particular, so variable that it can only be used to a very limited extent, and never by itself, for the discrimination of species. The statement that all species of *Cladophora* form, when young, attached tufts, is probably not true for *C. fracta*, or only in a very temporary manner. The branch almost always springs from the upper part of the lateral wall of the mother-cell (rarely from the lateral wall of the next cell). The first point to note in determining the position of a species of *Eucladophora* is whether it has primary (then always strong) basal organs of attachment. Species belonging to this class usually form zoospores; the free-swimming species are mostly propagated by resting spores. All the European species of *Cladophora* described by Rabenhorst, except the Ægagropilæ, must be regarded as varieties, forms, or conditions of *C. fracta* or *glomerata*. The protoplasm of *Cladophora* has an especial affinity for methyl-green-acetic-acid.

Fungi.

Influence of Nutrition on the Respiration of Fungi.†—As the result of a series of experiments, chiefly on *Agaricus campestris* and *Mucor Mucedo*, M. A. Fleroff finds these two fungi to be representatives of two different types. In *Mucor* the withdrawal of a nutrient substratum materially depresses respiration, while the supply of nutriment greatly increases it; with deficient nutrition the formation of spores is at once set up. With the mushroom, on the contrary, the development of the receptacle is hardly influenced by the supply or withdrawal of nutrition, the fungus itself containing sufficient food-material for its formation. The respiration of the mushroom is in general very feeble, 3·2 mgrm. of CO_2 per 1 hour for 1 grm. of dried substance; while that of *Mucor Mucedo* amounts to 28·8 mgrm. of CO_2 for the same time.

Compound Oosphere of Albugo Bliti.‡—Mr. F. L. Stevens describes the remarkable phenomena connected with the process of fertilisation occurring in *Cystopus* (*Albugo*) *Bliti*, belonging to the Phycomycetes, parasitic on species of *Amaranthus* in the United States. The mature oosphere contains a large number (as many as 300) of female nuclei, and these are impregnated by an equal number of male nuclei introduced into the oogone through the antheridial tube; this fusion in pairs resulting in the production of about 100 impregnated oospheres.

When the oogone is cut off from the parent hypha, it contains from 250 to 300 nuclei, which enlarge, and divide mitotically. The antherid,

* Bot. Centralbl., lxxix. (1899) pp. 145–52, 177–86, 209–21, 287–311 (3 pls.).
† Tom. cit., pp. 282–7.
‡ Bot. Gazette, xxviii. (1899) pp. 149–76, 225–45 (5 pls.).

on the other hand, contains about 35 nuclei, which also divide twice mitotically. While the antheridial tube is still very short, the nuclei of the oosphere all arrange themselves in a peripheral layer of the protoplasm. This is termed the period of zonation, and the nuclei are then usually in the metaphase stage. About the period of zonation, a central body is formed in the oosphere which the author terms the *cœnocentrum*. It may possibly result from a coalescence of oil-drops, and disappears before fertilisation. During the differentiation of the oosphere the nuclei in the oogone divide once, the mitosis occurring nearly simultaneously in all the nuclei. The multinucleate or "compound" oosphere contains, when completely differentiated, an average of 45 to 55 nuclei.

When the male nuclei enter the antheridial tube, they possess the characters of resting nuclei, but become pointed or fusiform as they enter the oogone. They move through the protoplasm to the female nuclei (the movement being probably chemotropic) and fusion takes place in pairs; the male nuclei are often somewhat in excess.

The primitive wall of the "oospore" first appears when the antheridial tube opens. Later the epispore is laid down upon it by the periplasm. Two endospores are formed by the ooplasm after the development in the vacuoles of a peculiar substance which disappears as the endospores reach maturity. After the complete encasement of the oospore, it becomes rapidly filled with food-materials. The fusion-nuclei pass the winter in the resting condition.

Reproduction of Saprolegnia.*—Herr G. Klebs makes the following statements respecting the various modes of reproduction of *Saprolegnia*, derived from the study of *S. mixta*, a species which grows on the bodies of flies in stagnant water. Multiplication by zoospores, oospores, or gemmæ is directly dependent on the external conditions; there is no regular alternation of sporangial and oogonial generations. From a systematic point of view *Saprolegnia* is very nearly allied to *Sporodinia*, while it differs widely both from that genus and from *Eurotium* owing to its aquatic mode of life. By far the most important factor in determining the mode of reproduction in *Saprolegnia* is the chemical composition of the medium, all other external factors—light, oxygen, moisture, temperature—being of subsidiary importance. Formation of sporanges takes place when the growing apices of the hyphæ of a mycele are in immediate contact with a medium deficient in nutritive substances, especially in nitrogen and carbon. Oogones, on the other hand, are formed when the entire mycele is subjected to a gradual diminution of nutriment. Thirdly, the gemmæ have no well-marked constancy either in morphological or in physiological characters. They are derived partly from the rudiments of sporanges, partly from those of oogones; but may also be formed from any portions of hyphæ that are exposed to very unfavourable conditions of nutriment.

Fertilisation in the Saprolegnieæ.†—Prof. M. Hartog criticises Trow's paper on the biology of *Achlya*, holding that his observations are in many points inaccurate, and maintaining his previous view that

* Pringsheim's Jahrb. f. wiss. Bot., xxxiii. (1899) pp. 513–93 (2 figs.).

† Ann. of Bot., xiii. (1899) pp. 447–59. Cf. this Journal, 1899, p. 515.

reproduction in the Saprolegnieæ is apogamic. This does not imply a complete absence of processes comparable with fertilisation. In the Saprolegnieæ the nucleus of the "oospore" is formed by the fusion of many nuclei, which possibly wandered from different parts of the plant, and which are, in any case, essentially different from all those formed by repeated nuclear fission in the previous life-history of the plant.

Aspergillus Oryzæ.*—Katherine E. Golden has cultivated this mould, largely used in Japan in the manufacture of saké, and finds no indication that it has the power of causing alcoholic fermentation, or of being capable of transformation, through any conditions whatever, into a yeast. It cannot be used effectively in bread-making.

Phyllactinia.—In this genus of Erysipheæ Dr. F. W. Neger † describes the tufts of branched cells (in *P. guttata*) which form mucilaginous drops on the peritheces. By their power of swelling and their viscid nature they fix the half-ripe perithece to moist leaves or other objects, and prevent the spores from falling to the ground before they are fully ripe.

E. S. Salmon ‡ gives a more detailed description of a similar structure in the case of *P. corylea*, and ascribes to the arrangement the same function as does Neger.

Wilt-Disease of Cotton, Water-melon, and Cow-pea.§—Mr. Erwin F. Smith gives a detailed account of these diseases, and of the parasitic fungus which causes them, which he makes the type of a new genus *Neocosmospora*, nearly allied to *Cosmospora*, with the following characters:—Peritheces as in *Nectria* (bright red in the known species); asci numerous; ascospores 8, in one row, brown, globose or shortly elliptical, continuous, with a distinct wrinkled epispore; paraphyses present, inconspicuous, broad, loosely pointed, unbranched, consisting of about five cells. Three conidial stages, viz.:—Cephalosporium, Fusarium, and Oidium. The three varieties of the fungus, which occur on the cotton, water-melon, and cow-pea (*Vigna sinensis*), have hitherto been known as varieties of *Fusarium vasinfectum*.

Fat-destroying Fungus.‖—Mr. R. H. Biffen describes a fungus, belonging to the Hypocreaceæ but the position of which is not further determined, found on germinating coco-nuts, which has the property of breaking up the oil in the endosperm. The reproductive bodies observed were megaconids, microconids, pycnidiospores, and peritheces; but all attempts to produce ascospores in the peritheces failed. The author attributes the property of splitting up oil to an enzyme which can be obtained as a flocculent precipitate by the addition of an excess of absolute alcohol.

Red Mould.¶—Mr. R. G. Curtiss describes a red mould, found in a plate-culture, capable of passing abruptly from a mould to a yeast stage.

* Proc. Indiana Acad. Sci., 1898, pp. 189–201 (12 pls.). Cf. this Journal, 1898, p. 113.
† Bot. Centralbl., lxxx. (1899) p. 11.
‡ Journ. Bot., xxxvii. (1899) pp. 449–54 (1 pl.).
§ U.S. Deptmt. Agriculture (Div. Veg. Physiol. and Pathol.), Bull. No. 17, 1899, 53 pp. and 10 pls.
‖ Ann. of Bot., xiii. (1899) pp. 363–76 (1 pl.).
¶ Proc. Indiana Acad. Sci., 1898, pp. 202–8 (10 pls.)

No production of conids could be induced; but bodies were obtained under cultivation which the author believes to be the result of a sexual process.

Reticulate Interruptions in the Thallus of Lichens.* — Herr G. Bitter offers an explanation of the mesh-like perforations which occur in the lower tissue-layer, or in the entire thallus, of certain foliaceous and fruticose lichens (*Umbilicaria pustulata*, *Peltigera*, *Solorinia*). The rupture of the lower epidermal layer appears to be due to the activity of the strongly intercalary growth of the upper layers. The veining on the under side of the thallus of species of *Peltigera* has a similar origin.

Fate of Yeasts in the Organism.† — Dr. Skchiwan communicates the results of injecting yeasts into the peritoneal sac and blood-current of animals. The yeasts used were *Saccharomyces subcutaneus tumefaciens*, a pathogenic species isolated by Curtis, *S. pastorianus*, and red yeast. The author confirms the results of Schattenfroh, who found that the yeasts were destroyed by phagocytosis, and also the observation of Busse, who noticed that after 24 hours pathogenic yeasts were often surrounded by a capsule. In unstained preparations the capsule presents the appearance of a bright ring, and if stained with methylen-blue becomes a marked example of metachromatism. Much stress is laid on a rosaceous appearance produced by a collection of mononuclear leucocytes surrounding a yeast-cell.

Actinomycosis and Pseudactinomycosis.—Dr. P. Kruse ‡ records a case having the ordinary clinical features of actinomycosis, though suppuration of glands is mentioned. The pus contained typical granules, and microscopical preparations presented appearances characteristic of actinomycosis. Cultivations made on suitable media showed that the fungus differed from the *Streptothrix actinomyces* of Kruse, and from *Str. Israeli*, though it possessed many resemblances to both.

Dr. N. Berestnew § would divide the ray-fungus disease into two groups, actinomycosis and pseudactinomycosis. Actinomycosis is caused by parasites belonging to the genus *Actinomyces*, and also by microphytes described as *Streptothrix*, *Oospora*, *Nocardia*, and *Cladothrix*. The principal depot of the foregoing is fodder. The ray-fungus disease occurs as typical actinomycosis when the parasites answer to the description of Bollinger, Boström, and others, and is atypical when there are no granules and no club-shaped elements. In pseudactinomycosis granules and clumps occur, but they are devoid of radiation and of the club-shaped forms. Pseudactinomycosis may be subdivided into two groups, according as the parasite stains by Gram's method or not.

Herr J. Berg ‖ records the occurrence of three cases of actinomycosis in sheep. In two cases the tongue was affected in the ordinary way; in the third there were small submaxillary abscesses. The fungous tufts were small, but the clubs were well developed.

* Festschr. f. Schwendener, 1899. See Bot. Centralbl., lxxix. (1899) p. 163.
† Ann. Inst. Pasteur, xiii. (1899) pp. 770–8 (1 pl.).
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 209–12.
§ Zeitschr. f. Hyg. u. Infektionskr., xxix. (1898) pp. 94–113 (3 pls.).
‖ Maanedsskrift for Dyrlaeger, x. p. 1. See Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) p. 231.

Formation of the Teleutospore in Puccinia.*—M. R. Maire describes the cytological phenomena which precede or accompany the formation of the teleutospores in *Puccinia Liliacearum*. In the terminal cells of the filaments which produce the teleutospores, the division of the nucleus is not followed by septation; these cells are therefore binucleated. A nucleole or plasmosome makes its appearance in each nucleus, and gradually increases in size. The safranophile chromatin disappears, or is transformed into an acidophil substance, but not identical with the substance of the plasmosome. At the time when the teleutospore is formed, the nucleus has become entirely acidophil; and after the fusion of the two nuclei, the resulting nucleus is still acidophil. The cell which constitutes the pedicel of the teleutospore has gradually lost its protoplasm, which has passed into the teleutospore itself. While the increase in number of the cells of the mycele takes place by amitotic divisions, the teleutospores themselves are formed by mitosis.

Myxomycetes.

Comatricha obtusata.†—Herr E. Jahn finds this Myxomycete on branches of fir, less often of oak. The sporanges resemble those of *Stemonitis*, but are solitary, not collected on an expanded hypothallus; they have a hollow pedicel which is not twisted. The young sporanges appear in the form of milk-white drops on the wood. The capillitium begins to be formed before the pedicel is fully developed. The author holds that the nucleus takes no part in the formation of the membrane.

Macbride's North American Myxomycetes.‡—Dr. T. H. Macbride publishes a monograph of the North American species of Myxomycetes (including Central America), prefaced by an account of the structure and life-history of the group. The number of species described is about 200, of which a very few are new. The genus *Plasmodiophora* is first separated as the sole North American member of the sub-class Phytomyxinæ, distinguished by its parasitic habit. The saprophytic Myxomycetes are then divided into the Exosporeæ with free spores, and the Myxogastres in which the spores are contained in receptacles or sporanges. The first group comprises the single genus *Ceratiomyxa*; the second group is again divided into five orders—the Physaraceæ, Stemonitaceæ, Cribrariaceæ, Lycogalaceæ, and Trichiaceæ.

Protophyta.

β. Schizomycetes.

Structure of Bacteria.§—Mr. S. Rowland, who has made some interesting observations on the structure of bacteria and the embryology of the spore, states that in the actively living cell, i.e. one which is about to divide, or has just divided, no reticular structure can be demonstrated. An organism in which structure is visible is not an actively living cell, but is progressing either to spore-formation or to granule-

* Comptes Rendus, cxxix. (1899) pp. 839–41.

† Festschr. f. Schwendener, 1899, p. 288 (1 pl.). See Bot. Centralbl., lxxix. (1899) p. 252.

‡ 'The North American Slime-Moulds,' New York, 1899, xvii. and 233 pp. and 19 pls.

§ Trans. Jenner (late British) Inst. Prevent. Med., 1899, ser. ii. pp. 143–60 (1 pl.).

formation. The actively living cell consists of cell-wall, cell-plasma, and granules. The cell-wall is a progressive formation, and becomes finally a rigid structure. The cell-plasma is hyaline or very finely granular. The granules are refractive, spherical, and stain vividly with rosein; they may participate in cell-division, and may be extruded from the cell through the cell-wall. Their indiscriminate distribution, and their existence in the surrounding medium, negative the view of their nuclear nature. In a limited sense they may be regarded as excretory products; but inasmuch as they so often take part in the division of the cell, and as the embryo, on emergence from the spore-case, contains a granule, it is highly probable that these granules are fundamental elements of the bacterial cell.

Resorption of Cells.*—Under this title M. E. Metchnikoff describes another phase of phagocytosis. Beginning with the appearances observed on injecting spermatozoa into the peritoneal sac of guinea-pigs, he passes on to describe the resorption of the chromocytes of geese in the peritoneal sac of guinea-pigs; the antagonism of the antisomes of the guinea-pig and the chromocytes; the resorption of the chromocytes in the organism of guinea-pigs possessing antisomes in their juices; and lastly, antileucocytic serum. The observations and experiments are summed up as follows:—Cell-resorption is chiefly the work of macrophages, which can deal with living as well as dead cells. The mononuclear phagocytes seize hold of cells by means of small pseudopods. When injected into the peritoneal sac, the chromocytes are almost exclusively devoured by macrophages, which find their way by the usual channels into the blood, wherein the agglutinating and hæmolytic substances are principally formed. The immunising substance (*substance sensibilisatrice*) is probably an excretion from macrophages which have finished digesting. The extracellular dissolution of geese-chromocytes can be prevented in guinea-pigs whose body-juices are hæmolytic. This fact indicates that the excreted immunising substance circulating in the blood requires the intervention of another substance which is more closely connected with phagocytes. The resorption of macrophages calls forth the formation of serum, which destroys polynuclear leucocytes and Ehrlich's cells (*Mastzellen*).

Bacterial Disease of the Sugar-Beet.†—Clara A. Cunningham has studied a disease of the sugar-beet which prevailed in the United States, and finds it to be caused by an organism having the form of a small bacillus 0·9–1·3 μ long by 0·5–0·8 μ broad, single or in pairs, and motile, but showing neither spores nor flagella by any process of staining. The author is doubtful whether it is identical with the organism named *Bacillus Betæ*, or with that which produces *bacteriosis gummosa*, described by Sorauer, Kramer, and Erwin F. Smith. Another organism resembling a *Leuconostoc* was found in the diseased beets.

Bacterial Disease of the Haricot.‡—The haricot crops in the neighbourhood of Paris are greatly infected by a disease known as *la graisse*, which M. Delacroix finds to be due to a Schizomycete apparently identical

* Ann. Inst. Pasteur, xiii. (1899) pp. 737–69 (2 pls.).
† Bot. Gazette, xxviii. (1899) pp. 177–92 (5 pls.). Cf. this Journal, 1898, p. 462.
‡ Comptes Rendus, cxxix. (1899) pp. 656–9. Cf. this Journal, 1898, p. 115.

with E. F. Smith's *Bacillus Phaseoli*. It is composed of motile rods, somewhat rounded at the ends, usually distinct, less often in chains of 3 or 4, about 1·2–1·5 μ by 0·3–0·4 μ.

Butyric Acid Ferments.* — Further investigations by Herren A. Schattenfroh and R. Grassberger indicate that the butyric acid fermentation of carbohydrates is excited by two species of bacteria which are so closely allied that they may be considered as belonging to the same genus. The two species are designated *Granulobacillus saccharobutyricus immobilis liquefaciens*, and *Granulobacillus saccharobutyricus mobilis non-liquefaciens*, terms which fairly represent their prominent characteristics. The liquefying species has been described under various names by at least five other observers, while the non-liquefying species was isolated by the authors. Both organisms produce lactic acid, as well as butyric acid, carbonic acid, and hydrogen, from sugar and starch; indeed, the liquefying species formed considerably more lactic than butyric acid. The quantity of volatile and non-volatile acids formed during the decomposition of one and the same carbohydrate varied from time to time, but no satisfactory explanation of the vicissitudes is forthcoming. No noteworthy difference was discovered in the output of acid by anaerobic cultivation. Both species coagulated milk, but did not peptonise it. The liquefying species stain by Gram's method, and the non-liquefying species was imperfectly, but not altogether, decolorised by the same method.

Thermophilous Bacteria.†—Dr. A. Macfadyen and Dr. F. R. Blaxall describe fourteen species of thermophilous bacteria derived chiefly from the soil, though some originated from dejecta, ensilage, sea-water, and Thames mud. On the ordinary culture media all grew well at from 55° to 65° C. All were sporing forms of bacilli. The growth in most instances was remarkably rapid, and presented instructive appearances, especially on salt-potato-agar. The majority of the bacilli showed a tendency to grow in long chains, and though branching forms appeared, true dichotomy was not observed. Two organisms (*Bac.* x. and xiv.) were motile when young. Some developed pigment, the majority curdled milk, and seven liquefied gelatin. The indol reaction was present in most cases. The optimum temperature for the group was 55° or thereabouts. While pure cultures failed to grow under anaerobic conditions, evidence was obtained of the anaerobic existence of certain thermophilous forms at high temperatures. The majority of the organisms reduced nitrate; some produced acid, others alkali. Proteid-media (gelatin, serum, meat, blood-albumen, and eggs) were decomposed. Eight species inverted cane-sugar, and starch was diastased by four. Experiments with cellulose showed that this substance was digested by thermophilous bacteria, the rate of fermentation and disintegration varying from 7 to 21 days as a rule. These results were brought about by mixed cultures, and their action appeared to be of a symbiotic nature.

Tables are given with the appearances on the different culture media, and illustrating the range of temperature.

Thermophilous Microbes of Hot Springs.‡—Mdlle. Tsiklinsky describes six species of microbes isolated from three hot springs with tem-

* Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 697–702.
† Trans. Jenner (late British) Inst. Prevent. Med., 1899, ser ii. pp. 162–86 (3 pls.).
‡ Ann. Inst. Pasteur, xiii. (1899) pp. 788–95 (9 figs.).

peratures of 43°, 51°, and 73° respectively. All six species had certain common morphological and biological characters. All were motionless rodlets, easily stainable with anilin dyes and also by Gram's method. All were aerobic, and their optimum temperature was 60°, though all could grow at 70°, and none could develope below 37°. One formed spores, and another possessed a proteolytic diastase. The most interesting was isolated from the spring with temperature 51°. This possessed morphological and biological characters like *Bacillus subtilis*, and on experimenting with an old laboratory specimen of the latter, the authoress found that it was capable of growing at 57°, though less freely than at 37°. By gradually raising the temperature, the laboratory specimen was found, at the thirtieth generation, to grow abundantly at 58°, but stopped at 58°·5. After alluding to Dallinger's success in breeding flagellate infusoria at 70°, the authoress expresses the hope that by following on similar lines *B. subtilis* may be cultivated at temperatures above 58°.

Denitrification Bacteria and Sugar.*—Herr H. Jensen attacks the results obtained by Stutzer and Hartleb, who found that carbohydrates (hexoses and pentoses) serve equally well with the salts of organic acids as pabulum and source of energy to bacteria capable of decomposing saltpetre.

The author has repeated Stutzer and Hartleb's experiments, and has obtained diametrically opposite results.

Action of Toxins and Antitoxins.†—After discussing the theory of Ehrlich of the constitution of toxins and the properties of mixtures of toxins and their antitoxins, M. J. Danysz states that he is of opinion that the peculiar feature of the action of toxins and the properties of mixtures of toxins and antitoxins, are not due to the splitting up of the toxin into different substances more or less toxic, but simply to the presence of phosphates in the mixtures in greater or less proportions, according to the degrees of weakening (more or less advanced) of the toxins. According to the proportion of the phosphates and other salts contained in the mixtures (and in the tissue in the case of a living animal), one and the same active substance may produce variable effects. Hence the difference in the sensitiveness to, and the action of a toxin on different species of animals.

Bacteriology of the Gangrene of Tooth-Pulp.‡—Herr F. E. Zierler isolated from typical cases of gangrene of tooth-pulp a microphyte, which, while presenting many of the characters of *Bacillus gangrenæ pulpæ*,§ differs therefrom in some essential particulars. The chief of these are that the author's microbe has rounded ends; it is not at all pleomorphic; it is very prone to form spores; and in relation thereto it is asserted that Arkövy mistook spores for a vegetative coccus form on agar. Additional information relative to some biological characteristics is supplied. Gas formation in saccharated media is copious; most of the gas is CO_2. Neither indol nor sulphuretted hydrogen is produced. In 2 per cent. grape-sugar-bouillon, acid is formed for the first seven

* Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 716-20.
† Ann. Inst. Pasteur, xiii. (1899) pp. 581-95.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 417-25.
§ Cf. this Journal, 1898, p. 579.

days, the reaction then becomes amphoteric for 2–3 days, after which it is alkaline.

Bacterium of Eclampsia.*—Dr. Levniovitsch has found a large round or oval coccus in forty-four cases of puerperal convulsions. They were sometimes found in the blood before the first fit; were most abundant during the convulsions; and two days after the last attack steadily diminished in numbers. The coccus was cultivated in broth, gelatin, and agar, to which blood was added; but the best growth took place on media composed of placental tissue. The cocci are motile and flagellate. Pure cultures were pathogenic to guinea-pigs.

Organisms of Bacillus coli communis Group isolated from Drinking Water.†—Dr. J. Lunt gives a comparison of eight organisms belonging to the coli group with the normal *B. coli communis*, and shows how each variety differs from the normal in one or more of the characters supposed to be diagnostic of *B. coli communis*. The eight varieties were derived from potable water of fair quality, from polluted water, and from urine of typhoid patients. The chief differences from the normal were that variety A did not curdle milk. B did not curdle milk or form indol. C did not curdle milk, did not form indol, and liquefied gelatin after 7–10 days. D was markedly motile, and did not form indol. E did not form indol, and liquefied gelatin after 10–13 days. F liquefied gelatin after 7–10 days, did not form indol, and curdled milk after 3–5 days. G liquefied gelatin after 5–9 days, did not form indol, or curdle milk. H was not motile, and gave a positive indol reaction. This form closely resembled in other respects the bacillus of typhoid.

Photobacterium liquefaciens Plymouthii.‡—Mr. J. E. Barnard describes a photogenic bacterium isolated from deep sea-water outside Plymouth breakwater. The organism, called *Photobacterium liquefaciens Plymouthii*, liquefies gelatin more rapidly than any other known phosphorescent bacterium. The phosphorescence appears when the cultures are about four days old, and successive transfers to media containing at least 2 per cent. sodium chloride resulted in an increased power of phosphorescence. Gelatin is completely liquefied in four days at 20°. In liquid media the organism grows well, but the phosphorescence is of short duration; it thrives on agar. Morphologically, it is a rodlet 2 μ long by 1·5 μ broad, when grown on ordinary gelatin; on salted gelatin it is longer. It is somewhat pleomorphic (i.e. coccus and filamentous forms appear sometimes), and exhibits inconstant and involution forms. It is motile, and is possessed of long flagella demonstrable only with difficulty by van Ermengem's method. The light emitted is of a bluish-white colour. The bacterium does not grow on potato, and spore-formation was not observed. The author's communication is not confined to this one organism, but deals generally with photogenic bacteria, and is an admirable précis of the subject.

Is the Alinit Bacterium an Independent Species?§ — Dr. R. Hartleb is strongly of opinion that *Bacillus ellenbachiensis* α, the effec-

* Centralbl. f. Gynäk, 1899, No. 46. See Brit. Med. Journ., 1899, epit. 453.
† Trans. Jenner (late British) Inst. Prevent. Med., 1899, ser. ii. pp. 219–31.
‡ Tom. cit., pp. 81–112 (2 pls.)
§ Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 706–12.

tive agent of alinit, is an independent bacterial species and cannot be identified with *Bacterium megaterium* or *Bacillus subtilis*, as maintained by Stoklasa and Lauck. The bacteria differ in size, in their cultural characters on grape-sugar-meat-extract-agar, in their behaviour in sterilised milk, and in their reducing properties.

Bacillus of Pseudotuberculosis.*—Dr. Klein states that he has found the bacillus of Pfeiffer in Thames and Lea water, in sewage, and in milk. The organism was isolated by injecting raw material into the subcutaneous tissue of guinea-pigs. The morbid anatomy and microscopical appearances are indistinguishable from those of true tuberculosis, though the organism, a short thick bacillus, has no morphological resemblance to that of tuberculosis. The disease is reproducible in monkeys; and by treatment with dead cultures animals became resistant.

Bacillus of Crab-plague.†—Dr. A. Weber states that Prof. Hofer has isolated from the muscle of diseased crabs a bacillus which he regarded as the exciting cause of crab-disease. The bacillus is 1–1·5 μ long and 0·25 μ thick. It is motile; the flagella are 1–6 in number. The bacillus stains well, but not with Gram. It is easily cultivated, and liquefies gelatin. Blood-serum is soon liquefied, and there arises at first a honey-like odour, but afterwards sulphuretted hydrogen is developed. On potato the growth is yellowish-brown. Milk is coagulated, the reaction being acid. Traces of indol were detected in bouillon. Hofer's bacillus is a potential anaerobe; it can live a long time in water; it ferments sugar, and reduces sulphindigotate of soda and salpetre. It is extremely pathogenic to crabs and also to fish.

Bacillus putrificus.‡—In the course of researches on the processes and agents of putrefaction, Dr. Bienstock lighted on a micro-organism which appears to possess a specific decomposing action on fibrin. It appears to be identical with *B. putrificus coli*, described by the author in 1884. It is a drumstick bacillus, forming terminal spores; is very thin with rounded ends; and though the average length is 5–6 μ it sometimes forms filaments. It is extremely motile, and is covered with flagella. It is easily stained by the usual dyes, and also by Gram's method. The spores will resist 180° for 2 hours and boiling for 3 minutes; after 5 minutes they are dead. *B. putrificus* is an anaerobe, and in the depth of glucose-gelatin the colonies produce gas. The microbe is not pathogenic to animals. By its action on fibrin are produced H_2S, leucin, tyrosin, fatty and aromatic acids, amines, and paraoxyphenylpropionic acid. Consequently it gives rise to real putrefaction, and that too under anaerobic conditions. When associated with certain aerobic organisms, putrefaction takes place, but the process is delayed; with others putrefaction does not occur at all.

B. putrificus is not the only cause of putrefaction; other agents are *B. œdematis maligni*, symptomatic anthrax, and *Clostridium fœtidum*. But all these are anaerobes, and it would seem that aerobes are incapable of exciting putrefaction, though they may participate in the process by

* Brit. Med. Journ, 1899, ii. p. 1357.

† Arb. a. d. Kais. Gesundheitsamte, xv. (1892) part 2. Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 370–2.

‡ Ann. Inst. Pasteur, xiii. (1899) pp. 854–64.

deoxidising the medium, and so rendering it suitable for the action of anaerobic bacteria.

New Pathogenic Streptothrix.*—Dr. G. Dean isolated from a subcutaneous swelling in a horse a streptothrix which had given rise to appearances resembling actinomycosis. No granules were found in the pus, but delicate filaments with dichotomous branching were observed. The organism was cultivated successfully on agar-bouillon and the yeast medium. No growth occurred on blood-serum, potato, or gelatin. The optimum temperature was 35°–37°. The growth on agar and in bouillon is described as resembling little masses of white coral or cauliflower.

Microscopical preparations showed that the organism was extremely pleomorphic, the forms varying from coccus and bacillus to filaments. The majority are rods 3–5 μ long and 0·3–0·4 μ broad. The bacillus form especially, owing to polar staining, is practically indistinguishable from diphtheria bacillus. In ascitic fluid and serum bouillon branching filaments predominated. Inoculation experiments gave positive results; those on rabbits being most successful. In the successful cases were found nodules with lanceolate and club-shaped processes arranged in rosette fashion.

Though the disease caused by this streptothrix presented features resembling actinomycosis, the organism differs widely from the laboratory *Actinomyces*, and the author's results tend to show that the Streptotricheæ are more nearly allied to bacilli than to moulds, and that the disease known as actinomycosis is caused by different species of allied organisms.

Streptothrix Capræ.†—Dr. Silberschmidt describes an organism which was isolated from the lungs of a goat, the morbid appearances simulating those of tuberculosis. *Streptothrix capræ* is non-motile; it stains well with anilin pigments, and also by Gram's method. The most effective staining was attained by Gram and eosin. The microbe is pleomorphic, presenting itself in cocco-bacillus forms and also as filaments of variable length, which may be branched. The filamentous form occurs more frequently in pus, in sections, and in deep bouillon colonies. The rodlet shape is more prevalent on agar cultures, and in the superficial bouillon colonies. The older the cultures the less frequent are the filament forms. Appearances resembling spores were observed, but this mode of development was not exactly ascertained. *Strep. capræ* is pathogenic to laboratory animals. Cultivations were made on gelatin, agar, bouillon, serum, potato, pepton-water, straw-infusion, and milk.

Streptothrix Nature of the Diphtheria Bacillus.‡—Dr. W. Spirig states that if diphtheria cultures be kept for a year or more, chalky looking deposits appear in the central parts of the growth, and on microscopical examination streptothrix forms and actinomycosis-like appearances become evident.

Pathogenicity of the Pseudo-Diphtheria Bacillus.§—Diphtheritic organisms of every grade of virulence are to be met with, says Dr. A.

* Ann. Inst. Pasteur, xiii. (1899) pp. 841–53 (5 figs.).
† Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 540–1.
‡ Trans. Jenner (late British) Inst. Prevent. Med., 1899, ser ii. pp. 113–24 (2 pls.).
§ Tom. cit., pp. 17–44 (3 pls.).

Salter. The weakest, known as Hoffmann's or the pseudo-diphtheria bacillus, and representing the most attenuated form of the Klebs-Loeffler bacillus, is capable of killing only certain highly susceptible small birds of the finch tribe. Organisms of a slightly higher degree of virulence can kill other and more resistant small birds of the bunting family. Others still more active can cause larger birds (*Merulidæ*) to succumb; whilst the most virulent of all can kill certain rodents, e.g. guinea-pigs.

Physiological analysis of the pseudo-diphtheria toxin shows that it contains bodies identical with or allied to certain of the constituents of the true diphtheria poison known as toxoids, and these bodies possess the power of neutralising or "fixing" antitoxic serum, and to a degree much greater than that of the true toxin. To this product Ehrlich gave the name of protoxid. The presence of this common product of the diphtheria and the pseudo-diphtheria bacilli is another argument in favour of the identity of the two organisms.

Bacillus of Acute Rheumatism.* — Prof. Savtschenko found the microbe first isolated by Achalme in five out of six cases of rheumatism. The rodlet is of variable height; it forms terminal spores; it is easily stained with anilin dyes and also by Gram's method. It is an essential aerobe. Its optimum temperature is from 30°–37°. The most favourable medium is bouillon with 0·5 per cent. lactose and 0·33 sterilised milk. The microbe is extremely pathogenic to laboratory animals, but they may be immunised by successive inoculations. It is extremely sensitive to salicylate of soda. In the bouillon-lactose-milk medium the lactic fermentation is excited, the milk being at the same time coagulated. The microbe grows equally well in extract of muscle. Its virulence is weakened by repeated cultivation, but may be restored by passage through animals. From 0·5–1 ccm. of human blood is required for each tube, as the microbe is infrequent.

Constitution of the Diphtheritic Poison.†—M. Th. Madsen discusses at some length the composition of the diphtheritic poison, and after describing the views of Ehrlich on the subject, gives an account of his own experiments with four different samples. The net result appears to be that the diphtheria bacillus produces two different substances in bouillon cultures, toxins and toxones, both of which fix antitoxin. The toxins are divisible into three groups which differ in their degree of affinity for antitoxin. Each of these three groups has two modifications which differ from each other in their degree of stability. Modification α is easily converted into toxoid, by which is meant toxin that has lost its power of killing an animal, though it has retained the property of fixing antitoxins. In each equivalent of the diphtheritic poison are two independent atomic groups:—(1) the haptophore group, which possesses fixative properties only; (2) the toxophore group, which possesses toxic properties and produces the specific effects of the poison through the intermediary of the fixative haptophore group. The toxones possess analogous, though feebler, properties, and undergo the same changes as the toxins. The toxones are secreted by the microbes at the same time

* Archiv. Russes Pathol. Méd. et Bact., v. (1898) p. 558. See Physiologiste Russe, i. (1899) pp. 223-4. † Ann. Inst. Pasteur, xiii. (1899) pp. 568-80, 801-32.

as the toxins, and their formation is arrested on removal from the incubator, while toxoids are chiefly formed in filtered bouillon cultures at the expense of the toxin. One of the properties of toxones is the production of late paralysis.

Meat Poisoning from Presence of Bacillus enteritidis.*—A series of cases of meat poisoning occurred in Sheffield on October 11th. The meat was tinned "corned beef," and nothing particularly abnormal in its appearance was noticed. Twenty-four persons were affected, and one died. The symptoms, which appeared suddenly after a latent period of 1–3 hours, were drowsiness, giddiness, headache, vomiting, diarrhœa, colic, and collapse. A bacteriological examination made by Dr. J. Robertson disclosed the presence of *B. enteritidis* Gaertner, an organism belonging to the coli group. Its identity was established by its staining reactions, motility, cultural characters, and pathogenicity.

Occurrence of Bacillus enteritidis sporogenes in Ulcerative Colitis.†—Dr. R. T. Hewlett has formed the conclusion that *B. enteritidis sporogenes* ‡ is probably an inhabitant of the normal digestive tract and frequently to be found in the dejecta. He has isolated it from cases of ulcerative colitis, diarrhœa, chronic dysentery, from dejecta of healthy persons, from road-dust, water, and milk. Considering its ubiquitous distribution and the resistant nature of its spores, the conclusion seems highly probable.

Actinomycetic Appearances produced by the Tubercle Group.—Dr. O. Schulze § records a series of experiments made for ascertaining the conditions under which actinoid and club formations are produced by tubercle bacilli. The animals were inoculated both locally and by intra-arterial injection, and in all cases actinomycetic appearances were observed. Though cultures of all degrees of virulence gave rise to the formations, they (the formations) first developed from cultures of low virulence. The general conclusion is that between true actinomycosis and tuberculosis are numerous gradations and affinities, and that the tubercle bacillus is to be regarded, not as a fission, but as a filament fungus.

The subject is pursued by Prof. O. Lubarsch,‖ whose investigation is a pendant and continuation of the foregoing. He records the result of experiments made with (1) modified tubercle; (2) pseudo-tubercle; (3) *Streptothrix asterioides* and *Bac. mallei*; (4) some other microphytes of the streptothrix group. From these it is inferred that ray and club forms are to be regarded as malformations by arrest, and that actinomycetic appearances are common to a group of fungi, viz. the Streptotricheæ. These microphytes should not be classed either with Schizomycetes or with Hyphomycetes, but should be located between the two as an independent transition form, and *Actinomyces* proper should be regarded as a sub-species of *Streptothrix*. The illustrations, which are in a plate common to both authors, leave no doubt as to the resem-

* Brit. Med. Journ., 1899, ii. pp. 1367–8.
† Trans. Jenner (late British) Inst. Prevent. Med., 1199, ser. ii. pp. 70–80.
‡ Cf. this Journal, 1899, pp. 429–30.
§ Zeitschr. f. Hygiene u. Infekt., xxxi. (1899) pp. 153–86.
‖ Tom. cit., pp. 187–220 (1 pl.).

blances; for there are depicted branched forms, club-shaped elements, radiating tufts, and confused central networks of filaments.

Del Río's Bacteriology.*—Dr. L. Del Río has obtained the distinction of being the first to bring out in his mother tongue a treatise on Bacteriology, all the previous works on this subject in Spanish being translations of foreign authors. The 'Elements of Microbiology for the use of medical and veterinary students' will no doubt supply a want hitherto felt by the Spanish-speaking scientist and student, more especially as it contains all the information necessary for acquiring a good practical knowledge of the subject. The first chapter is devoted to the biographies of those distinguished microbiologists, Pasteur and Koch, a feature which distinguishes the work from other treatises on Bacteriology.

* Madrid, 1899, 648 pp. and 195 figs..

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Chamot's Microscope for Microchemical Analysis.†—This instrument, which is made by Messrs. Bausch and Lomb, has been designed by the inventor to meet the growing demands of microchemistry. The Microscope is intended to be efficient, cheap, and suitable for class work, and its general nature is that of a simplified petrographic instrument.

The stand (fig. 1) is of the Continental type, and, since its use would always be vertical, it was not thought necessary to provide it with a jointed pillar. The coarse adjustment is by rack-and-pinion, and the fine by micrometer-screw. The stage is circular, rotating, provided with centering-screw; its circumference is graduated into degrees for measuring crystal angles. The stage is faced with rubber, and the substage is adjustable by means of a quick-acting screw. Into the substage is fitted the polarising apparatus, consisting of a Nicol prism of large size, and so mounted that, by means of a pin fitting into a slot in the substage-ring, the prism can always be replaced in exactly the same position. The polariser can be swung aside when polarised light is not desired. The prism is so arranged that it can be rotated, and is provided with a circle graduated in degrees. The analysing nicol is also provided with a graduated circle, and it is so mounted that it fits over and above any eye-piece. The draw-tube of the Microscope is furnished with a small projecting pin, which fits into a slot cut in the bottom of the tube-mounting of the analyser. This slot lies in the same vertical plane as the zero points of the analyser, the polariser, and the stage. The zero points of polariser and of analyser are arranged as usual, i.e. for the position of crossed nicols. It follows, therefore, that when the polariser is at zero, and is swung in position below the stage, and the analyser is also at zero, and is in position with its slot on the pin, the nicols are crossed without further adjustment. It is therefore possible to quickly change eye-pieces, drop the analyser in place, and not be obliged to spend time in adjusting it, as is so often the case. Magnifying power is obtained by low objectives and high eye-pieces, so as to diminish risk to the objectives from corrosive fluids. Each eye-piece is provided with cross-hairs at right angles, and a projecting stud fitting into a nick in the upper edge of the draw-tube for lining them. It is found that 1-in., 1/2-in., and 1/4-in. objectives form a convenient set, with 2-in., $1\frac{1}{2}$-in., 1-in., and 1/2-in. eye-pieces. This gives a range of magnification between 20 and 500 diameters, which is amply sufficient for all ordinary analytical work.

The draw-tube of the Microscope is graduated as usual; the mirrors, plane and concave, are on a swinging bar.

* 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. App. Micr., 1899, pp. 502–5 (1 fig.).

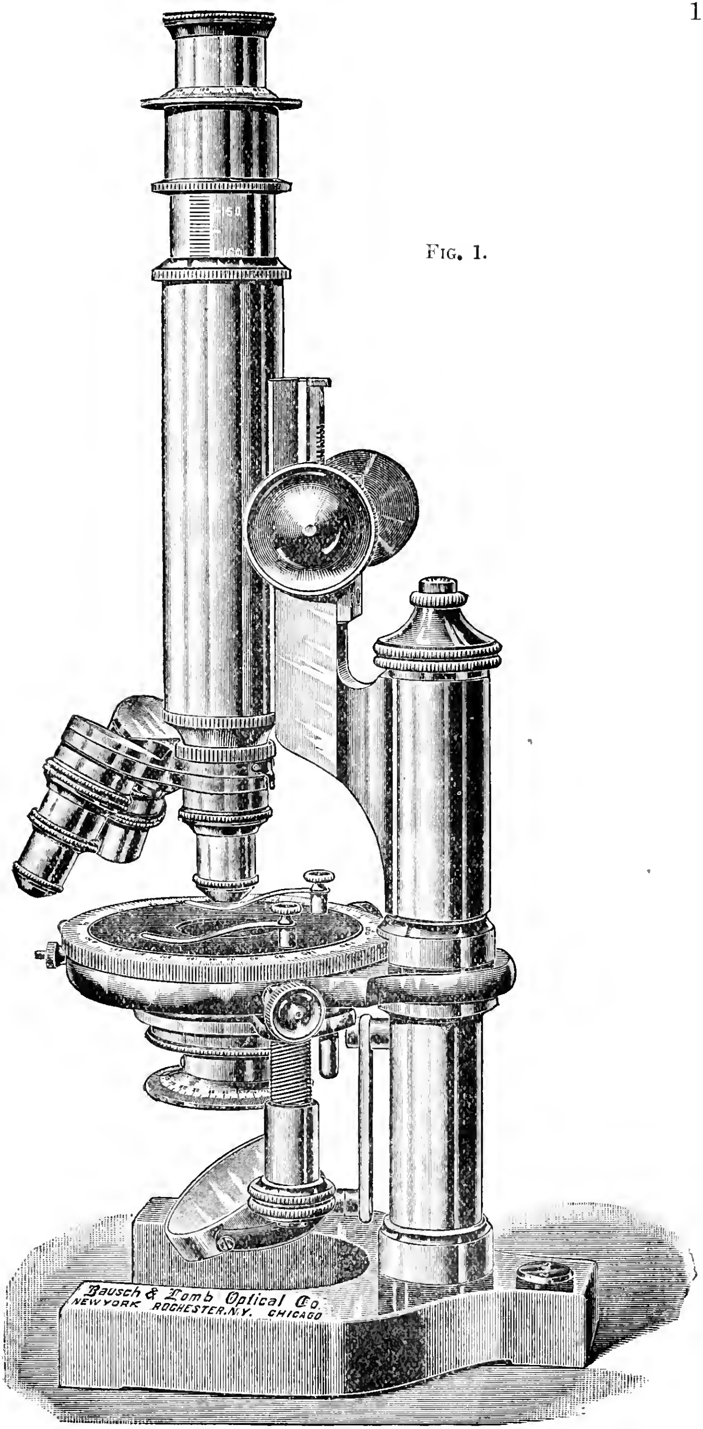


Fig. 1.

Three Small Hand-Microscopes.—With regard to these, which were exhibited by Mr. E. Swan at the Meeting in last November,* it is interesting to note that a figure and description of the original instrument has been found by Mr. Parsons in the first edition of *Carpenter on the Microscope* (1856), p. 73, fig. 15. It was designed by Mr. Gairdner and made by Bryson of Edinburgh.

Berger's New Microscope.—The accompanying cut (fig. 2) illustrates the description of the mechanical stage of Berger's new Microscope,

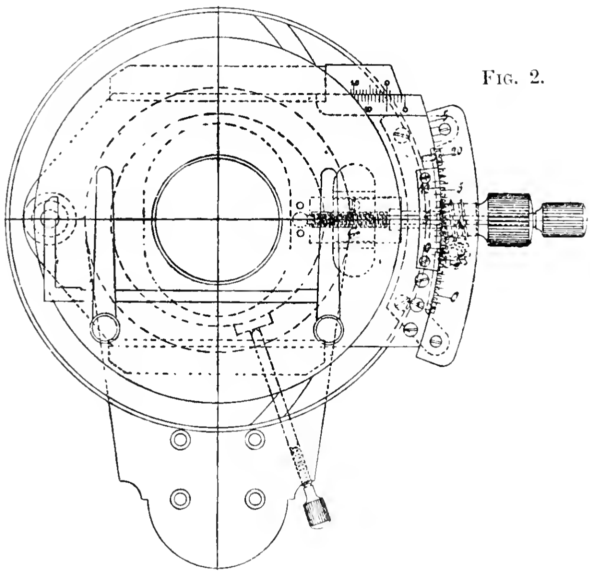


FIG. 2.

which appears on p. 649 of the Journal for 1899; see also figs. 98, 99, and 100 on pp. 584, 585, in the Journal for 1898.

Leitz Travelling Microscope.—This instrument (fig. 3) packs into case 21 by 14 by 7 cm., and weighs only 4 lb. It will be seen from the figure that to set up the instrument for use, the mirror and stage have to be attached, and the tube which carries the ocular must be unscrewed and reversed. It will also be seen that it has rack-and-pinion coarse, and micrometer-screw fine adjustment; the only point not quite clear in the illustration being the method of folding the foot. This foot is a very ingenious one, consisting of two solid rectangular bars of brass lying against each other when the instrument is packed, but which can be opened out so as to make an angle of some 40°, in which position they are firmly held by a spring-catch, and as there is no inclination, this gives ample stability.

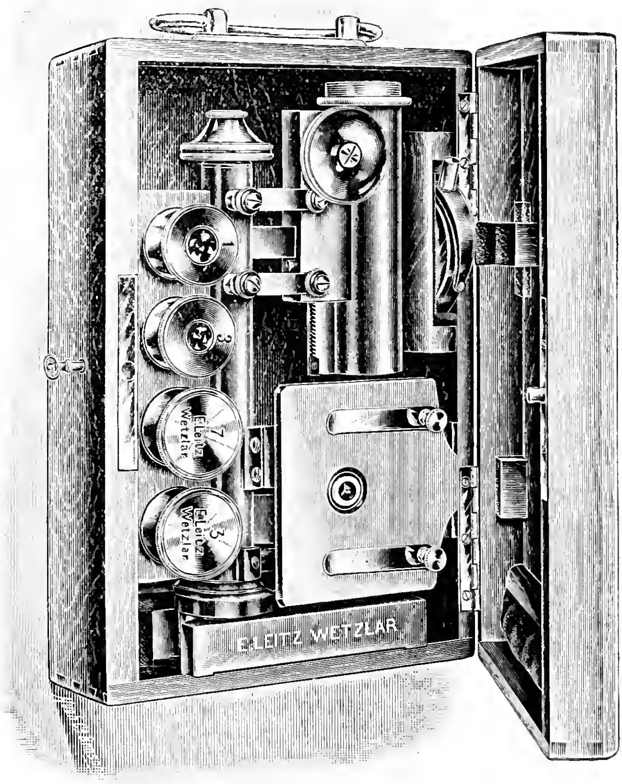
Leitz Horizontal Microscope or Cathetometer.—This instrument appeals rather to the physicist than the microscopist; it consists essen-

* Cf. this Journal, 1899, p. 643.

tially of a Microscope mounted on an adjustable pillar (fig. 4), the Microscope being of the compound type, with ocular and combination objective, giving focal distances of 5, 9, and 48 cm. It has rack-and-pinion adjustment for focus, also for vertical adjustment, in addition to a sliding adjustment for the same purpose, both the latter being graduated.

The pillar is mounted on a base with levelling screws, both base and Microscope being provided with spirit-levels.

Fig. 3.



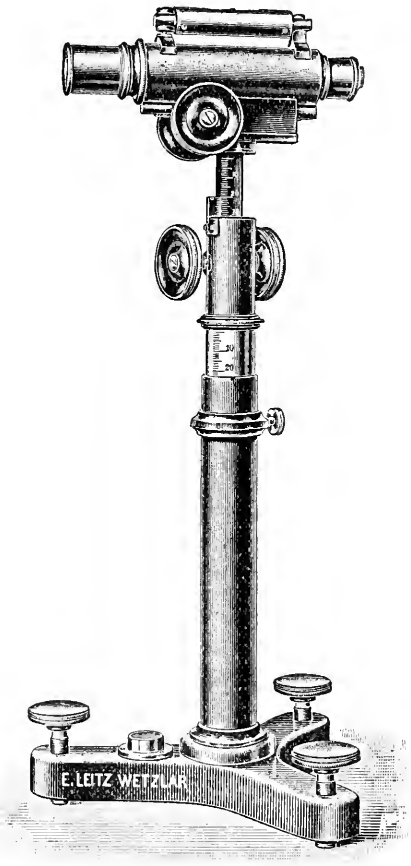
Leitz Nebelthau's Sliding Microscope.—This instrument (fig. 5), although originally designed for looking over large brain sections, will perhaps find its chief use in the bacteriological laboratory for the examination of culture plates. For this purpose its unique stage-plate would be particularly serviceable; it measures 16 by 20 cm., practically every part of which can be brought under examination by the mechanical movement of either Microscope or stage, the necessary illumination being obtained by means of a long rectangular mirror.

The compound Microscope figured can be detached, and a simple lens, shown lying in front of the instrument in the illustration, can be substituted.

It is only necessary to add that the movements of both Microscope and stage are graduated, so that any desired field may be recorded.

Leitz Dolken's Stand.—This instrument (fig. 6) was designed to overcome the difficulty experienced when examining large bacteriological culture-plates on the ordinary Continental model stand, owing to the

FIG. 4.



short distance from optic axis to limb. The stand is of the same size as the Leitz No. 1, the substage arrangements and focussing adjustments being similar in every respect. The method by which increased space is obtained is so clearly shown in the illustration as to make further description superfluous.

New Hot Stage.*—Dr. A. Macfadyen describes a hot stage, in the

* Trans. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 246–8 (2 figs.)

construction of which a new principle for regulating the temperature has been applied. The general design is shown in fig. 7.

A is a metal box, with inlet and outlet tubes *a* and *d*. A regulating valve is attached to *a*, and at *b* and *c* are openings, provided with screw-caps. The water in the flask B is heated up to 60°–70° C., and, after flowing through the hot stage, escapes at G. The means of regulating the temperature are shown in fig. 8. The water passes from *a* through

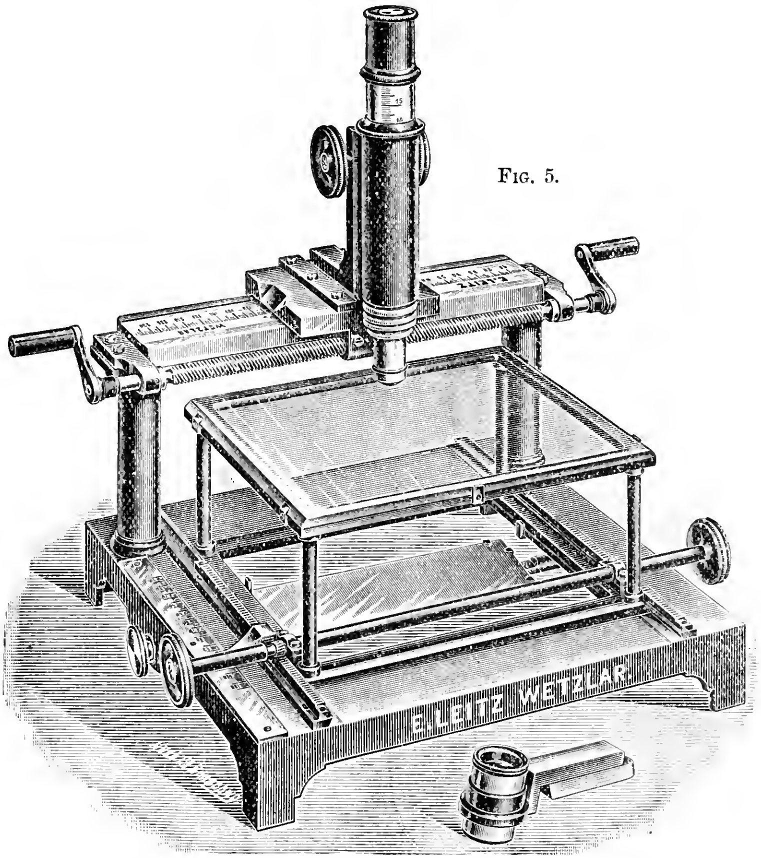


Fig. 5.

the closed cylinder *l*, which projects into air-chamber *g*. The volume of air in *g* varies with the temperature of the water, while the pressure of air in *g* and *l* is kept constant by the piston *k*, which slides freely in the tube *m*. Hence the temperature of the water corresponds to some position of the piston *k*. This carries at one end a flat plate *p*, by which the exit tube *d* is closed. The exit tube *d* not only slides through *i*, but can be adjusted by means of a screw-collar on *i*. To set the apparatus, water of a higher temperature than that required is allowed to flow through, and

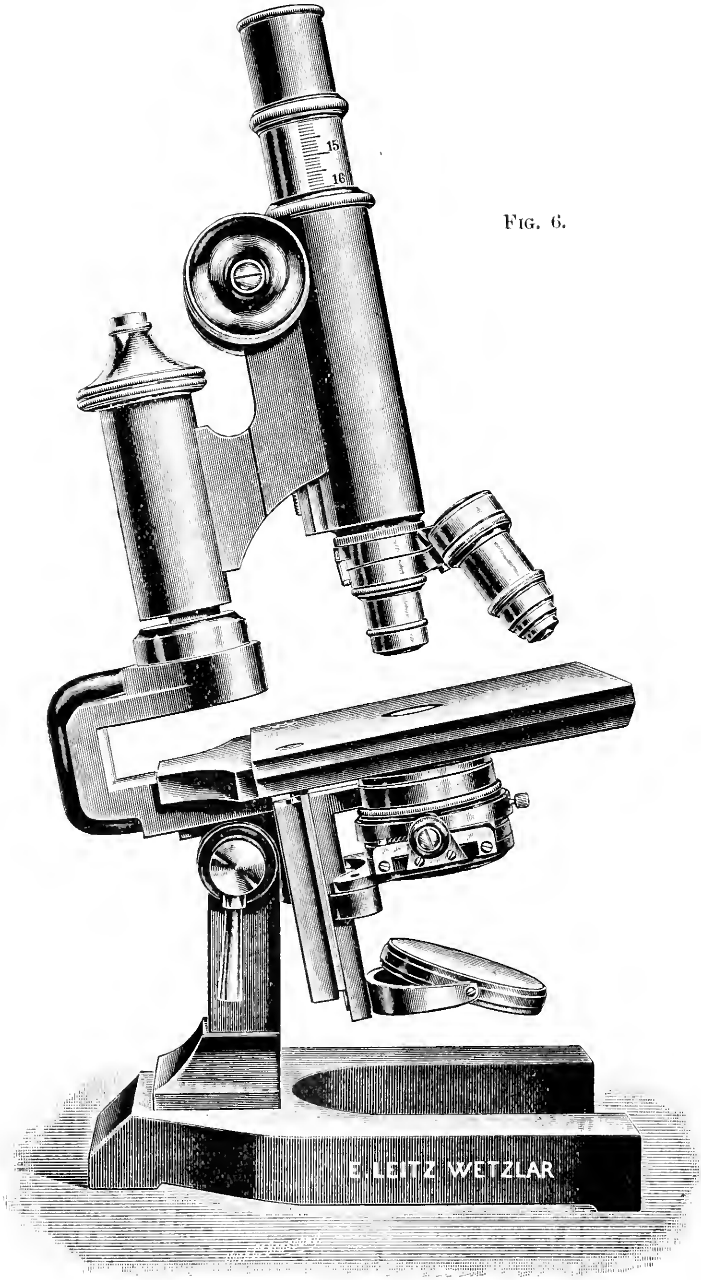


Fig. 6.

when the requisite temperature has been attained, *d* is then pushed in to arrest the flow. As the temperature falls, the volume of air in *g* and *l*

Fig. 7.

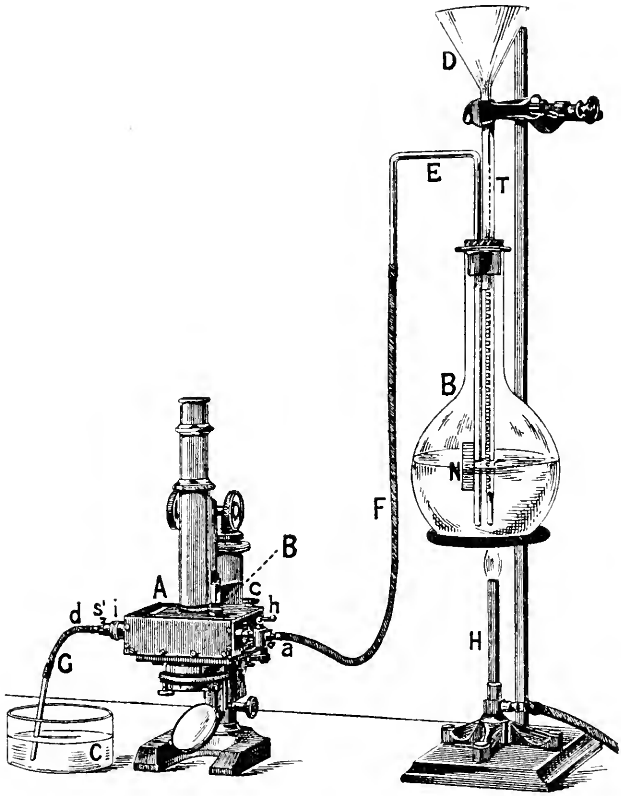
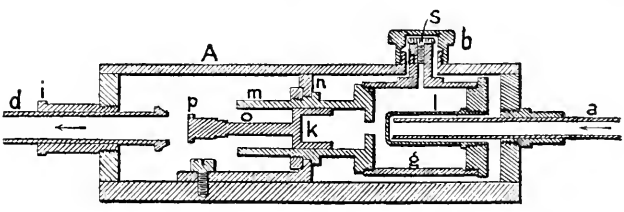


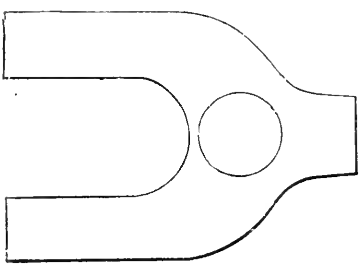
Fig. 8.



will diminish, and the piston *k* will travel in the direction of *a*, and so open *d* by removing the plate *p*. Fresh hot water then flows through, and the temperature rises, and so on. In this way any temperature between 20° and 60° is obtainable. The variations are not greater than 1/5 to 1/10 of a degree. The temperature of the object under examination is about 2° lower than that indicated by the thermometer in the stage.

U-shaped Foot.*—Under the title "The U-shaped Foot is clumsy," Mr. W. J. Beall, of Michigan Agricultural College, expresses his opinion of the horse-shoe or Continental form of Microscope foot. Nineteen years ago he selected one or more instruments of some fifteen kinds of stands in order that visitors, his students, and himself, might have a variety for comparison. Since that time he has added other styles to the number. Fig. 9 represents the shape of the horseshoe foot; fig. 10, the same in section as made of solid metal. Fig. 11 represents on the same scale the shape of the foot of another instrument used for nearly

Fig. 9.



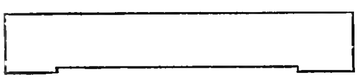


Fig. 10.

Fig. 11.

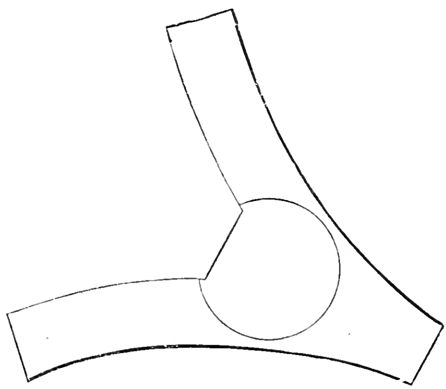


Fig. 12.

twenty years past; and fig. 12 gives a section of the same, the dotted lines indicating the depth of the hollow from the lower side. The first instrument mentioned is 30 cm. high, and weighs six pounds; the second one is 28½ cm. high and weighs a trifle over four pounds. If the first be placed on a table the least bit curved or uneven, the foot stands on three out of four points and rocks easily; while number two stands firmly on the table no matter what may be the condition of its surface. When placed side by side near each other, erect or inclined 20° to 30°, and a string is tied to the top, joining the two, and the feet are placed apart, the heavier instrument tips over before stirring the other one from its position. The author's opinion, which is strongly opposed to the Continental pattern, is best given *verbatim ac litteratim.* "True, the narrow base can be pressed into a smaller box than the other, but on the table there is room enough for a broader base. For utility and for beauty, it seems to me the horseshoe foot has scarcely a thing to com-

* Journ. App. Micr., 1899, pp. 623-4 (4 figs.).

mend it, when compared with the other here illustrated. A considerable portion of the extra two pounds weight seems to be for the purpose of making the stand firm on its feet, which it fails to do. In the use of Microscopes it has been my need to frequently lift them from one place to another, sometimes with considerable speed. Perhaps the extra two pounds may have been added partially with the view of strengthening the muscles of the arm of the one who handles the instrument; if so, the extra weight has accomplished something."

Ahrens' Erecting Microscope.—A point of considerable interest has been found in connection with Ahrens' new erecting Microscope, figured in this Journal for 1888, p. 1020, fig. 161. The erection is performed by means of "Porro" prisms. In the description it is said that "the erection of the image is obtained by two right-angled prisms crossed in the way used in some of the binocular field-glasses." This is probably the first application of "Porro" prisms to the Microscope; and the passage quoted shows that the new field-glasses are not so new as some of us believed.

(2) Eye-pieces and Objectives.

Modern Apochromatic Objectives.* — Dr. H. van Heurck, after some historical and theoretical introduction, summarises the chief forms of modern apochromats.

(1) *Objective* 16 *mm.*, *N.A.* 0·30 (fig. 13).—The system consists of three lenses: the frontal plano-convex of low curvature; the median double; and the superior slightly convex, and in reality formed of a highly curved biconvex lens between two menisci. The low numerical aperture of this objective permits its employment only for histological studies, for which it gives very beautiful and delicate images.

FIG. 13.

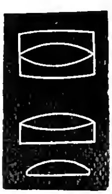


FIG. 14.

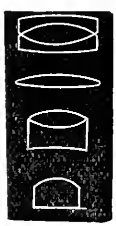
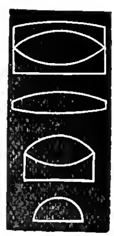


FIG. 15.



(2) *Objective* 8 *mm.*, *N.A.* 0·65 (fig. 14).—This is a quadruple combination of seven simple lenses of different kinds of glass, and of different curves. It is a very successful objective, and if a microscopist possesses only one apochromat he ought to select this. With different compensating oculars the magnification varies from 62 to 562 diameters. It shows Nobert's sixth group well with axial illumination, and resolves the striæ of *Pleurosigma angulatum*.

(3) *Objective* 6 *mm.*, *N.A.* 0·95 (fig. 15).—The construction of this objective resembles that of the last, but the curves are sharper, especially

* Ann. Soc. Belge de Micr., xxiii. (1899) pp. 43–73 (1 pl. and 6 figs.).

that of the frontal lens. It will resolve, with axial light, Nobert's twelfth group (2830 lines to the mil).

(4) *Objective* 4 *mm.*, *N.A.* 0·95; *and* 3 *mm.*, *N.A.* 0·95 (fig. 16).—These resemble the last in design. Dr. van Heurck finds that the 3-mm. will resolve Nobert's thirteenth group, and considers it somewhat superior to the 4 mm.

(5) *Objective* 2·5 *mm.*, *N.A.* 1·25, *water-immersion* (fig. 17).—Construction like last; a very beautiful objective. A slight alteration of

Fig. 16.

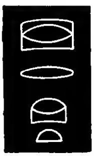


Fig. 17.

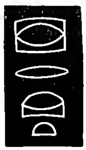
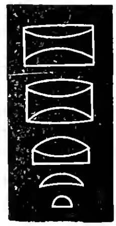


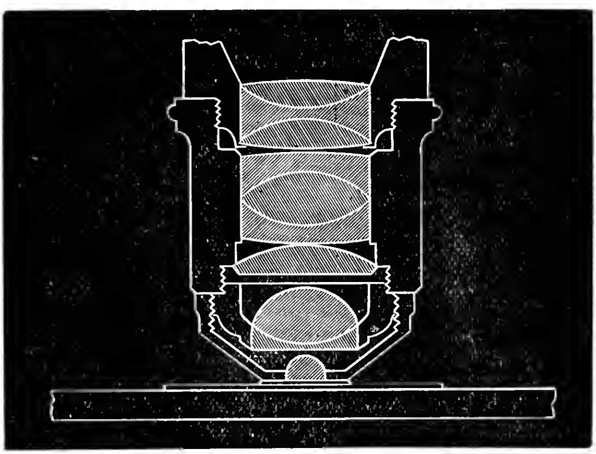
Fig. 18.



diaphragm produces a marked effect on the image, and with axial light the resolution lies between Nobert's 13th and 14th groups. With electric oblique light Nobert's 18th group is distinctly resolved.

(6) *Objective* 3 *mm.*, *N.A.* 1·40, *homogeneous* (fig. 18).—This contains ten lenses. The simple frontal lens slightly exceeds a hemisphere,

Fig. 19.



and the object of such a lens is to produce a notable amplification of the object without introducing at the same time great chromatic and spherical aberrations. It reduces the pencil aperture from 1·40 to 0·65. The first doublet discharges similar functions; at first it diminishes the pencil divergence, and afterwards intentionally introduces a certain amount of chromatic and spherical aberration for more complete correction by the upper lenses. The first triplet destroys spherical and chromatic aberration, and the second triplet the secondary spectrum.

Dr. van Heurck finally tabulates and compares the merits of 3 mm. and 2 mm. apochromats of the most modern makes.*

Fig. 19 is reproduced from Czapski's *Theorie der optischen Instrumente*.† It shows the older form of apochromat, and will be interesting for comparison. It represents an objective of 2 mm. equivalent focus and of N.A. 1·40, on a scale three times the natural size.

CHARLIER, VON C. V. L.—**Über akromatische Linsensysteme.** (On Achromatic Lens-Systems.)

[A very succinct article, with more particular reference, however, to telescopes.] *Öfver. K. Vetensk.-Akad. Förhandl.*, 1899, pp. 657–669.

Objectives of Telescopes. A series of articles in the *Zeitschr. f. Instrumentenkunde*:—

HARTING, H.—**Zur Theorie der zweitheiligen verkitteten Fernrohrobjektive.** (On the Theory of Cemented Doublet Telescope-Objectives.)

[An elaborate mathematical article with tables of constants for different kinds of glass.] Dec. 1898, pp. 357–80.

WOLF, M. — **Über ein Fernrohrobjektiv mit verbesserter Farbenkorrektion.** (On a Telescope-Objective with improved Achromatic Correction.)

Jan. 1899, pp. 1–4 and 1 fig.

HÖEGH, E. VON—**Zur Theorie der zweitheiligen verkitteten Fernrohrobjektive.** (On the Theory of Cemented Doublet Telescope-Objectives.)

Feb. 1899, pp. 37–9.

HARTING, H.—**Zur Berechnung astronomischer Fernrohrobjektive.** (On the Calculation of Astronomical Telescope-Objectives.) April 1899, pp. 104–11.

HARTING, H. — **Über Astigmatismus und Bildfeldwölbung bei astronomischen Fernrohrobjektiven.** (On Astigmatism and Circular Image Distortion in Astronomical Telescope-Objectives.)

May 1899, pp. 138–143, with several tables of constants.

STEINHEIL, R. — **Farbenkorrektion und sphärische Aberration bei Fernrohrobjektiven.** (Achromatic Correction and Spherical Aberration in Telescope-Objectives.) June 1899, pp. 177–183 and 3 diagrams.

HARTING, H. — **Über ein astrophotographisches Objektiv mit beträchtlich vermindertem sekundärem Spektrum.** (On an Astrophotographic Objective with considerably reduced Secondary Spectrum.) Sept. 1899, pp. 269–72.

LEMAN, A.—**Zur Berechnung von Fernrohr- und schwach vergrössernden Mikroskop-Objektiven.** (On the Calculation of Objectives of Telescopes and of Low-power Microscopes.) Sept. 1899, pp. 272–3.

HARTING, H.—**Bemerkung zu dem vorstehenden Aufsatze.** (Note on the foregoing Treatise.) *Ibid.*, pp. 274–5.

* We much regret that in this Journal (1899, p. 337) it was erroneously stated that "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."—EDITOR.

† Edition 1893, p. 245.

(3) Illuminating and other Apparatus.

Electric Microscope Lamp.*—Mr. J. E. Barnard has surmounted the difficulty of adapting the incandescent lamp to Microscopical purposes by strongly illuminating a white surface. The lamp (fig. 20) is enclosed in a brass tube, cut off obliquely at the end and with an aperture opposite the oblique surface. The inner surface of the tube is coated with a thick layer of zinc oxide which, when illuminated, reflects a perfect white light of sufficient intensity for most microscopical purposes.

Fig. 20.

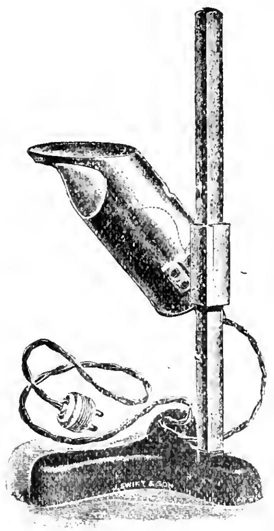
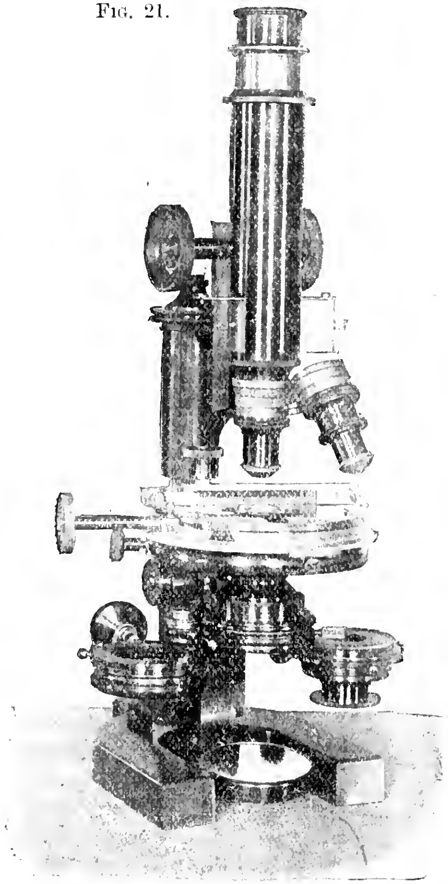


Fig. 21.



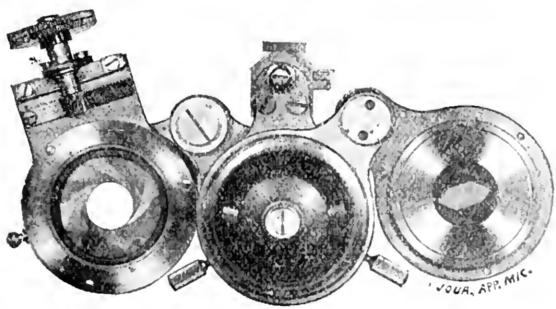
Winton's Micro-Polariscope for Food Examination.†—Mr. A. L. Winton has found polarised light of great value in the examination of foods, particularly in the detection of starches as adulterants. He thinks the method quicker and surer than the iodine test. For this purpose he uses an arrangement which he has adapted to a Bausch and Lomb's Continental Microscope.‡

* Trans. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 252–3 (1 fig.).
† Journ. App. Micr., 1899, pp. 550–1 (2 figs.).
‡ The device is, however, not new. In the volume of this Journal for 1881 (fig. 48, p. 302) will be found the description of an adapter, and also (fig. 210,

Usually in Microscopes the polariser is fitted to the substage ring which carries the Abbe condenser, and cannot be attached until the sub-stage is lowered and the condenser is removed. For attaching the analyser the Microscope-tube must be raised, the objective or nose-piece removed, and the analyser screwed at the upper end to the tube, and at the lower end to the objective or nose-piece. Both the substage and the tube must be readjusted before the object can be viewed. The change back again to plain illumination is equally laborious. These operations not only consume several minutes each time the polariscope is brought into service, but also, if often repeated, are ruinous to the screw-thread and other parts of the apparatus.

Fig. 21 shows Bausch and Lomb's Continental Microscope fitted with this arrangement. The polariser (fig. 22) is carried on an arm below the substage, and swings into position from the right, at the same time forcing the iris diaphragm out of position to the left. The analyser is mounted in the same manner as in petrographical instruments, the prism being contained in a box which slides in the main tube, so that

Fig. 22.



when pushed to the right, the light passes through the prism, but when pushed to the left, a round opening permits unobstructed vision. When polarised light is desired, the polariser is pushed to the left and the analyser box to the right, and the change to plain illumination is accomplished by the reverse operations. Either change can be made in less than a second, without disturbing the adjustment either of the tube or of the substage, and without damage to the instrument. Another advantage is that the condenser may be used in conjunction with the polariser, thus rendering the crosses on wheat, rye, barley, and some other feebly active starches more distinct. Selenite plates are mounted in a metal slip and are used on the stage.

Watson & Sons' New Substage Condensers.—Fig. 23 represents the dry parachromatic condenser lately introduced by Watson & Sons. It has a total aperture of 1·0 and an aplanatic aperture in excess of 0·90. Its power, 2/7 in., renders it suitable for critical and photographic work

p. 938) of a Microscope with analyser in box above the objective. In the volume for 1888 (fig. 40, p. 279) Messrs. Bausch and Lomb's "Petrographical Microscope," with this device, has already been described. Messrs. Swift also mount the analyser in a slide above the objective.—Editor.

with high-power objectives, and it possesses the convenience of a large field-lens, viz. 5/8 in. diam. The mounting, as shown in illustration, is convenient in form; the iris diaphragm has immediately above it the Society's objective thread into which the optical portion of the condenser screws. The tube surrounding the iris diaphragm is divided to enable the aperture at which the condenser may be working to be known; a carrier is also provided for coloured glasses, dark ground stops, &c. The top lens of the condenser can be removed for work with low-power objectives.

Fig. 23.

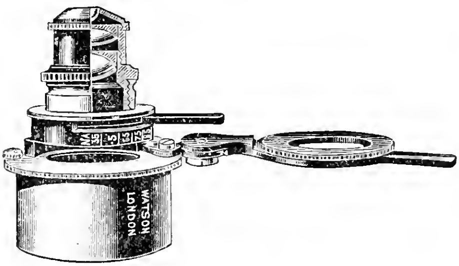


Fig. 24.

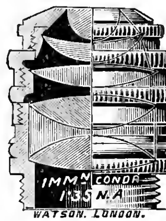
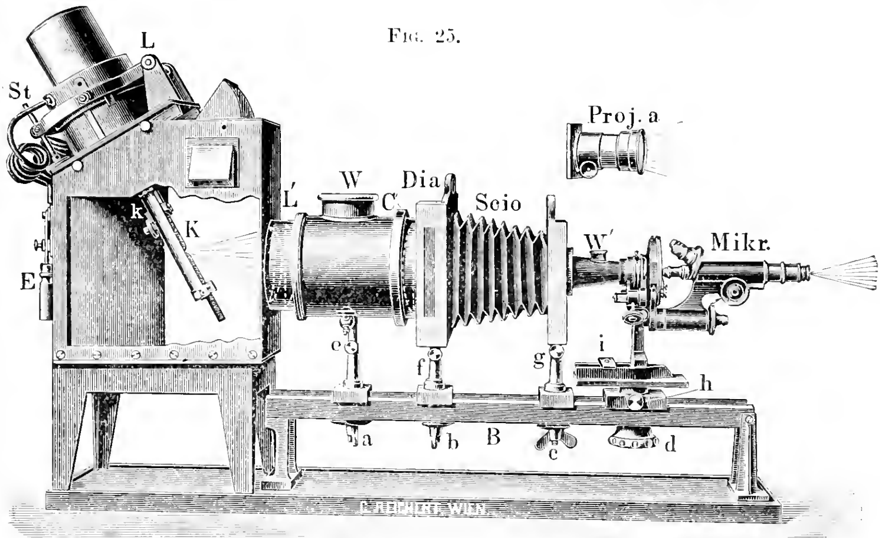


Fig. 24 represents an oil-immersion condenser by the same firm, having a total aperture exceeding 1·3 and an aplanatic aperture of 1·27. It will be noticed that it attains a very high degree of aplanatism, and this is brought about by the use of a triple back correcting lens which is 6/10 in. diam.; its power is 1/4 in. It also can be used dry for medium and low-power objectives by removing the top lens, when its power becomes 2/7 in. and the aperture 0·60 N.A. This optical part is also fitted with the Society's screw, and is supplied in a mount similar to the condenser above described, the iris diaphragm, however, being divided to suit the different optical system.

Reichert's New Projection Apparatus.—This apparatus (fig. 25) is fitted with an optical bench mounted on a solid board, and can be used with the ordinary type of adjustable Continental Microscope. The light-source is either a hand-feed arc lamp, or a Schuckert's automatic self-regulating projection lamp, in metal box lined with asbestos. The 3-lensed 150 mm. diameter condenser system contains a water-chamber affording a sufficient protection to the preparations against prolonged heating. The frame for the reception of the slides is 9 by 12 cm., and the projection-objective, adjustable by rack-and-pinion, is of about 12 cm. focus. There is an adjustable foot-plate to which is fastened the Microscope stand.

The apparatus may also be equipped with a special projection-Microscope stand which very much facilitates the working. The coarse adjustment is then by rack-and-pinion, permitting an especially long movement for the long-focussed objective; the fine adjustment is by micrometer screw. The tube is chosen of such a width that the light-cone of the weakest projection-objective is fully utilised. For the projection-ocular an adjustable draw-out tube is employed. The object-stage is movable, rotatory, and is fixed by means of screws. The Abbe condenser with iris diaphragm is central, and is adapted for raising and lowering, and can be changed revolver-fashion for a cylinder diaphragm. In order to protect the preparation from excessive heating in the event of long-continued projection, a second water-chamber for alum solution is inserted directly behind the Abbe condenser. For convenience of change from microscopic to diapositive projection, the whole Microscope

Fig. 25.



can be easily drawn off the bench and just as easily replaced. A diaphragm arrangement is provided for stopping off interfering side light.

(4) Photomicrography.

New Photomicrographic Apparatus.*—Mr. J. E. Barnard has devised a photomicrographic apparatus with the following novel modifications.

(1) Rigidity. The apparatus is supported on a cast-iron girder base, thus combining the maximum of strength with the minimum of weight.

(2) Focussing is accomplished in a novel manner. Running along the base is a steel rod, provided with movable brass heads, at the end of which is a grooved pulley carrying a silken cord kept uniformly tense by weights. The cord passes up through the pivot supporting the tail-piece, and is led over guide-pulleys to the fine adjustment. This arrangement allows the Microscope and illuminating apparatus to be swung aside without interfering with the fine adjustment arrangements.

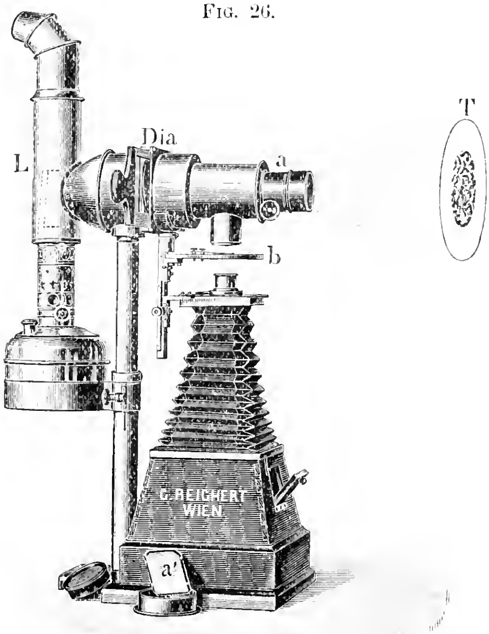
(3) The bellows are in segments, so that the whole or any part may be used. The supporting frames rest on brass tubes, running one on each side of the entire length of the girder base. The contact with the

* Trans. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 248–50 (1 pl.).

tubes is alternately V-shaped and flat, and the clamping arrangements are entirely independent. The illuminating apparatus is an arc lamp and parallelising system mounted on a brass tube fixed to the swinging tail-piece. The arc lamp is described in this Journal, 1898, p. 170. The entire instrument rests on three levelling-screws supported by thick lead disks on the surface of a stone table which is carried on brick supports above the concrete foundation.

Reichert's New Combined Apparatus for Drawing, Projection, and Photomicrography.—This apparatus (fig. 26) is principally adapted for low powers (6 to 30 diameters) and can be worked with various forms of the incandescent light (petroleum, spirit, gas). It answers the purposes of drawing with magnifiers, photomicrography, and the projection of lantern slides. It is supplied in three combinations:—(1) As a drawing apparatus consisting of a stand fitted with stage capable of moving up and down, condensing lenses in front of the light, mirror inclined at 45°, condensing lens above the stage, Welsbach spirit-lamp fitted with reflector, lens-carrier adjustable by rack-and-pinion, two

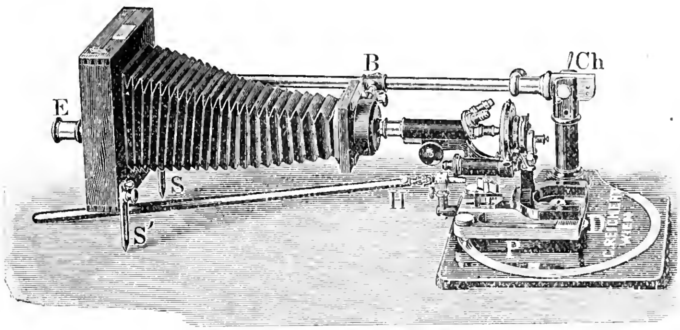
Fig. 26.



lenses magnifying 6 and 12 diameters; (2) as a photographic camera, double dark slide, and focussing screen; (3) as a projection apparatus, with frames for lantern-slides and projection-lens adjustable by rack-and-pinion.

Reichert's Small Photomicrographic Apparatus.—This apparatus (fig. 27) is made with the guide-rods hinged, so as to be used vertically or inclined. The base-plate is fitted with three levelling screws, and any of his Microscopes can be adapted. Dark slide for quarter and half plates, focussing screen, and Hooke's key, are supplied with the apparatus.

Fig. 27.



Guide to Photomicrographic Apparatus.* — Herr C. Reichert has issued a guide for the use of photomicrographic apparatus constructed by the firm. Most of the apparatus has been described before, but a modification suggested by von Martenson for low-power photography appears to be new. This consists in placing the principal and accessory parts on separate base-boards. This arrangement is found to be more convenient for examining the specimen, and prevents jarring when the Microscope is bent at an angle.

The photograms, which include objects as various as micro-organisms, the tarsal joint, and metals, are excellent.

B. Technique.†

(1) Collecting Objects, including Culture Processes.

Cultivation Medium for Thermophilous Bacteria. ‡— Dr. A. Macfadyen and Dr. F. R. Blaxall have found in potato-agar a good medium for cultivating thermophilous organisms. Hereon they grew as isolated colonies, remained discrete, and it was possible to obtain readily pure subcultures. Potato-agar is prepared as follows: Potatoes are steamed, peeled, and pounded. To 100 grm. of potato one litre of water is added, the mass steamed for half an hour, and then filtered. To the filtrate 2 per cent. of agar is added, and the whole autoclaved for 15 minutes. It was found an advantage to add 1 per cent. of salt. After neutralisation with soda and further steaming, the potato-agar is filtered into test-tubes and sterilised once more. This medium, which is practically a carbohydrate soil, is referred to as salt-potato-agar.

* Vienna, 1899, 13 pp., 6 figs., and 18 photograms.

† 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. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 164–5.

Cultivation and Staining of Amœbæ.*—Dr. Feinberg finds that the best medium for the cultivation of amœbæ is a mixture of several organic substances (not specifically mentioned) and common salt solution. In this development is rapid and copious, though the cultures are never pure. A drop of the fluid and a drop of serum are placed on a slide and fixed with sublimate-alcohol. The preparations are then treated with iodine-alcohol and stained with a dilute solution of hæmatoxylin. When the amœbæ become encysted, portions of the nutrient medium mass are fixed and hardened in absolute alcohol, imbedded in paraffin, and sectioned. The sections are best stained with methylen-blue and eosin.

Medium for Isolating Microbe of Scarlet Fever.†—Mr. W. J. Class has succeeded in isolating from scarlet fever cases a large diplococcus, which he believes to be the specific germ of the disease. The successful culture medium is glycerin-agar to which is added 5 per cent. by weight of black garden earth, previously sterilised by discontinuous heating. Epidermis scales are placed on the medium, and the tubes incubated from 2–7 days at about 35°. In about two days whitish-grey semitransparent colonies appear.

New Coloured Nutrient Medium and Appearances produced therein by certain Micro-organisms.‡—Prof. A. Caesaris-Demel, by pursuing the method of cultivating in liver-broth coloured with litmus, has obtained some interesting results with regard to the reaction produced in the medium by the following micro-organisms:—*Bacillus coli communis*, *B. typhi*, *B. pneumoniæ*, *B. anthracis*, *B. icteroides*, *B. prodigiosus*, *Proteus vulgaris*, *Staphylococcus pyogenes aureus*, *Vibrio choleræ*, fowl-bacillus, and *Sarcina lutea*. These results are pictorially summarised in two coloured plates, and the importance of the method for diagnostic purposes in regard to some microbes is thereby rendered obvious. For example, in the case of *B. coli*, the diagram indicates gas-formation and is coloured pink for the first period; the next stages are neutral (yellow), and the final blue-violet. In the case of *B. typhi* the first stage is neutral and all the rest pink. Cholera shows a red-violet hue on the first, and afterwards pink throughout. *B. icteroides* is pink from the start, with gas-formation on the first day.

Cultivations of *B. coli*, *B. typhi*, and *Proteus* under anaerobic conditions showed that after the first day the colour-reaction was neutral, but directly air was restored aerobic appearances presented themselves. The medium is composed of calf's liver infused for 24 hours in 1 litre of water. After expression and filtration the fluid is boiled for one hour, filtered again, and 10 grm. pepton and 5 grm. salt added. The fluid is boiled and filtered again and then neutralised with normal soda solution (about 3 ccm.). The broth is then autoclaved for half an hour at 115°, and after filtration 20 ccm. of neutral litmus tincture are added. 10 ccm. of the broth are poured into test-tubes, and these are sterilised for half an hour in an autoclave.

* Fortschr. d. Med., xvii. (1899) pp. 121–7 (2 pls.).
† Med. Record, lvi. (1899) pp. 330–2, 513–4 (4 figs.). See Brit. Med. Journ., 1899, ii. Epit. 420.
‡ Centralbl. Bakt. u. Par., Ite Abt., xxvi. (1899) pp. 529–40 (2 pls.).

Apparatus for the Cultivation of Anaerobic Bacteria without the use of Inert Gases.*—The development of anaerobes in fermentation tubes suggested to Dr. Th. Smith their cultivation in flasks. The apparatus depicted in fig. 28 was employed for the cultivation of the tetanus bacillus. There are two bulbs, A and B, connected by a heavy rubber tube C, and with a clamp D to regulate the communication between them. The bouillon ordinarily fills A and the space below the dotted line in B; but during sterilisation it is forced over into B. It is inoculated through the opening at E. The growth will extend around to A within 24 hours. F is a tin rack for supporting the apparatus. Fig. 29 shows a variation in which a litre flask A and a bent 100 ccm.

Fig. 28.

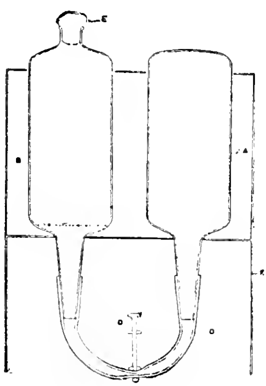
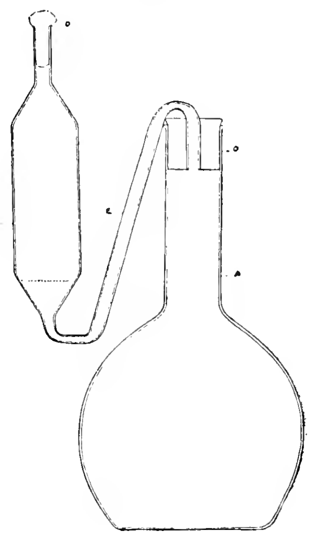


Fig. 29.



pipette B are used. The upper part of the pipette is shortened and plugged with cotton, while the lower part is bent and fitted to the flask with a rubber stopper. The bouillon is inoculated through D, and the growth reaches the flask in 24–36 hours. This form is only partly filled when sterilised, the extra bouillon being autoclaved separately.

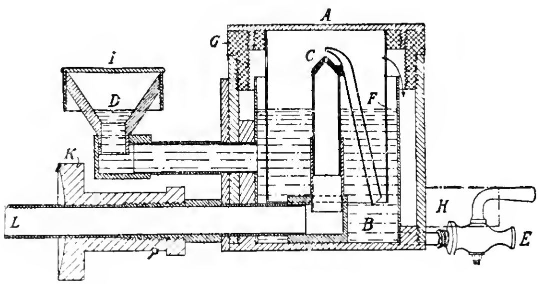
Urine-Gelatin for the Diagnosis of Typhoid.†—Dr. H. Wittich records some observations made on typhoid material with Piorkowski's medium,‡ the results of which indicate that the inventor took a too florid view of the value of urine-gelatin for diagnostic purposes. The author has found that, while the appearances of typhoid are as described by Piorkowski, other forms present the same appearances. As a cultivation medium for typhoid its value is highly appreciated.

* Journ. Bost. Soc. Med. Sci., iii. (1899) pp. 340–3. See Journ. App. Micr., ii. (1899) p. 572 (2 figs.).
† Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 390–6.
‡ Cf. this Journal, 1899, p. 348.

(2) Preparing Objects.

Delépine Ether Freezing Box.—This is an auxiliary of the Delépine microtome described on p. 128, and is also brought out by Messrs. R. and J. Beck. Although it has been in use for over sixteen years, it has not previously been described. The arrangement of the parts is so designed that the specimen to be cut will remain frozen for a much longer time after ceasing to work the bellows than is usually the case. Scarcely any ether is wasted, as the unevaporated and recondensed ether drops back into the reservoir, the only waste being that which passes out with the air; moreover, an object as large as 2 in. in diameter can be successfully frozen, thus enabling such a specimen as a whole eye to be cut into sections without any difficulty. The ether is introduced into the main chamber by unscrewing the funnel cap D (fig. 30), and the box B may be replenished, if required, during use. The bellows are attached to the end of the tube L, which communicates directly with the nozzle C; the distance of C below the freezing plate A is adjustable, so

Fig. 30.



that the ether may be sprayed over a large or small surface, according to the size of a section under the knife. After a few minutes' working the whole of the ether in B will become almost as cold as the freezing-plate; and to utilise this cold as much as possible, a tube F fixed to the freezing-plate passes down into the ether as in B, and thus equalises the low temperature over the whole of the large plate A much more efficiently than could be the case if only a single point were the source of the cold. The freezing-plate A and the tube F are insulated effectually from the rest of the metal-work by the solid vulcanite carrier G. The various parts are detachable for convenience of cleaning. The air from the bellows, after issuing from C, passes with its ether vapour through holes in the top of the tube F, and thence out of the box by the tube K. Any superfluous ether, as well as the water separated from the ether, may be drawn off by means of the tap E.

Microtechnique for the Study of Sponges.*—Dr. E. Rousseau communicates a summary of the procedures employed by him in the study of sponges. The first two steps are the same for the three kinds, Calcareous, Horny, and Siliceous:—(1) Thin little bits are removed

* Ann. Soc. Belge Micr., xxiv. (1899) pp. 49–56.

from the deeper parts. (2) These are placed in absolute alcohol, which is renewed several times for two days.

Calcareous sponges. (3) Overstain with aqueous 1 per cent. solution of nigrosin (2 days or more). (4) Frequent washing in 90° alcohol (1–2 days). (5) Absolute alcohol, 1 day. (6) Absolute alcohol and ether in equal bulks for 1/2–1 day. (7) Immersion in celloidin for several days. (8) Imbed in celloidin, hardening with chloroform vapour. (9) Place the blocks in 80° alcohol. (10) Decalcify (1–2 days) in the following mixture: alcohol (90°) 100 parts, nitric acid 20–50 parts. When the blocks cut easily, decalcification is complete. (11) Remove the excess of acid by means of powdered chalk. When the chalk no longer dissolves, the acid has been neutralised. (12) Wash in 85° alcohol. (13) Section. (14) Treat the sections successively in 90° alcohol and absolute alcohol, clear in origanum oil, and mount in balsam.

Horny sponges. (3) Absolute alcohol and ether in equal parts (1/2–1 day). (4) Saturate with celloidin (several days). (5) Imbed in celloidin, hardening with chloroform vapour. (6) Cut into blocks and keep in 80° alcohol. (7) Section. (8) Stain with Mayer's picro-magnesia-carmine, picronigrosin, indulin, or Mayer's carmalum. (9) Wash the sections successively in distilled water, 90° alcohol, and absolute alcohol, clear in origanum oil, and mount in balsam.

Siliceous sponges. (3) Absolute alcohol and ether in equal parts (1/2–1 day). (4) Saturate with celloidin (several days). (5) Imbed in celloidin, hardening with chloroform vapour. (6) Cut into blocks and preserve in 80° alcohol. (7) Desilicify for one or more days in the following mixture: 90° alcohol 100 parts, hydrofluoric acid 20–40 parts. The vessels in which this stage is carried out must be made of gutta-percha, or if of glass must be coated with paraffin. (8) When the blocks cut easily, remove the excess of acid by repeated washings in 85° alcohol renewed frequently during several days. (9) Section. (10) Stain with Mayer's picro-magnesia carmine, picronigrosin, indulin, or with Mayer's carmalum; the sections must be kept in 90° alcohol, frequently renewed, before they are stained. (11) Wash successively in distilled water, 90° alcohol, and absolute alcohol, clear in origanum oil, and mount in balsam.

The procedure of other observers is noticed by the author, but only the remarks relative to impregnation with gold and silver need be quoted here. By means of chloride of gold, nervous formations are easily demonstrable in many sponges. Impregnation with silver nitrate shows up the limits of the endothelial cells, and the remains of the formative tissue on the sheath of the spicules. In order to effect this impregnation, the fragments must be previously immersed in a 5 per cent. solution of nitrate of potash for half an hour to remove the chlorides. It is possible to stain the silver preparations afterwards with picrocarmine.

Whey-Gelatin with High Melting-point.*—Dr. O. Appel prepares a whey-gelatin which does not melt easily in the following way. 1 litre of separated milk is heated in a water-bath to 40°, some rennet added and left till it clots. It is again heated, the water-bath being kept on the boil for 1/4 hour, after which it is sieved to separate the whey from

* Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 76-8.

the curd. The whey is then mixed with 1000 grm. water, 100 grm. gelatin, 10 grm. pepton, and 5 grm. salt, and the solution sterilised for half an hour at 105°. After removal from the autoclave, the solution is filtered through paper into previously sterilised vessels.

If separated milk is not obtainable, skim milk may be used, but then greater care is required for sterilising.

Improved Method for Detecting Bacillus typhi abdominalis in Water and other Substances.*—The extensive experience in India of Mr. E. H. Hankin has enabled him to develope a method for isolating typhoid microbes from water and other substances, which appears to be successful in many difficult cases. The procedure is not altogether new, but is rather a modification of methods which have been long in vogue. To give the method in full detail as narrated by the author would require too much space, and it will be sufficient to indicate the essential feature of the modification. The author's experience is that "if tubes containing smaller quantities of Parietti's solution than the maximum permitting growth are chosen, there is a far better chance of isolating the microbe" than if the tube containing the greatest number of drops, and which has become turbid after 24 hours, be selected. It is possible that the method would give better results if the Pasteur-Chamberland filter were used to concentrate the water.

Formalin as a Reagent in Blood Studies.†—Mr. E. J. Kizer has found formalin a useful reagent for demonstrating the structure of blood-corpuscles, as it produces no appreciable distortion, does not interfere with staining, and is an excellent preservative. One volume of fresh blood is mixed with three volumes of 2 per cent. formalin, and, after standing for an hour, a drop is pipetted from the sediment to a cover-slip, and, having been spread evenly, the film is allowed to dry by evaporation. The slips are next fixed on the flame, and then dipped once or twice into a 5 per cent. solution of acetic acid. The acid is removed by water, and the film stained in 2 per cent. gentian-violet solution; methyl-blue and gentian-violet; hæmatoxylin and eosin; methyl-green and safranin, or Ehrlich's triple stain. Excess of stain is removed by water or alcohol as the stain requires. Lastly, clove oil or xylol and balsam.

(3) Cutting, including Imbedding and Microtomes.

New Delépine Microtome.—This instrument, brought out by Messrs. R. and J. Beck, was invented by Prof. Delépine some eighteen years ago, and its details have been from time to time perfected and improved by him. It may be used for cutting tissues imbedded in paraffin or in celloidin, and is specially intended for cutting sections of frozen tissues (see p. 126) previously imbedded or not imbedded in celloidin. It claims certain marked advantages over other microtomes, including:—(1) The extreme rigidity both of the razor and of the object; (2) the unusual strength of its construction, and its durability; (3) the simplicity and delicacy of the raising motion of the object-holder; (4) the automatic arrangement for regulating the thickness of

* Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 554–60.
† Proc. Indiana Acad. Sci., 1898, pp. 222–3.

sections; (5) the rapidity of use in cutting large numbers of sections of uniform thickness for class purposes; (6) the new and greatly improved ether-box; (7) the large size of the section that can be cut;

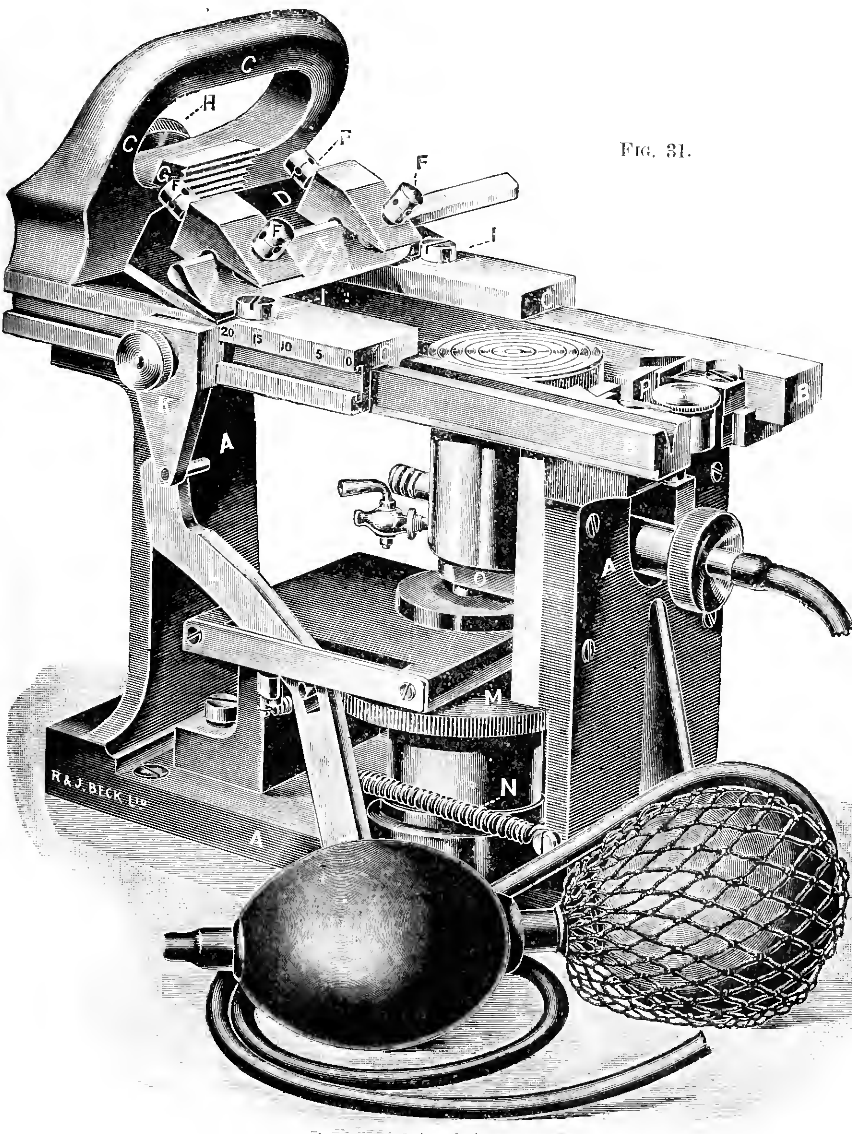


FIG. 31.

(8) its adaptability to various microtomic processes. The stability of the instrument is indicated by the fact that it weighs 24 lb. complete.

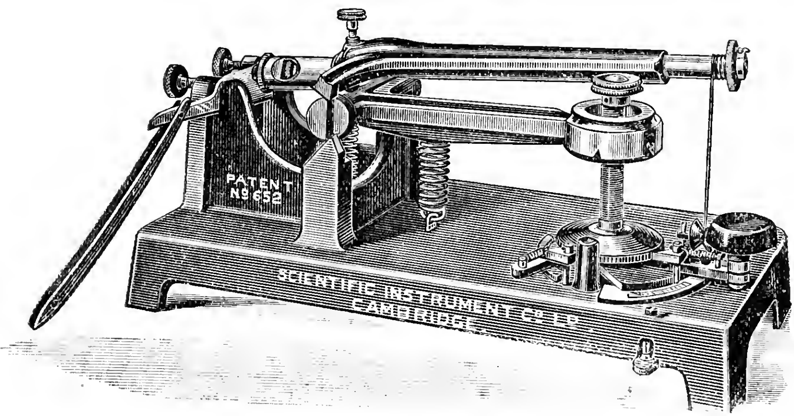
The frame A (fig. 31) is made of cast iron, and is screwed down to the bench by four screws; but it may, if preferred, be merely fastened by clamps. On the upper portion of A, at a height of $6\frac{1}{2}$ in. above the table, two parallel rails B are fixed, and upon these, which are $9\frac{1}{2}$ in. long, the razor-carriage C travels. The process of fitting the razor-carriage has been adopted by Prof. Delépine after many trials, and is that employed for the saddle of the best American lathes. On one side the rail has a V-shaped depression, the razor carriage being provided with a similar projection along its entire length to fit into it. The bottom of this groove is cut away so that, even when the sides have been somewhat worn with constant use, the V-shaped projection still rests evenly on its two sides and does not touch the groove with its point. On the opposite side the carriage has a perfectly flat surface which slides on a similarly flat rail; thus the only points at which the carriage touches the rails are the two edges of the V on one side and the flat surface of the rail on the other. The carriage overhangs the rails by both side and under pieces; the latter prevent it from being lifted off the stand at any point of stroke; but as these are not made to fit they do not interfere with the perfect sliding of the carriage. The carriage is made of one solid piece of gun-metal, and is pushed backwards and drawn forwards by means of the upper portion, which is in the form of a handle; its heavy weight and the pressure of the operator's hand hold it firmly on the rails.

The razor-holder D, with its two jaws, is really an adjustable portion of the razor-carriage, and is made of one solid gun-metal casting; this is necessary to ensure the rigid holding of the razor E by the four set-screws F, two of which clamp the razor down on its carrier, and the other two clamp it from behind. The razor can be adjusted at various angles by means of the serrated movable piece G, which is pressed against the carrier D by means of the thumb-screw H. Thus, if it is necessary for the razor to be at a steep angle to the object, the carrier D is tilted upwards and clamped with its edge in the top groove of the piece G against the two screws I on the carriage. The razor-carrier D can be made in such a manner that the knife may be set at an oblique angle if specially ordered. These valuable adjustments in no way decrease the rigidity of the razor.

In the right-hand side of the knife-carriage is a dovetailed slot in which there slides a projecting piece K terminating in a pin, which at the return of each stroke impinges against a lever L, and this, in its turn, transmits the motion to the ratchet wheel M. The scale on the side of the carriage indicates the number of ratchet teeth moved at each stroke of the lever, and the projecting piece is clamped against the desired number. The scale extends to twenty; there are 250 teeth on the circumference of the ratchet wheel, and one complete revolution raises a micrometer screw through half a millimetre; thus one tooth represents a raising of the object to the extent of 2 μ. This screw presses against the projection O of the dovetailed rising slide P, and by this means the raising and lowering motion of the object is attained. The lever L is brought back after each movement by the spring N. It will be noted that the object is only raised after the section has been cut and the knife withdrawn. The dovetailed rising slide P, with its projection O, takes either a clamp for imbedded objects or the special Delépine freezing box; these are clamped on to it by the aid of a strong milled head, and can be withdrawn through a slot in the top of the fitting P, when they pass out through the rails.

Cambridge Rocking Microtome, 1900 Pattern.*—The Cambridge Scientific Instrument Company have recently introduced some new features and modifications in their well-known rocking microtome, and for the new pattern (fig. 32) the following advantages are claimed:—increased rigidity, impossibility of tearing sections on the upward movement of the object, impossibility of cutting thick and thin sections,

Fig. 32.



graduated arc for showing the thickness of the sections, catch for holding object above the razor edge, improved method of fixing the cord. The tearing of the sections is obviated by a simple device, by means of which the object is drawn backward before the upward movement begins. The older instrument not infrequently cut sections of variable thickness, but the new pattern is free from this defect. The new instrument is fitted with an orienting object-holder of an improved design; it is simpler than the old pattern and certain in its action.

(4) Staining and Injecting.

Flagella and Capsule Staining.—Mr. N. Morton † gives the following modification of McCrorie's night-blue method. Slides are used in preference to cover-slips. They are washed, bathed in 25 per cent. nitric acid, and kept in methylated spirit. A 24 hours surface-agar culture is used. A small portion is suspended in a few drops of tap water. The suspension is best made by agitating the watch-glass until the germs spread out through the water. A drop or two of the suspension

* Descriptive pamphlet from Cambridge Scientific Instrument Company, 1900. See also Nature, Nov. 30, 1899.

† Trans. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 242–3.

is placed on the slide, and made to spread over the surface by turning the slide about—not by using the needle. Excess is removed with blotting-paper, and the films are allowed to dry at room temperature. The film is not fixed. The stain is made by dissolving 1 grm. of tannic acid, 1 grm. of potash-alum in 40 ccm. distilled water, and adding 0·5 grm. of night-blue dissolved in 20 ccm. of absolute alcohol. The precipitate is removed by filtration, and the filtrate is the stain. The slides are stained for 2 minutes and then washed in running water. Only the flagella are stained, and in order to show up the body of the cell a contrast stain is used. Anilin-water-gentian-violet gives a good contrast.

As the night-blue staining is caused by precipitation, it is advised to filter the solution on to the slide; or the preparation may be over-stained and decolorised in dilute alcohol. The results obtained by this process are better and more certain than those of any other method yet described.

Mr. A. Moore * states that night-blue is very effective for staining capsules, e.g. *Diplococcus pneumoniæ*, *Pneumobacillus*, and *M. tetragenus*. A thin film of liquid serum culture is spread on a slide, dried, fixed with dilute acetic acid, and washed with distilled water. The preparation is then stained with carbol-fuchsin for about a minute, washed again, and dried. The night-blue stain is then applied for one or two minutes, aided if necessary by gentle heat, then washed and dried.

New Method of Flagella Staining.† — Dr. E. Welcke adopts the following procedure for staining flagella. The agar culture should be less than 24 hours old; the bacteria should be killed with 4 per cent. formalin or 1 per cent. osmic acid solution. The film is fixed by heat, and when cold mordanted with Loeffler's or Bunge's fluid, diluted to from 1 to 4 or 1 to 20. After washing and removing the water, the preparation is treated with silver oxide-ammonia solution and heated until it begins to brown. After having been washed, it is immersed in 1 per cent. $HgCl_2$ solution for 1/4 minute. It is again washed, and the treatment with silver-oxide-ammonia solution repeated for 1, 2, or 3 minutes. It is washed again and treated with rodinal- or menthol-developer for 1/4 minute. It is then washed and dried.

Demonstrating the Structure of Bacteria.‡ —Mr. S. Rowland, for his observations on the structure of bacteria, selected rosein, as this stain is extremely soluble, innocuous to the organisms examined, and possesses a distinctive and constant differential staining power for certain parts of the bacterial cell. A drop of the culture is placed on a slide and surrounded with droplets of stain, and then mixed together with a needle. A cover-glass is then superposed. With a little practice the amount of fluid between the glasses was so graduated that, while movement was prevented, crushing was avoided. Plasmolysis did not occur if the precautions were properly adhered to.

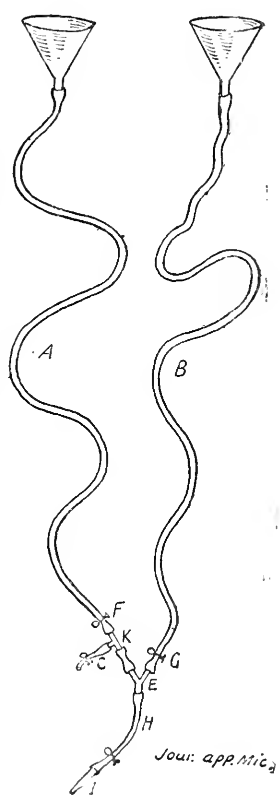
In order, as far as possible, to avoid errors of interpretation, the violet

* Tom. cit., p. 244.
† Arch. f. Klin. Chirurgie, lix. (1899) pp. 129–40 (4 figs.).
‡ Trans. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 143–60 (1 pl.).

end of a wide cone of light was used. The light, before entering the condenser system, was passed through a Gifford's screen, and in this way the image was much improved. This screen is made by dissolving methyl-green in hot glycerin, placing the solution in a glass tank, and immersing in the liquid a piece of Chance's signal-green glass. If constructed with care the red end of the spectrum may be cut off to the line F. Another use of this screen is that even unstained organisms may be examined, and with comparatively wide illuminating cones.

Neisser's Stain for the Diphtheria Bacillus.*—Dr. R. T. Hewlett describes Neisser's diagnostic stain for the diphtheria bacillus. (1) One gram of methylen-blue (Grübler) is dissolved in 20 ccm. of alcohol (96 per cent.), and mixed with 950 ccm. of distilled water and 50 ccm. of glacial acetic acid. (2) Two grams of vesuvin are dissolved in 1000 ccm. of boiling distilled water, and the solution cooled and filtered. Cover-glass preparations are stained in (1) for 1–3 seconds, rinsed in water, counter-stained in (2) for 3–5 seconds, washed in water, dried, and mounted in balsam. The bacillus appears as a slender longish rod stained brown, and generally containing granules of a deep blue or inky tint. There are usually two granules, one at each pole, and occasionally a third in the middle.

Fig. 33.



Histological Fixation by Injection.†—Mr. F. M. McFarland describes a simple apparatus for injecting small animals with a fixative solution. The apparatus (fig. 33) consists of two glass funnels connected with the arms of a Y-tube by rubber tubing. The leg of the Y-tube connects, also by means of rubber tubing, with a cannula which, of course, may be of any size. The main tube A has a lateral tube C for removal of air-bubbles. All the rubber tubes are supplied with pinch-cocks. The tube B is filled with normal saline solution warmed to body temperature, and to it are added a few drops of lactic acid or amyl nitrite to ensure dilatation of the blood-vessels. The tube A is filled with warm fixative solution, e.g. Zenker's. The cannula having been introduced into the aorta, say, of a kitten, the vascular system is first flushed with the saline solution, and when the blood has been removed the fixative in A is run through. The pressure, of course, will vary according to the height the funnels are raised.

* Trans. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 201–6.

† Journ. App. Micr., ii. (1899) pp. 541–2 (1 fig.).

Staining and Fixing Spore-mother-cells of Anthoceros.* — Mr. Bradley M. Davis makes the following notes on various processes in the case of this representative of the Hepaticæ.

Chromacetic acid fixes filarplasm, but the safranin stains diffusely after it, and gentian-violet does not hold well in the spindle-fibres. If sections fastened to the slide are left several days in weak Flemming, the staining qualities with safranin and gentian-violet are much improved. Merkel's fluid (1 per cent. chromic acid 12 ccm., 1 per cent. platinum

Fig. 34.

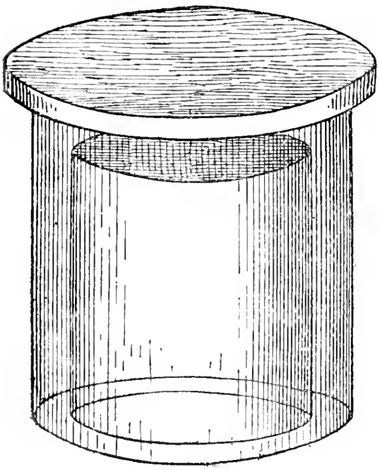
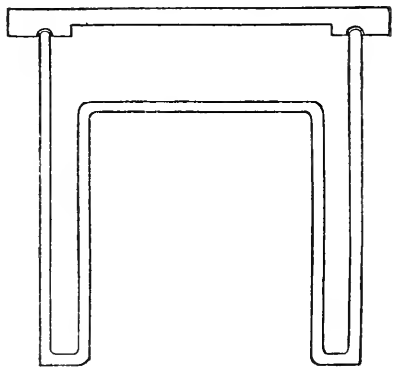


Fig. 35.



chloride 12 ccm., water 72 ccm.), even when used for long periods (36 hours), is thoroughly unsatisfactory; the spindles are badly fixed. Boveri's picro-acetic acid gives beautifully bleached tissue, but achromatic regions are not clearly differentiated, although chromatic elements stain well. Sublimate-acetic (5 per cent. glacial acetic acid in saturated solution of corrosive sublimate) is not good; nuclear membranes and filarplasm are very poorly preserved. Hermann's fluid is very much like Flemming's in its effects, and is thoroughly satisfactory. The osmic acid of the Flemming's and Hermann's mixtures appears to give them certain advantages over all other fluids.

Photochemical Methods of Staining Mucilaginous Plants.†—Mr. A. Lundie stains mucilaginous plants by the chromatype method, using a saturated solution of potassium bichromate mixed with one-twentieth of its volume of saturated cobalt nitrate solution. A piece of an alga, *Batrachospermum* for example, is suspended in this mixture in a glass tube, and exposed to diffuse daylight for 30 minutes. It is then transferred to a slide, treated with silver nitrate solution, and again exposed to light for five minutes. The nitrate is now removed, and an

* Bot. Gazette, xxviii. (1899) pp. 105–6. Cf. *supra*, p. 88.
† Trans. and Proc. Bot Soc. Edin., xxi. (1899) pp. 159–62.

ammonium chloride solution added and allowed to remain until all the chromate has become converted to chloride. The completion of this reaction is marked by the disappearance of the characteristic red coloration of silver chromate. The surplus liquid is now dried off with cigarette paper, and the excess of silver chloride removed by sodium thiosulphate solution. After thorough washing, the preparation is either mounted in glycerin, or, after dehydration by absolute alcohol, in Canada balsam. The staining is uniform throughout, the colour is yellow, and the outline of the mucilage is quite sharply marked off.

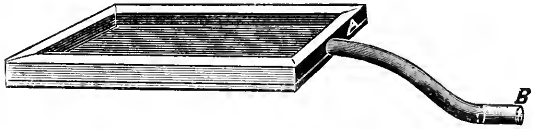
Mucilaginous plants, *Batrachospermum*, *Rivularia*, &c., may be coloured by first impregnating with bichromate and then treating successively with silver nitrate and sodium chloride solutions. The application of this process to seaweeds indicates a method of determining the distribution and the chemical nature of salts present in the tissues of these plants.

Convenient Staining Dish.*—Mr. J. H. Schaffner has designed a staining vessel (figs. 34, 35) which combines the advantages of the Stender dish and the staining dish made by placing a number of crystallising dishes inside each other. It is made of white glass 2 mm. thick. The inside height is 80 mm., of the central part 60 mm.; the internal diameter 80 mm.; diameter of central column, 68 mm. The cover should be 6 mm. thick around the edge, which is grooved so as to fit accurately to the top. The dish will hold eight or ten slides at a time.

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

Apparatus for Removing Air-bubbles from Mounts.† — Mr. J. H. Cooke describes an exhaust apparatus for removing bubbles from mounts (fig. 36). It consists of a slip of plate glass 4 in. by $1\frac{1}{2}$ in., to which is cemented a wooden frame of such a size as to allow ordinary slides to be placed in it. In one side of the frame is bored a hole, and into this is cemented one end of a rubber tube, 6 in. long and 3/16 in. in diameter. A piece of glass tubing B, 1 in. long, closed at one end, and having a small hole at about a quarter of an inch from the closed end, is inserted

Fig. 36.



in the free end of the rubber tube, and so arranged that the hole shall just be covered by the rubber, and the closed end outwards. To use the apparatus, the mount is placed in the cell and covered with a second piece of glass of the same size as the first, and the edges of which have been greased with tallow. If the frame have been properly made the cell will now be air-tight. Exhaust the cell by drawing air through the tube. The valve formed by the hole will prevent the re-entrance of air, and any air-bubbles in the mount will quickly disappear.

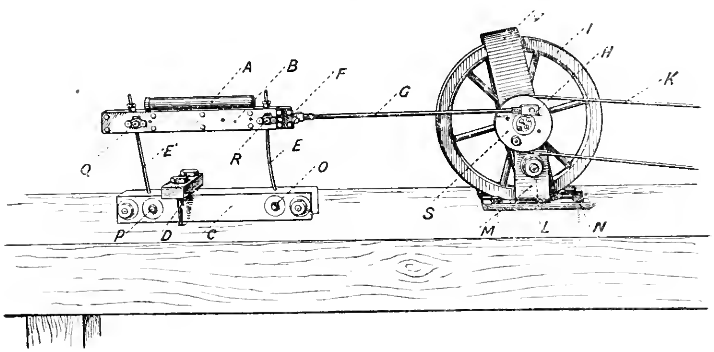
* Journ. App. Micr., ii. (1899) p. 559 (2 figs.). † Tom. cit., pp. 621–2 (1 fig.).

(6) Miscellaneous.

Method for Ascertaining Frequency of Pathogenic Microbes in Air.*—Dr. E. Concornotti exposed glycerin-agar surfaces in Petri's capsules for different lengths of time to the air in various places and spaces. The capsules were then incubated for 24 hours at 37°. Sterilised water was then run over the plate, so as to obtain an emulsion of microbes. Some of this emulsion was examined microscopically in order to obtain a rough estimate of the kinds of organism present. With other portions rabbits were intravenously and intraperitoneally infected. The intravenous method was very successful in discovering pathogenic germs. and seems especially suitable when their virulence has been lowered. Pathogenic bacteria were most frequent in, or in the vicinity of dirty places, and their order of frequency was found to be *Staphylococcus pyogenes aureus*, *St. pyogenes albus*, *Bacillus coli communis*, *Diplococcus pneumoniæ*.

Apparatus for rapidly Disintegrating Micro-organisms.†— Mr. S. Rowland describes an apparatus for obtaining the cell-contents of micro-organisms. A mass of the organisms together with quartz sand and steel

Fig. 37.



balls are placed inside the steel tube A (fig. 37), which is closed at both ends and rigidly fixed to the aluminium frame B. The frame is caused to oscillate horizontally by means of the rod G and the crank-pin H. Two steel rods E, E′ support B, and parallel motion is allowed by means of the joints Q, R, P, O. C is a steel frame clamped to the table by D. Motion is given to the crank-wheel S by the cord K, driven by an electro-motor. The axle of S runs in bearings supported in the frame J, and carries a fly-wheel I. The frame J swings about the stud L, carried in a pair of angle-pieces M, and bolted to the table by N. This arrangement allows easy adjustment of the cord K for tension. At 3500 revolutions a minute, tubercle bacilli are disintegrated in 10 minutes.

Contact Negatives for the Comparative Study of Woods.‡ — Mr. R. A. Robertson describes how he gets large sections of woods on a

* Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 492–501 (2 figs.).
† Trans. Jenner (late British) Inst. Prev. Med., ser. ii. (1899) pp. 250–1 (1 fig.).
‡ Trans. and Proc. Bot. Soc. Edin., xxi. (1899) pp. 162–5 (1 pl.).

single sensitive plate which can be used directly as a lantern slide, or as a negative for ordinary prints. The materials used were typical blocks which had been seasoned ten, fifteen, or more years. From these thin hand-plane sections were prepared. The sections, about 6 in. long by 2 or 3 in. broad, were immersed for 24 hours or more in a mixture of absolute alcohol and glycerin, and were kept flattened out under a glass plate. They were then stained with aqueous solution of Bismarck-brown or orange G. The sections were toned in weak spirit, dehydrated in absolute alcohol, and cleared in oil of cloves; eventually mounted in balsam. If mounted in glycerin jelly, the sections were passed from alcohol to a mixture of absolute alcohol and glycerin, and then to pure glycerin.

Thus prepared, the sections are used as negatives for direct contact printing with lantern slides. A plate of glass is fitted into an ordinary printing frame, and on this the series of wood-sections is

Fig. 38.

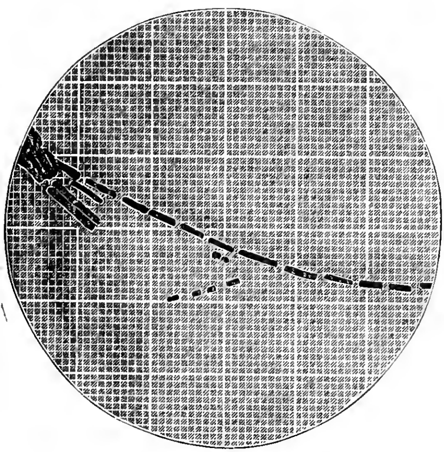
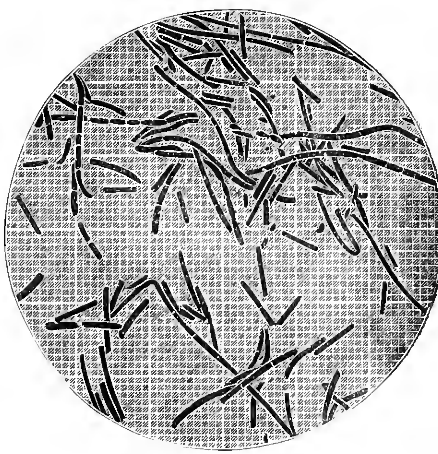


Fig. 39.



arranged in a thin layer of oil of cloves or of glycerin. In the dark room an ordinary lantern slide is placed in contact with these, and clamped down firmly so as to expel air-bubbles and keep the surfaces uniformly in contact. The plates were exposed to gas-light, the time varying with the intensity. After exposure the plate was washed in alcohol followed by water, or in water only in the case of glycerin preparations. The plates were Ilford and the developer hydroquinon; better results were obtained with weak or used developer than with a strong solution.

Antibacterial Action of Acrolein.*—Dr. E. Koch and Dr. G. Fuchs record some experiments with acrolein, which chemically belongs to the class of aldehydes and is therefore related to formaldehyde. The microbes tested were *B. pyocyaneus*, *B. coli*, *Staph. pyog. aureus*, and

* Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 560-3.

Staph. pyog. albus. The results of the experiments are regarded as satisfactory in respect to the antibacterial and disinfecting properties.

Measuring Bacteria.* — Dr. E. H. Wilson and Mr. R. B. F. Randolph describe a simple and accurate method for measuring bacteria by means of photography. The photographic apparatus is adjusted for an amplification of 1000 diameters, by measuring the magnified image of a stage micrometer on the ground-glass screen (figs. 38, 39). "A drawing is made of a convenient size by ruling with ink two sets of equidistant lines at right angles to each other, each tenth line being somewhat heavier than the others; this drawing should be at least four times the size of the negative to be prepared from it, in order to secure the requisite fineness of the lines. The drawing is then reduced by photography to such a size that the rulings are exactly one millimetre apart. The negative so obtained is the scale used. The image of this scale is superposed on the image of the photomicrographic negative by a process of double printing, the photomicrographic negative being printed first, and the scale afterwards on the same paper, or *vice versa*. The amplification being 1000 diameters and the scale being in millimetres, the reading is directly in micromillimetres."

* Journ. Applied Microscopy, 1899, pp. 598–9 (2 figs.).

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on the 20th of December, 1899, at 20 Hanover Square, W., The President, E. M. Nelson, Esq., in the Chair.

The Minutes of the Meeting of November 15th 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 Society were voted to the donors.

	From
Creighton, Chas. Researches on Glycogen. Part II. (8vo, London, 1899)	*The Author.*
Macbride, Thos. H., The North American Slime-moulds. (8vo, New York and London, 1899)	*The Publishers.*
Quaintance, A. L., Some Important Insect Enemies, being Bull. 45 of the State College of Agriculture and Mechanic Arts, Georgia	*The Author.*
Rio, Dr. Luis del, Elementos de Microbiologia. (8vo, Madrid, 1899)	*The Author.*
Festschrift zur Feier ihres fünfzig-jahrigen Bestehens, herausgegeben von der Physikalisch-Medizinischen Gesellschaft zu Würzburg. (4to, Würzburg, 1899)	*Die Physikalisch-Medizinische Gesellschaft zu Würzburg.*
A Gillett Substage Condenser with Adjustment	*The President.*
A Model of Reichert's New Fine-Adjustment	*Ditto.*
Two Slides of *Salix Wallichiana*	*Mr. Frank Gleadow.*

Mr. Conrad Beck exhibited and described a new microtome made for Prof. Delépine upon the principle of one which he had used for a number of years, but which had never, he believed, been publicly shown. The chief feature of this instrument was the extremely heavy knife-carrier, made of solid metal which slid along the bed-plate on two bearings, one being V-shaped and the other flat. It moved along these quite freely, the weight and method of mounting preventing it from easily getting off its bearings. This carried another piece of solid metal, upon which the knife was clamped at any desired angle to the direction of the movement. The thickness of the sections to be cut could be regulated by means of a ratchet wheel, each tooth of which represented $2\,\mu$, at the bottom of the stand, and when set it worked automatically, raising the object the given distance each time the knife-carrier was drawn back. The ether box was made on a plan which it was claimed used up less ether than any other similar box in the market, and the water which was always deposited with the spray fell back into the ether and helped to cool it. The spread of the spray could also be regulated to cover any required area, and the supply of ether could be replenished if necessary whilst the machine was in use. It was remarkably efficient in use, and when clamped down firmly to a table, sections could be cut with great rapidity, and the accumulation of these dropped into a vessel placed in front to receive them (see pp. 126, 128).

Dr. Hebb said he had not sufficient opportunity of examining this instrument to be able to say much about it, but so far as he could form an opinion, he should think it would be a very useful piece of apparatus in any large laboratory where they were cutting sections all day long. The great weight of the carrier was no doubt a point of advantage.

Mr. Beck, in reply to inquiries, said that Prof. Delépine had been using his microtome for the last 15 years, and it was still in very good condition. The price of the instrument exhibited to the Meeting was 10 guineas, with the ether box complete and one knife. The paraffin lamp was 12*s*. extra.

Mr. C. L. Curties exhibited three new instruments by Messrs. Leitz, the first of these being an improved form of Cathetometer with a dividing objective of 5, 9, and 54 centimetre focus, a micrometer scale in the eye-piece, levelling-screws, and spirit-level. The second instrument was a Microscope of the ordinary Continental pattern, but made with an extra large stage, and the upright carrying the body attached by means of a bracket-piece so as to considerably increase the distance between the pillar and the optic axis. The third was a Microscope of entirely novel construction, designed especially for the examination of very large sections which were placed on a glass stage mounted upon a frame which could be rapidly moved longitudinally by means of a rack-and-pinion beneath the horizontal bar upon which the Microscope tube was mounted. The tube itself was so fitted as to traverse this bar from end to end by a rapid screw motion, giving a range transversely of about 7 inches. The illumination was by reflection from a rectangular plane mirror beneath the stage. This instrument was intended for use with low powers only, and if required for use as a dissecting Microscope, the compound body could be removed and a simple lens substituted (see pp. 108–110).

The President expressed the thanks of the Society to Mr. Beck and Mr. Curties for these exhibits. Remarking upon the novelty of the last form of Microscope exhibited, he said, if these things went on growing larger they might expect one day to see something fitted with an overhead travelling crane so as to carry an object as large as the whole human body!

Dr. Hebb said they had received another paper from Mr. Millett, being Part VII. of his description of the Foraminifera of the Malay

Archipelago. As in the case of those which preceded, it would be taken as read, and published in the Journal.

The President said the Council had, after careful consideration, adopted some standard sizes for eye-pieces and substage fittings, particulars of which will be given in the Journal. The standard sizes were the inside diameters of the tubes, into which the eye-pieces and substage apparatus were to fit, and it would be left to the makers to determine how tight or how loose the eye-pieces should fit into the tubes. Sets of plug and ring gauges would be provided of these standard sizes, which would be open to public inspection. No. 1 was that of the Continental draw-tube. No. 2 was a larger size used by the Trade in England for small Microscopes of inexpensive character, the Continental size being found too small to give a sufficiently large field with low powers. No. 3 was the size which had given them the most trouble, as the sizes used in the smaller-sized binocular Microscopes were so various; but as these were found to range from 1·2 in. to 1·35 in., the Council had taken the mean between these sizes and adopted 1·27 in. No. 4 was the largest size that a long-tube binocular Microscope could take. The size of the eye-piece really determined the size of the Microscope, as they would see by the examples upon the table before them, in which the difference between the eye-pieces does not amount to two-tenths of an inch. In coming to a decision on these questions the Council had received very great assistance from the Trade, and they desired to say how greatly obliged they felt for the information and help so given.

Dr. Spitta then gave a demonstration of some of the results obtained by him in the course of his practical work in Photomicrography. In his preliminary remarks he explained that the subject might be divided into three sections:—low-power work, in which a Microscope cannot be used, with powers ranging from 1½ to 10 diameters; medium-power work, with the Microscope and powers from 10 to 600 diameters; and high-power work above 600, which was called critical photography. The term "covering power" he fully explained, and showed its importance, especially with low powers. A remarkably fine series, consisting of nearly 100 lantern slides, was then shown upon the screen, each being accompanied by a brief description of the special points of interest in connection with the subject, and the method or lens with which the picture had been taken. The examples shown in illustration of work with quite low powers comprised insects, spiders, plant sections, echinus spines, &c., some of which were taken in duplicate to show the comparative merits and different objectives employed—those pictures produced by the planar being conspicuously fine. Under medium-power work some excellent photographs were also shown of portions of insects; lancets and other mouth-organs being amongst the best of the series. How to photograph thick specimens was explained, the sections of kidney and of nerves being extremely well shown; but perhaps the greatest interest was shown in some unique views of *Filariæ* in the blood-vessels of the human lungs, and in the bodies of the mosquitoes which had drawn them up with the blood they had sucked. Some successful attempts at instantaneous photomicrography of the Amœbæ were also shown. As illustrating photomicrography with extremely high powers, a series of slides of the usual test objects was shown, such as *Podura* scale, up to × 2500, *Pleurosigma angulatum* up to × 2200, and *Amphipleura pellucida* up to × 4250—the highest ever taken direct by the lecturer with a lens lately made by Powell. The finest and most interesting pictures shown in this section were undoubtedly those of bacteria which had been stained and photographed through coloured screens, the use of which was duly explained. These included the specific organisms of diphtheria, bubonic plague, cholera tubercle, and typhoid. The action of phagocytosis was also admirably showu.

The lecturer remarked that the 1/8 apochr. N.A. 1·40 by Zeiss was, he believed, the finest lens in the world; other makers might equal it, but none, in his opinion, had ever surpassed it. Although he had shown such fine results with Powell's lenses, these two great firms held the apochromatic world under their thumbs, and merited the warmest thanks of all microscopists. Notwithstanding this, he had shown some very good work that could be done with low powers by Beck, and especially by the photo-corrected series by Wray.

Owing to the lateness of the hour at which the exhibition concluded, it was not found possible to discuss the many interesting points which had arisen, but the President tendered on behalf of the Society their indebtedness to Dr. Spitta for the very beautiful exhibition he had given them, and also for his extremely interesting explanations.

A hearty vote of thanks to Dr. Spitta was formally put to the Meeting by the President and carried by acclamation.

Dr. Hebb having been obliged to leave the meeting at an earlier period of the evening, Mr. Vezey on his behalf reminded the Fellows that the next meeting would be the Annual Meeting, at which the Officers and Council for the ensuing year would be elected. The nominations for these were as follows:—

President—Mr. Wm. Carruthers, F.R.S.

Vice-Presidents—Messrs. A. W. Bennett, G. C. Karop, E. M. Nelson, and A. D. Michael.

Treasurer—

Hon. Secretaries—Dr. W. H. Dallinger and Dr. R. G. Hebb.

Members of Council—Messrs. J. M. Allen, C. Beck, Dr. R. Braithwaite, Rev. E. Carr, Mr. E. Dadswell, Sir Ford North, Messrs. H. G. Plimmer, T. Powell, C. F. Rousselet, Dr. Tatham, Messrs. J. J. Vezey, and Geo. Western.

Curator—Mr. C. F. Rousselet.

The Council had also appointed Mr. J. M. Allen as Auditor of the Treasurer's accounts on their behalf, and requested the Fellows of the Society to appoint another of their number to act with him.

Mr. G. E. Mainland was then proposed by Mr. Western, seconded by Mr. Rheinberg, and unanimously elected Auditor on behalf of the Fellows.

Notice was then given as to the closing of the Society's rooms during the Christmas Holidays.

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

Mr. C. Baker:—Three Microscopes by Leitz.

Messrs. R. and J. Beck:—The New Delépine Microtome.

New Fellows:—The following were elected *Ordinary* Fellows:—Messrs. Horace Courthope Beck, Oliver T. Elliott, Peter Lawson, Dr. Milton Ashby Nelms, and Mr. Geo. Hy. Jas. Rogers.

ANNUAL MEETING

Held on the 17th of January, 1900, at 20 Hanover Square, W.
The President (E. M. Nelson, Esq.) in the Chair.

The Minutes of the Ordinary Meeting of the 20th December, 1899, were read and confirmed, and were signed by the President.

The List of Donations (exclusive of exchanges and reprints) was read, and the thanks of the Society were voted to the Donors.

	From
The Norwegian North Atlantic Expedition, 1876–78, No. xxv. Zoology: Thalamorphora, by Hans Kiær, No. xxvi. Zoology: Hydroida, by Kristine Bonnevie. (4to, Christiania, Leipzig, London, Paris, 1899)	*Editorial Committee of the North Atlantic Expedition,* 1876–78.
Doct. J. Bapt. De Toni, Sylloge Algarum, vol. iv. sec. ii. Florideæ. (8vo, Padua, 1900)	*The Author.*
The Journal of the Board of Agriculture, vol. vi. No. 3, Dec. 1899. (8vo, London, 1899)	*The Board of Agriculture.*
Anales del Museo Nacional de Montevideo, tomo ii. fasciculo xii. (8vo, Montevideo, 1899)	*Museo Nacional de Montevideo.*

Attention was specially called to the work received from Prof. De Toni as being extremely valuable.

The President said it was with very great regret that he had to announce the death of their Treasurer, Mr. W. T. Suffolk. This information had come to them as a sudden shock, Mr. Suffolk having been present with them at the last meeting of the Society, apparently in his usual health, but died twelve days afterwards from an attack of influenza. He joined the Society in 1863, and had been a worker all the time. His great work, in addition to acting for some years as their Treasurer, was in connection with the slides in the Society's Cabinet, numbering upwards of 7700, the whole of which he had examined and catalogued, and had remounted many hundreds of them which were found to be leaking or otherwise imperfect. The Council had that evening passed a Resolution expressing their great sympathy with Miss Suffolk in her loss, and also acknowledging the gift to the Society of her uncle's cabinet of slides representing his life-work. The Resolution in question was then read to the Meeting, and at the request of the President the Fellows present unanimously endorsed the action of the Council in the matter by show of hands.

The President, having appointed Messrs. C. L. Curties and F. W. W. Baker as Scrutineers of the Ballot for Officers and Council for the ensuing year, pointed out that, in consequence of the death of Mr. Suffolk since the December Meeting, the bye-laws did not permit the Council to print the name of any gentleman on the ballot paper for nomination to the office of Treasurer. In these circumstances the Council had availed itself of its powers under the bye-laws, and had filled up the vacancy by appointing Mr. Vezey, who was intimately acquainted with the accounts of the Society, Treasurer for the time being. Owing to the excellent order in which Mr. Suffolk had left the accounts, Mr. Vezey had, at a very short notice, been able to prepare the balance sheet for audit, and therefore the business of the evening would not be delayed. He now asked those Fellows who approved of the Council's nomination, to fill in Mr. Vezey's name as Treasurer on the ballot paper, and the name of Mr. E. T. Browne for the vacancy among the twelve Members of Council.

Dr. Hebb then read the Report of the Council for the past year, as follows:—

REPORT OF THE COUNCIL FOR 1899.

FELLOWS.

Ordinary.—During the year 1899, 29 new Fellows were elected, 11 have died, 14 have resigned, and 16 have been removed from the list for the non-payment of subscriptions and other causes.

Honorary.—Two Honorary Fellows, the Abbé Comte François Castracane and Surgeon-Major Geo. Chas. Wallich, have died.

The list of Fellows now contains the names of 494 Ordinary, 1 Corresponding, 46 Honorary, and 83 Ex-Officio Fellows, being a total of 624.

FINANCES.

Subscriptions.—These are somewhat larger than those of last year, a special effort having been made to reduce the amount of arrears at the end of the year.

The item of receipts for the sale of Journals is considerably less than that in last year's balance-sheet; this is largely due to a different arrangement with the publishers, referred to in last year's Report, by which the account for 1898 received three half-years' payments.

Investments.—The investments remain the same as for last year, but the sum of 63*l.*, the amount of two compounding fees, has been added to the deposit account, and the amount of the admission fees received during the year will be placed to the same account early in the new year. These sums will be invested as soon as a suitable opportunity presents itself.

JOURNAL.

The Summary of Current Researches in Zoology, Botany, and Microscopy has been continued as heretofore in the Journal during the past year, with the addition of a new feature, or rather the reintroduction of one discontinued since the year 1892, viz. a Bibliography of all papers on Microscopy (including also Microtomes) accessible to the editorial staff, published in this country or elsewhere. It is hoped that this will be useful to anyone investigating any point connected with the structure of the Microscope or with Microscopic Optics. Brief biographical notices have also been given of two distinguished members of the Society who have died during the past year—with one exception the two oldest of our Honorary Fellows—Comte Abbé F. Castracane and Dr. G. C. Wallich. A complete list is given of Dr. Wallich's published contributions to scientific literature; an account of Count Castracane's very numerous papers on the structure and reproduction of diatoms will be found elsewhere.* As a frontispiece we give a reproduction of an admirable portrait of the late Mr. Hugh Powell.

The editorial staff has agreed to continue to work on the same conditions as have existed for the past three years.

CABINET.

Nine slides have been presented during the year:—One slide of Sections of Diatoms, from Mr. F. J. Keeley; Six slides of Clionidæ, from Mr. Jas. Yate Johnson. Two slides of transverse sections of Stem of *Salix Wallichiana*, from Mr. Frank Gleadow.

The card index has been arranged, and it is available for the use of Fellows wishing to refer to the collection; everything known has been recorded on each card, frequently more than is contained on the labels, many of which, especially the older ones, are very defective.

Those to whom the convenience of a card catalogue is unknown are invited to examine it; the system enables any slide to be found with the minimum of trouble, and is well adapted to meet the wants of a growing collection, alterations being made with ease and expedition.

Although a full manuscript subject catalogue is a desideratum, there will now be no occasion for undue haste; the work must occupy considerable time and be the work of many hands, and now the heaviest part of the work has been accomplished it is to be hoped that volunteers will be found to assist in those subjects with which they are familiar; such aid will be gladly received by the Council.

The slides existing at the time of the present revision have been numbered consecutively, preceded by the initials "O.C." (old collection); since that period the system advised by Prof. F. J. Bell, our late Secretary, has been adopted. Each slide now bears a date as its register mark. The advantage of this is obvious; the slide itself, in the absence of other records, furnishes the means of investigating its history, and removes a difficulty only too well known during the work on the old collection.

The examination of the diatoms by Mr. T. Comber has been completed. Too much cannot be said in praise of his thorough investigation. The results are embodied in the valuable notes appended to the list supplied to him. These papers have been bound and kept for reference, and his notes have also been copied on to the cards.

The valuable collection presented by the late Dr. G. C. Wallich has not at present been completely examined. In addition to the slides, some note-books and other manuscripts, and a volume of drawings, are in the possession of the Society. The whole donation represents the life work of our late Honorary Fellow. The aid of one of our Fellows acquainted

* See *La Nuova Notarisia* for January 1900.—Ed.

with the work of the late Dr. Wallich would be acceptable to the Council.

The number of slides in the Cabinet now amounts to 7699.

The printed catalogue published in 1865, edited by the late R. J. Farrants, contains 1300 slides.

INSTRUMENTS AND APPARATUS.

During the past year the President has made a careful examination of the various eye-pieces and other apparatus in the collection, and has classified these with the Microscopes to which they belong.

Pending the conclusion of this work, not much progress has been made with the Catalogue, but it has now been taken in hand, and will be completed during the coming Session.

Messrs. Powell, Beck, and Baker have very generously and kindly cleaned all the objectives in the collection free of all charge, and the apparatus is now in very excellent condition.

The following additions have been made to the collection during the past year:—

February 15.—An old Microscope (No. 33) and a 1/4-in. Objective by Andrew Ross. Presented by Messrs. W. Watson and Sons.

April 19.—An old Microscope by Adams. Presented by Mr. J. M. Offord. An old Microscope, attributed to Benjamin Martin. Presented by Dr. W. H. Dallinger.

July 21.—A 1/8-in. Objective (1838) by Andrew Ross, made for the late Prof. Lindley. Presented by the Right Hon. Sir Nathaniel Lindley, Master of the Rolls.

October 18.—A Gillett Condenser with fine adjustment, by Andrew Ross (registered July 20, 1849). Presented by the President. A Model of Reichert's new Fine Adjustment. Presented by the President.

STANDARDISATION OF THE SUBSTAGE, AND OF THE INTERNAL DIAMETERS OF THE DRAW-TUBES OF MICROSCOPES.

The following Resolutions were adopted by the Council on December 20th 1899:—

(1) That the Standards adopted by the Council in 1882 be withdrawn.

(2) That the Standard size for the inside diameter of the substage-fitting be 1·527 in. = 38·786 mm.

(3) That the gauges for standardising eye-pieces be the internal diameters of the draw-tubes, the tightness of the fit being left to the discretion of the manufacturers.

(4) That the following four sizes of the internal diameters of the draw-tubes be adopted:—

R.M.S. No. 1,	·9173 in.	=	23·300 mm.
„ No. 2,	1·04 „	=	26·416 „
„ No. 3,	1·27 „	=	32·258 „
„ No. 4,	1·41 „	=	35·814 „

(5) That a set of plug and ring gauges of all the above sizes be kept in the Society's rooms, and that the public, on payment of a small fee, be allowed to inspect them.

(6) That the Society acknowledges with thanks the assistance it has received from many firms in reply to the circulars sent out.

NOTES.

(1) The substage gauge adopted is that which has been used by the English trade for many years past, the variation amongst different makers being not more than a few thousandths of an inch.

(2) R.M.S. No. 1 is the Continental gauge.

(3) R.M.S. No. 2 is the mean of the sizes used by the English trade for students' and small Microscopes.

(4) R.M.S. No. 3 is the mean of the sizes used for medium-sized binoculars and other Microscopes of a similar class.

(5) R.M.S. No. 4 is the maximum size for long tube binoculars.

(6) In all probability the eye-piece cap, and apparatus to be used above the eye-piece, will be standardised in a few weeks.

Mr. Vezey, on being called upon to read the Treasurer's Financial Statement, expressed his great regret at the circumstances which had so unexpectedly placed him in that position. He desired to bear his testimony to the efficient way in which the late Treasurer had kept the accounts, for when the books were placed in his hands for the preparation of the accounts for the Auditors, he found them posted up to within a few days of Mr. Suffolk's death, so that the closing of the year's cash accounts had been a comparatively easy task.

Mr. Vezey wished to be allowed to make a short personal explanation. It was known to many of those present that he had just resigned the Treasurership of another Society on the ground that it was necessary to his health that he should be relieved of some work, he having so many calls on his spare time. It might therefore be thought inconsistent that he should allow himself to be nominated for the post of Treasurer of this Society. He might mention, however, that a large amount of the detail work here was performed by the Assistant Secretary; but in any case, the Council were placed in such a difficulty by the sudden death of Mr. Suffolk; and as the accounts were kept on a system suggested by himself, and he therefore had them at his fingers' ends, he had felt it his duty to be willing to undertake the work, even at a personal sacrifice to himself.

The Treasurer's Statement of Accounts was then read.

Mr. Karop said he had much pleasure in moving that the Report of the Council, and the Treasurer's Statement and Balance Sheet now read, be received and adopted.

Mr. Rousselet having seconded the Motion, it was put to the Meeting by the President and carried unanimously.

THE TREASURER'S ACCOUNT FOR 1899.

Dr.

1899.	£	s.	d.	£	s.	d.
To Balance from 1898				132	13	9
,, Admission Fees				60	12	6
,, Annual Subscriptions—						
1895	1	8	6			
1896	8	18	6			
1897	19	10	1			
1898	64	18	9			
1899	611	11	10			
1900	31	3	11			
				737	1	7
,, Compounding Fee				31	10	0
,, Interest on Investments				36	4	11
,, ,, on Deposit Account				4	7	3
,, Sale of Journal				309	5	11
,, Receipts for Advertisements				60	0	0
,, ,, ,, Catalogues sold				0	4	0
,, ,, ,, Lists of Fellows sold				0	15	1
,, ,, ,, Reprints				4	10	7
,, ,, ,, Sale of Surplus Books				1	15	0
,, ,, ,, Screw Tools sold				11	2	9
,, Sundries				0	5	0
				£1390	8	4

Cr.

1899.	£	s.	d.	£	s.	d.
By Rent, Coals, Attendance, &c.				131	6	0
,, Salaries, Reporting, Commission, &c.				153	16	1
,, Books, &c., and Binding				77	2	5
,, Expenses of Journal—						
Printing	£433	11	1			
Illustrations	91	14	0			
Editing	175	3	8			
				700	8	9
,, Refreshments				13	10	0
,, Stationery, &c.				15	2	8
,, Fire Insurance				2	0	0
,, Postage and Petty Expenses				26	12	0
,, Deposited with the Union Bank of London				63	0	0
,, Sundries				11	19	2
,, Balance in hand				195	11	3
				£1390	8	4

Investments.

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.
313*l.* On Deposit, Union Bank of London.

J. J. VEZEY, *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.

January 10th, 1900.

J. MASON ALLEN } *Auditors.*
G. E. MAINLAND }

The President then read his Annual Address, the first portion of which reviewed the work done during the past year in connection with the Society and Microscopy generally, the latter part being in continuation of the optical subjects dealt with in his previous Addresses, and specially having reference to the aplanatic oil-immersion front, and the construction of the Huyghenian eye-piece. The Address was listened to with great attention, and warmly applauded at its conclusion.

Mr. A. D. Michael said that as this was the last occasion on which they would have the pleasure of hearing a Presidential Address from Mr. Nelson, he would ask the Fellows present to pass a very hearty vote of thanks to him, not only for the Address they had just heard, and which he hoped the President would allow them to print, but also for his eminent services to the Society during the whole time that he had occupied the chair. Since he assumed the office of President, Mr. Nelson had given them from time to time a series of Addresses which would form an admirable record of the practical application of the principles upon which the optical part of the Microscope was constructed, a subject upon which there was little reliable literature; he had now completed the series by a final communication not less valuable than its predecessors. His papers would form a means of reference of permanent and substantial value as demonstrating what had previously been so little on record, namely, the theory of the construction of objectives and eye-pieces explained from a practical standpoint. He ventured to think that the Fellows of the Society would wish to extend this vote of thanks to cover the whole period during which Mr. Nelson had been in office, and to express their sense of gratitude for his conduct as their President. They would miss him greatly, and parted from him with extreme regret, notwithstanding the fact that he was to have so excellent a successor. He had much pleasure, therefore, in moving "That the best thanks of the Society be given to Mr. Nelson for his Address, and also for his conduct in the chair during the time he had occupied it as President of the Society."

Dr. Braithwaite, in seconding this vote of thanks, expressed his sense of the admirable way in which the President had carried out the duties of his office; it would doubtless be a great satisfaction to the Fellows to know that he was leaving the Society in a much sounder condition than he found it when he first occupied the presidential chair.

The President being unable himself to put the motion from the chair, it was put to the meeting by Mr. Michael and carried by acclamation.

Mr. Nelson said he was greatly obliged to Mr. Michael and to Dr. Braithwaite for the kind way in which they had referred to his services, and to the Fellows for the hearty manner in which they had carried this vote of thanks. He felt that what he had been able to do for the Society was very little, but if he had been of any service to them the knowledge that his efforts had been appreciated was his reward.

The Scrutineers having handed in the result of the ballot, the President declared the following Fellows to be elected as Officers and Council of the Society for the ensuing year.

President—William Carruthers, Esq., F.R.S., F.L.S., F.G.S.

Vice-Presidents—Alfred W. Bennett, Esq., M.A., B.Sc., F.L.S.; George C. Karop, Esq., M.R.C.S.; A. D. Michael, Esq., F.L.S.; E. M. Nelson, Esq.

Treasurer—J. J. Vezey, 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.; Edward Thomas Browne, B.A.; Rev. Edmund Carr, M.A., F.R.Met.S.; Edward Dadswell, Esq.; The Hon. Sir Ford North; Henry Geo. Plimmer, Esq., M.R.C.S., F.L.S.; Thomas H. Powell, Esq.; Charles F. Rousselet, Esq.; John Tatham, Esq., M.A. M.D., F.R.C.P.; George Western, Esq.

Curator—Charles F. Rousselet, Esq.

The President said that there remained only one further duty for him to perform, which was to ask his friend Mr. Carruthers to take the chair. He said that no introduction would be necessary on his part, as Mr. Carruthers had been a Fellow for twenty years, and it was upwards of thirty years ago that he read his first paper before the Society. He thought the Society were very fortunate in securing the services of so eminent a President as Mr. Carruthers, and it was with very great pleasure that he now asked him to take the chair.

Mr. Carruthers, having taken the chair, said it was not expected that he should address the Fellows of the Society at any length on that occasion, but he should like to express his grateful sense of their great kindness in asking him to take a chair which had been occupied by so many distinguished men in the past. He had already had some experience of the Council, and knew he might count upon their assistance; and he would now call upon the Fellows of the Society for their indulgence and for their assistance in carrying on the work of the Society, feeling sure that the work would be rendered more interesting if all took a personal interest and share in it. He must express his own sense of unfitness to succeed one so well acquainted with every detail connected with the Microscope as Mr. Nelson. He had for half a century used the instrument for the purpose of investigation, but he knew little about the building up of the Microscope or the mathematical conditions which govern the construction of its lenses, subjects in which Mr. Nelson had been so well able to instruct them. He hoped, however, that he might be able to place before them some of the results which had been secured through the help of the Microscope.

Mr. Western moved a vote of thanks to the Officers and Council of the Society for their services during the past year, especially to Mr. Vezey for his kindness in coming forward to assist the Council at such short notice in the way he had done.

Mr. Marshall having seconded the motion, it was put to the Meeting and carried unanimously.

A vote of thanks to the Auditors and Scrutineers was proposed by Mr. J. M. Offord, seconded by Mr. Dadswell, and carried *nem. dis.*

The following Object was exhibited:—

Mr. C. Rousselet:—*Stephanoceros Eichhorni*, mounted, fully extended.

New Fellows.—The following gentlemen were elected *Ordinary* Fellows of the Society:—Messrs. Alex. John Currie, Fredk. Enock, F.L.S., F. Victor Massard, and Aloysius Verinder.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY

APRIL 1900.

TRANSACTIONS OF THE SOCIETY.

III.—*The President's Address.*

By Edward M. Nelson.

(*Delivered 17th January*, 1900.)

ERRATUM.

The foot-notes on page 102 *should read thus* :—

* Trans. Jenner (late British) Inst. Prevent. Med., 1899, ser. ii. pp. 17–44 (3 pls.).
† Ann. Inst. Pasteur, xiii. (1899) pp. 841–53 (5 figs.).
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 540–1.
§ Trans. Jenner (late British) Inst. Prevent. Med., 1899. ser. ii. pp. 113–24 (2 pls.).

are in a sounder position, your Meetings have been made more interesting, and in consequence have been better attended, also a larger number of new Fellows has been elected; all this must surely be taken as a sign that the Society has entered upon a new era of prosperity and usefulness.

The special thanks of the Society are due to your Editor and Abstractors, who by their untiring efforts have maintained the efficiency of your Journal.

The gifts to the Society's Cabinet of Instruments and Apparatus during the past year have been numerous and of much interest. Two Microscopes, one by Benj. Martin, presented by Dr. Dallinger, and one by G. Adams, presented by Mr. J. M. Offord, are important, as both are examples of high types of pre-achromatic instruments, and in them we see some original devices still to be found in instruments of the present day.

A third Microscope, presented by Messrs. Watson and Son, repairs to a certain extent an unfortunate mistake made by the Society a good many years ago. About the year 1841 the Council ordered a Microscope to be made by each of the three principal Microscope makers of that time, viz. Powell, Ross, and Smith.* Those by Powell and Smith are still in our Cabinet, but the original Ross was exchanged by the Society thirty-seven years ago for a then modern one. We are now unable to find out what this original Ross Microscope was like, which is to be greatly regretted, because the value of these old instruments is to us solely an antiquarian one. (It should, however, be noted that the coarse adjustments of these old Microscopes are quite as good as anything now made, as also are the low-power objectives. The Powell, for example, if only it had the optical part of a modern wide-angled condenser fitted to it, in place of the narrow-angled one it has, would work the widest angled oil-immersion objective as efficiently as any modern Microscope, and a great deal better than very many at present in use.)

But to return to the Ross Microscope which has been presented to the Society: we find that, although it is not dated, it is signed, and has the address, 33 Regent St., Piccadilly, engraved upon it.

Now, it is known that Andrew Ross was at this address as early as 1838, and the first record we find of the Ross model as figured on the frontispiece in the first edition of Quekett (1848) is in the London Physiological Journal for December 1843; but we do not know if the Microscope delivered by Ross to the Society on March 15th, 1843, was the same as that represented on the frontispiece in the first edition of Quekett, or if it was similar to that presented to the Society by Messrs. Watson and Son, and which is figured in the Journal (1899, p. 215, fig. 47).

A very portable Microscope by Cary, figured and described in the Journal (1898, p. 474, fig. 82), has been presented by Mr. Frank Gleadow. A very early and unique example of a lens by Andrew Ross, fitted with a primitive correctional adjustment, and which formerly belonged to the second President of this Society, has been very generously presented by his son, Lord Justice Lindley, the Master of the Rolls. This lens must have been made between the years 1837, when correctional adjustment was invented, and 1839, when the screw collar was introduced; it has been figured in the Journal (1899, p. 437, fig. 103). A Gillett achromatic condenser by the same author, dated 1849, and fitted with a correctional collar, has also been presented. Finally, Miss Suffolk has generously given, as a memorial of our late Treasurer, a cabinet containing 1400 of his preparations.

This year a large number of new and important improvements in the Microscope and apparatus have been exhibited and brought to the notice of the Society. Among these may be mentioned a new form of lever coarse and fine adjustment, acting on one and the same slide, invented by Mr. Keith Lucas. Mr. C. Baker exhibited a Microscope

* The order was given to Smith on August 19th, 1840, and to Powell and Ross on June 24th, 1841. Smith delivered his Microscope to the Society on November 24th, 1841, Powell his on December 22nd, 1841, and Ross his on March 15th, 1843.

by Reichert, which had a new form of lever fine adjustment adapted to the Continental stand. Those acquainted with Microscope construction have expressed their conviction that this ingenious and thoroughly practical adaptation must effect a speedy revolution in direct-acting screw fine adjustments, as at present fitted to Microscopes of the Continental pattern. The same firm also exhibited a new electrical hot stage by Reichert; and a very simple form of portable Microscope by Leitz, eminently suitable for doctors for bedside diagnosis. They also showed a new D.P.H. stand of their own manufacture; the fine adjustment is of the long first order lever type, it has a mechanical stage and substage, and it is a Microscope designed to meet the wants of bacteriologists. Messrs. Beck and Co. brought a new form of compressor made of ebonite, and consequently very light; it was designed by Mr. H. R. Davis. Messrs. Watson and Son exhibited a new low-power binocular dissecting Microscope by Leitz, consisting of a pair of Brücke lenses mounted upon an adjustable stand; a large Microscope of their own manufacture, which had a mechanical stage, capable of being rotated through an entire circle; a very simple and ingenious hot stage and stage preserver, designed by Mr. G. T. West; also a new cheap School Microscope, which they have built very substantially, and which has an excellent coarse, but no fine adjustment. They have also introduced a new eye-piece called "Holoscopic"; this is an ordinary Huyghenian eye-piece fitted with a sliding adjustment, which permits the distance between the eye-lens and field-lens to be altered, and gives it a considerable range of correctional adjustment. Messrs. Zeiss have exhibited a new low-power binocular of great excellence, in which two objectives are used, and erection performed by Porro prisms. It is necessary in this form of binocular to erect the image, otherwise the image would be pseudo-stereoscopic. They also exhibited an entirely new form of Microscope, in which the fine adjustment is actuated by means of the interposition of an endless screw. It also has a new form of stage movement, inasmuch as the vertical movement is one in arc, which is accomplished by pivoting the stage-plate on one side, and by moving the other by a rack-and-pinion motion worked by an endless screw.

It is with pleasure that I draw attention to the many interesting subjects which are now brought before our monthly meetings. Among these may be mentioned an excellent demonstration with the lantern Microscope by Mr. Lewis Wright; a first-rate lecture on the Trapdoor Spider by Mr. Enock; a first-rate exhibition of Pond Life by the Quekett Microscopical Club; and a capital collection of those marvellously beautiful objects the Foraminifera by Mr. A. Earland.

Dr. Spitta kindly gave an excellent demonstration on Photomicrography. A large number of his beautiful slides were thrown upon the screen, and as a short explanation accompanied each slide, the exhibition was rendered interesting and instructive.

A great amount of time and thought must have spent upon these exhibitions, and I feel sure that it matters not whether an exhibition is on a large scale, using many Microscopes, or a complicated piece of apparatus, or whether it is a single object shown under a single Microscope, the interest that that exhibition will have, and the pleasure and profit it will impart to others, largely depend on whether it has, or has not, been carefully thought out and prepared beforehand. When an exhibition has been prepared it is sure to be successful; it may not attract the attention of everyone, because it may not be in his own particular line of work; but if an exhibition is well done, it is more than likely to interest observers beyond the circle of those for whom it is specially intended.

While dealing with the subject of exhibitions, your Council has thought that the state of the funds of the Society did not justify it in incurring the expenditure necessary for a special exhibition, such as the Society has given in former years. In fact it is doubtful whether such a large exhibition does any real good to the Society, and whether the smaller exhibitions, held at our ordinary meetings, where only one subject is dealt with, are not of more value, from an educational point of view, than an exhibition upon a larger scale, where a number of heterogeneous subjects are presented, and where the opportunity for studying any particular one of them is necessarily less. In any case, judging from the number of attendances, it would seem that these smaller exhibitions have been much appreciated. It may be of historical interest to know that one of the largest, if not the largest microscopical exhibition ever held was given by this Society forty years ago, at the South Kensington Museum; 300 Microscopes were exhibited, and the attendance exceeded 3000. Another very large exhibition was, in 1864, given at Bath; we know neither the number of attendances nor of Microscopes, but the latter must have been fairly large, as it is recorded that they were insured for 6000*l*.

There is just one item in this year's Report which cannot be regarded as quite satisfactory, viz. the small number of papers we have received; this may be due, as I have before pointed out, to the extreme length to which specialisation is at present carried. There may be found a Society for every "ology" but two that this Society deals with, the exceptions being "diatomology" and "foraminiferology." Therefore until special Societies are formed to consider those subjects, we may expect to receive papers from investigators in those branches of study Going back to the first ten years of this Society's existence, it will be found that the average number of papers is 6·3 per annum (in this enumeration addenda, if read on a different date to that of the original paper, and short notes, are counted as papers). Although we have during the past year doubled the number of papers read during the years of the Society's youth, yet it can hardly be said that we have kept pace with the great increase that has taken place in biological research. Let me draw the attention of biologists and others to the two great advantages with regard to the publication of papers offered by this Society:—first, prompt publication; secondly, large circulation.

Mr. C. F. Rousselet has again kindly consented to act as your Curator, and the catalogue of instruments and apparatus is in course of formation.

Mr. Parsons' assistance has been of great value to your staff in carrying on the work of the Society.

The special thanks of the Society are due to Messrs. Baker, Beck, and Watson for so freely lending us instruments on those occasions when the exhibition required more Microscopes than we could supply.

The block in the shelves in our Library is being actively dealt with by your Council, and we hope shortly to have all the literature that is quite foreign to our own work disposed of.

Death has removed from us two well known and eminent microscopists who were Honorary Fellows of this Society, viz. Dr. Wallich and Count Castracane, of whom obituary notices have already appeared in the Journal.

It is with feelings of deep regret that I now allude to the great loss this Society sustained, only a little more than a fortnight ago, by the death of Mr. W. T. Suffolk, its Treasurer. His decease came upon us as a sudden shock, for he was, as you will all remember, with us at our last meeting on the 20th of December, and twelve days after that he died. His loss will not only be felt by this Society and by other kindred Societies with which he was connected, but he will also be greatly missed by a large number of personal friends throughout the entire microscopical world in this country. He was elected a Fellow of this Society thirty-six years ago, and he joined the Quekett Microscopical Club a month after it was inaugurated. In the second Annual Report of that Club (1867) we read that, "The Committee feel they would be ill-discharging their duty were they to omit to express to Mr. Suffolk the warmest thanks of the Club for his continued efforts to promote its usefulness." This passage adequately expresses the debt due him from the Quekett Club, and from this Society, for his labours during the whole time of his connection with them.

During the past eight years he has been our Treasurer; but his greatest work was the preservation, arrangement, cataloguing, and indexing the slides in our Cabinet, which number about 7700. Many of the specimens were, as you know, perishing from leakages and imperfect cementing; these, numbering some hundreds, he remounted, and in addition to this, he wrote a manuscript catalogue, and prepared a card index of the whole of them. It would be difficult to estimate the amount of work and time Mr. Suffolk so generously gave to the Society in addition to that entailed by his office as Treasurer.

Your Council has been able to meet a long-felt want in the microscopical world by standardising the substage and eye-pieces of Microscopes. In this matter the trade came forward and rendered material assistance to the Council; for it must be obvious to everyone that apart from the co-operation of Microscope manufacturers, any scheme of this kind must fall through.

On investigation it was found that a Whitworth plug and ring gauge of 1·527 in. for substages had been used by Messrs. Smith and Beck many years ago, and that Mr. T. Ross had in 1863 adopted this identical gauge, and that subsequently it had also been adopted by Messrs. Powell and Lealand. As the majority of our English manufacturers had followed suit, the substage was already standardised by the trade themselves, in this country at least, so your Council had nothing further to do than to recommend that that gauge be adopted. In this connection it was not necessary to consult with our confrères either on the Continent or in America, because on the Continent a substage, as we understand it, is practically unknown, a condenser-fitting being used instead; and in America nothing but Microscopes on the Continental model are now manufactured.

Now, with regard to the eye-pieces; it was evident that the draw-tube of the Microscope required standardisation, and not the tube of the eye-piece itself, for the reason that ordinary eye-pieces ought to fit loosely, so that they may be easily changed without any risk being incurred of shifting the position of the body; whereas for a screw micrometer eye-piece the fit should be somewhat tight, to prevent it rocking about in the draw-tube when its screw-head is revolved. Your Council, therefore, wisely determined to standardise the inside gauge of the draw-tubes, and not the outside gauge of the eye-piece tubes.

With regard to the first or smallest size, there was no hesitation in adopting the Continental gauge; neither was there any difficulty experienced in selecting the largest gauge, because that was limited by the size of the field-lens of a 2-in. focus Huyghenian eye-piece for use in a long tube Wenham binocular.

With regard to the second size, it was found necessary to standardise some such gauge as this, because many of our English manufacturers make their smaller Microscopes, for medical students and school purposes, about this size in preference to that of No. 1, because a larger field can be obtained with the lowest power eye-piece, and a large field is of much assistance when it is necessary to find some particular object.

The Council considered it necessary to standardise a fourth size, intermediate between Nos. 2 and 4, suitable for medium-sized binoculars, for which purpose No. 2 is obviously too small, and No. 4 quite unsuitable, because a Microscope capable of carrying so large an eye-piece as No. 4 must be of the largest size, and consequently expensive. (It is quite remarkable what a notable difference a single tenth of an inch in the diameter of an eye-piece makes in the total size of a properly proportioned Microscope.)

For gauges Nos. 2 and 3, a mean size of the various manufacturers' gauges was in each case adopted, About eighteen years ago your Council attempted to carry out this same idea of standardisation, and proposed that of 1·5 in. for the substage, and 0·92 and 1·35 in. for the tubes of eye-pieces.

It was a foregone conclusion, however, that those gauges could never have been adopted by the trade, because, with regard to the substage, we have seen that it had already been standardised in this country, and manufacturers did not see any sufficient reason why they should incur the expense and inconvenience of changing the gauge of their substage for one that not a single maker was using.

With regard to the two gauges for eye-pieces, the smallest, viz. 0·92 for the eye-piece tube, made it too large to enter any Continental Microscope; 1·35 in. was too small to give a maximum field with a Wenham binocular, and too large for a small binocular to be sold at a popular price; manufacturers therefore could not adopt either of these gauges. The thanks of the Society are due to Mr. Conrad Beck for the assistance he has rendered to the Council in this matter.

With regard to our accounts, Mr. Vezey most kindly consented to act as Treasurer, and by doing so has enabled the Council to lay before you the year's accounts duly audited as is customary at our Annual Meeting.

The Aplanatic Immersion Front.

We will now pass on to the Address; and I am going to ask you to kindly bear with me for a short time while I endeavour to explain a few points which will conclude the subject already dealt with in my two former Addresses.

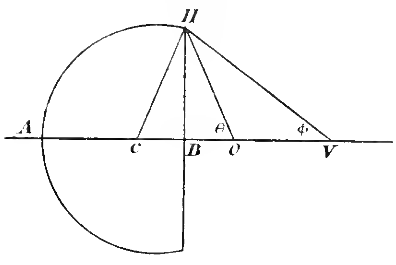
You will no doubt remember that the subject was divided into three parts, and that one which was called the middle portion came first, and the first portion second; so this, the last, will be the only one in its proper place. Before beginning, permit me to point out that, as in my previous Addresses so also in this one, nothing either new or startling will be brought before you, and the subject will be treated, as before, in a practical rather than in an academical style. To exhaust any one of these divisions more space would be required than could reasonably be allotted to all three Addresses together; therefore each must be regarded only as a very fragmentary presentation of the subject.

The simplest part of all Microscope lens construction is the aplanatic oil-immersion front; it is, I fear, nevertheless very imperfectly understood by microscopists as a whole, or even by many of those forming the brass and glass contingent. Strange to say that, although so important, it has not, so far as I am aware, been dealt with in the whole range of microscopical literature except in a single instance, on which occasion it was so ably handled by Sir G. Stokes that it would not now have been taken up again had the point of view been the same. Sir G. Stokes' paper was one of the many written during the aperture controversy, and its object was to prove that the aperture of 180° in air could be exceeded by an oil-immersion lens. All who remember that controversy and the bitterness engendered by it, will be thankful that it has passed away never to return; it was, however, not without its use, for it was the means of disseminating a large amount of optical literature, which undoubtedly enlarged the views of microscopists at that time, and enabled them to form correct ideas about the nature of the instrument they were using.

The aplanatism of a single refracting surface was first investigated by Descartes, who described the various curves of a surface that would refract light aplanatically; but the proof of the proposition appears to have been first published by Newton, in his 'Principia'; for he says, "The invention of which, since Descartes concealed it, I have thought proper to lay open in this proposition."

These refracting surfaces were curves consisting of ellipses, hyperbolas, parabolas, and Cartesian ovals; but all these have disappeared from practical optics, with the exception of the parabola, which is still used in Newtonian reflectors; it is, however, with glass lenses and not with reflectors that we are at this moment concerned. Under certain varying conditions of the distances of the point and its image from the vertex of the curve of the glass refracting surface, the Cartesian oval becomes more and more like a spherical curve, until a definite position of the point and its image is arrived at, when the curve becomes truly spherical. This position is, when the distance of the virtual image from the vertex of the refracting surface is μ times that of the object from the vertex. In fig. 40, let A be the vertex, O the object, and V the virtual image, then the condition for aplanatism by a spherical surface is that A V must be equal to μ A O; for simplicity, call A O, p, and A V, q, then

Fig. 40.



$$q = \mu p. \qquad \text{(i.)}$$

Call the semi-angle of aperture, viz. C O H, θ, and the angle C V H, ϕ, and the radii C A, C H, r.

Now p, q, and r are related by the common formula for refraction at a spherical surface, viz.

$$\frac{1}{q} = \frac{\mu}{p} - \frac{\mu - 1}{r}. \qquad \text{(ii.)}$$

Combining (i.) and (ii.), we obtain

$$r = \frac{\mu p}{\mu + 1}, \qquad \text{(iii.)}$$

$$r = \frac{q}{\mu + 1}. \qquad \text{(iv.)}$$

From (iii.) we have $r = \mu (p - r)$; but $p - r = \text{C O}$

$$\therefore \quad \text{C O} = \frac{r}{\mu}.$$

From (iv.) we have $q - r = \mu r$; but $q - r = \text{C V}$

$$\therefore \quad \text{C V} = \mu r.$$

Now, in the two triangles H C O, H C V, we have the included angle at C and the side $\text{H C} = r$ common to both, and the sides $\text{C O} = \frac{r}{\mu}$ and $\text{C V} = \mu r$ both determined; therefore the remaining sides

$$\left.\begin{aligned} \text{H V} &= r \sqrt{\mu^2 + 1 - 2 \mu \cos \text{C}} \\ \text{and} \quad \text{H O} &= \frac{r}{\mu} \sqrt{\mu^2 + 1 - 2 \mu \cos \text{C}} \end{aligned}\right\} *$$

$$\therefore \quad \text{H V} = \mu \, \text{H O}.$$

Let $\text{H O} = a$, then $\text{H V} = \mu a$, and $r \sin \text{C} = a \sin \theta$, and $r \sin \text{C} = \mu a \sin \phi$.

$$\therefore \quad \text{Sin } \theta = \mu \sin \phi.$$

When the lens is a hemisphere, then H C becomes perpendicular to the axis, and $\tan \theta = \mu$, and $\cot \phi = \mu$.

Although it is outside the subject in hand, it is interesting to note that these two triangles are similar,† therefore the angle $\text{C H V} = \theta$, and $\text{C H O} = \phi$. Again, because C H is the normal, C H V is the angle of incidence, and C H O that of refraction; and as $\sin \theta$ has been proved equal to $\mu \sin \phi$, therefore $\sin \text{C H V} = \mu \sin \text{C H O}$, which proves the aplanatism of the lens, when the condition that $q = \mu p$ is fulfilled, because it is true wherever the point H may be placed on the curve A H. The limit is reached when V H is a tangent to the curve, i.e. when θ is a right angle.

We will now take a practical example to illustrate the use of the above formulæ. Let it be required to construct an aplanatic front for an oil-immersion objective of N.A. 1·3; let $\mu = 1 \cdot 5$.

* The above is the common formula for the solution of the third side of a rectilinear triangle, when two sides and the included angle are given, viz.—

$$c^2 = a^2 + b^2 - 2 a b \cos \text{C}.$$

† Euclid, Bk. vi. Prop. 6.

Lay off a distance A O, say 1 in.; then A V will be μ A O = 1·5; next find r by (iii.); in this manner, multiply A O by μ and divide by $\mu + 1$, thus $\frac{1 \cdot 5}{2 \cdot 5} = 0 \cdot 6$. Next divide the N.A. by μ, thus $\frac{1 \cdot 3}{1 \cdot 5} = 0 \cdot 8666$; this is the sine of θ, the semi-angle of aperture; by a table of natural sines we find that it corresponds to an angle of 60° – 4′. From the point O lay off the angle A O H = 60° – 4′; from the centre C with radius C A = r = 0·6 describe the circle. The front is therefore constructed, and all rays proceeding from O will be aplanatically refracted as if they had come from the point V. Now, in order to find ϕ we must divide θ by μ, thus $\frac{0 \cdot 866}{1 \cdot 5} = 0 \cdot 5777$, which by the tables of natural sines we learn is 35° – 18′.

Some would no doubt prefer a more mathematical treatment than that of drawing out the lens in order to determine its thickness, the diameter of its front, and the working distance. In the triangle H C O call the angle H C O, β, and the side H O, b, and let the front of the lens cut A V in B. Then $\beta = 180° - (\theta + \phi)$; $b = \frac{r \sin \beta}{\sin \theta}$; the diameter of the lens front $= 2\, b \sin \theta$; the working distance B O = $b \cos \theta$; and the thickness A B = p – B O. In our example then the following will be the values of the above terms: β = 84° – 38′, b = 0·689, diameter of front 1·195, working distance = 0·344, thickness of front = 0·656.

The Huyghenian Eye-piece.

History.—I have not been able to ascertain the date of the application of this eye-piece to a telescope, but it is highly probable that the addition of a field-lens to a Microscope by Monconys in 1660 followed its introduction, and no chronological anachronism would be occasioned by this supposition, as Huygbens would have been thirty-one years old at that date. It may be mentioned that this eye-piece has also been attributed to Campani, upon what grounds I am unable to say; in this country, however, it is known as a Huyghens' eye-piece; it is also sometimes called a negative eye-piece, but Coddington, writing in 1830, says that he is ignorant of the reason. It should be noted that Monconys' eye-piece, according to the published formula, had a field-lens of shorter focus than the eye-lens, and a distance between the lenses equal to the focus of the eye-lens; this eye-piece therefore was more like that of Ramsden's than Huyghens' construction. Huyghens' sole aim in his eye-piece appears to have been the enlargement of the telescopic field, and the only condition he introduced was that the total deviation should be equally divided between the two lenses.

His selection of 3 : 1 for the ratio of the foci of these two lenses seems to have been empirical, his one condition being secured by placing the two lenses the difference of their foci apart. Boscovich subsequently pointed out that the foci as selected by Huyghens fulfilled another and important condition, viz. that half their sum was equal to the distance of their separation, by which the achromatism of the eye-piece was secured. It is hardly necessary to mention that achromatism in this eye-piece means something very different from achromatism in an objective. The achromatism in this eye-piece might be appropriately termed "an achromatic effect," for it merely signifies that the unequally magnified chromatic images formed by the field-lens are unequally magnified by the eye-lens in such a manner that they finally appear the same size.

Theory.—It is to be feared that the action of the Huyghenian eye-piece is but very imperfectly understood by microscopists, and no wonder; as an old and erroneous theory, published many years ago, is copied in several text-books on the Microscope. The old theory was that the objective image, which was slightly convex towards the eye, was changed by the action of the field-lens into one that was concave towards the eye-lens, and therefore in the best position with regard to the eye-lens for obtaining a flat image. This, however, is incorrect: the objective image may be slightly convex towards the eye as in the large dotted arrow in fig. 44, but the action of the field-lens is to increase that convexity in the same direction, and most certainly not to invert the curvature.

With regard to distortion, which owes its existence to spherical aberration causing too great a refraction of the excentrical pencils which fall on the marginal zone of the field-lens, it will be better perhaps to illustrate this defect in the eye-piece by means of a definite example. Suppose we have a square grating focussed by the object-glass, then the objective image will be slightly barrel-distorted, but by the influence of the field-lens it will be reduced in size, and much more barrel-distorted, as in fig. 41. Now the action of a single lens in forming a virtual image, as in a simple non-achromatic Microscope, is to enlarge an image and give it pincushion-distortion, fig. 42; but as the image at the diaphragm of the eye-piece, which the eye-lens is magnifying, is already barrel-distorted, the eye-lens, by reason of its pincushion-distorting power, neutralises this barrel-distortion, and so makes the final image rectilinear. It would therefore be a mistake to attempt to form a rectilinear image at the diaphragm of the eye-piece, because the inevitable result of such a procedure would be a final image that was pincushion-distorted by the action of the eye-lens. It is therefore useless to aplanatise either lens without the other.

Fig. 41.

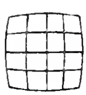
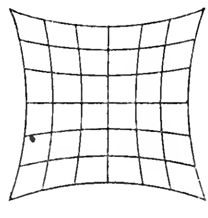


Fig. 42.



There is yet another error in this eye-piece, viz. astigmatism; but as I have already dealt with this in the Journal for 1898, p. 402, it will be merely necessary to say that rays issuing from a point and falling excentrically upon a lens will not be accurately refracted to another point, but will be focussed into two lines separated from and at right angles to one another. The following, therefore, are the errors in this eye-piece:—

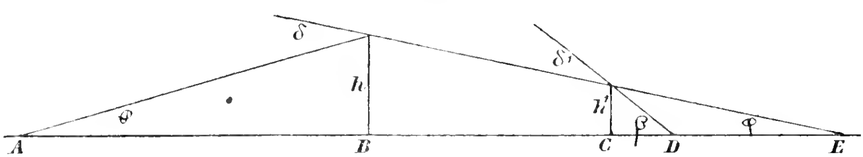
1. Chromatism.
2. Curvature of image.
3. Distortion.
4. Astigmatism.

Formulæ.—If we turn to the text-books, we shall find formulæ for a telescopic Huyghenian eye-piece which will satisfy the conditions both for achromatism and also for equal deviations at each lens. When we wish to construct a Huyghenian eye-piece suitable for a Microscope, these formulæ will not serve us, because the distance from the field-lens of the point where the axis of the excentrical pencil cuts the axis of the eye-piece can no longer be considered infinite; in other words, the axis of the excentrical pencil incident upon the field-lens is so much inclined to the axis of the eye-piece that to regard it as parallel would introduce too great an error into the calculation.

Coddington and subsequent authors give a formula that will satisfy the condition of achromatism when the axis of the incident pencil is inclined to the axis of the eye-piece, but none for equal deviations at each lens, under similar circumstances. It is therefore my intention to-night to supply this defect.

Symbols.—Let us call the focus of the field-lens f, that of the eye-lens f', the distance between the lenses d, the equivalent focus of the eye-piece F, its power m, the distance from the field-lens of the point

Fig. 43.



where the axis of the excentrical pencil incident upon the field-lens cuts the axis of the eye-piece p, its conjugate focus p', the similar distances from the eye-lens q and q', the deviation at the field-lens δ, and that at the eye-lens δ' (see explanation of fig. 43 *infra*), then the condition of achromatism is

$$d = \frac{p\,(f + f')}{2\,p - f}. \qquad \text{(i.)}$$

For equal deviation at each lens the conjugate of p must bear the same ratio to the equivalent focus of the eye-piece that the distance between the lenses does to the focus of the eye-lens; thus

$$\frac{p'}{F} = \frac{d}{f'} = a. \qquad \text{(ii.)}$$

In addition to these there are the well-known equations, viz. that for equivalent focus,

$$F = \frac{f f'}{f + f' - d}; \qquad \text{(iii.)}$$

and that for magnifying power,

$$m = \frac{p}{F}. \qquad \text{(iv.)}$$

From these we obtain

$$d = \frac{m f}{p - f} \cdot f'. \qquad \text{(v.)}$$

Now, as p and m are given, and as a is the coefficient of f' in the last formula, by combining and simplifying, we obtain the following working equations:—

$$f = \frac{a\,p}{m + a}; \quad f' = \frac{a\,p}{(2\,a - 1)\,m + (a - 1)\,a}; \quad d = a\,f',$$

$$a = 2 + \frac{m}{2\,p^2}.$$

Example 1.—An eye-piece of 10 power is required for a short-tube Microscope. Find the foci of the lenses, and the distance between them.

Data: $m = 10$, $p = 160$ mm. $= 6 \cdot 3$ in.

$$a = 2 + \frac{10}{79 \cdot 38} = 2 \cdot 126; \quad f = \frac{2 \cdot 126 \times 6 \cdot 3}{10 + 2 \cdot 126} = \frac{13 \cdot 394}{12 \cdot 126} = 1 \cdot 104;$$

$$f' = \frac{13 \cdot 394}{3 \cdot 252\,m + 2 \cdot 394} = \frac{13 \cdot 394}{34 \cdot 914} = 0 \cdot 3836;$$

$$d = 2 \cdot 126 \times 0 \cdot 3836 = 0 \cdot 816.$$

A trigonometrical trace of a ray incident upon the field-lens at a distance $h = 0 \cdot 3$ in. from the axis shows that $\delta = 15° - 22'$ and $\delta' = 15° - 20'$, which is sufficiently accurate; and as the value of d, viz. $0 \cdot 816$, exactly satisfies equation (i.), the required foci and distance have been found (fig. 43).

Example 2.—An eye-piece of 5 power is required for the long tube. Find the foci and lens distance.

Here $m = 5$, and $p = 10$.

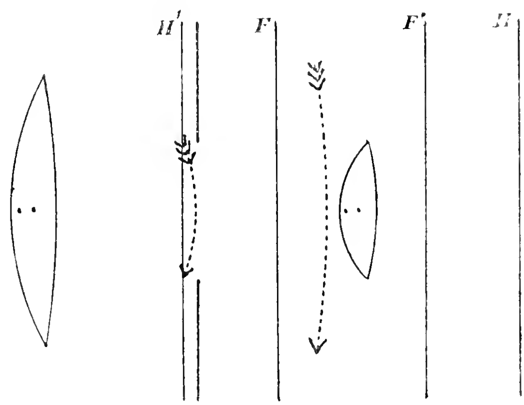
$$a = 2 + \frac{5}{200} = 2 \cdot 025\,;\ f = \frac{20 \cdot 25}{7 \cdot 025} = 2 \cdot 883\,;$$

$$f' = \frac{20 \cdot 25}{15 \cdot 25 + 2 \cdot 076} = \frac{20 \cdot 25}{17 \cdot 326} = 1 \cdot 169.$$

$$d = 2 \cdot 025 \times 1 \cdot 169 = 2 \cdot 367.$$

A trigonometrical trace shows that $\delta = 5° - 57'$ and $\delta' = 6° - 1'$, the difference between these being only 4′, which is sufficiently accurate. The value of d precisely satisfies equation (i.), therefore the correct foci and lens distance have been found.

Fig. 44.



Example 3.—An eye-piece of 40 power is required for a 4-in. telescope of 60 in. focus. Required the foci and lens distance.

Here $m = 40$ and $p = 60$. Then $a = 2 \cdot 00\dot{5}$, $f = 2 \cdot 865$, $f' = 0 \cdot 983$, $d = 1 \cdot 971$.

The trigonometrical trace (rigidly performed) shows that the value of δ is $5° - 59'$, and that of $\delta' = 5° - 54'$; further, equation (i.) is satisfied by the above values.

Let us compute this eye-piece by the ordinary formulæ found in the text-books, then the following results will be obtained; $f = 3$, $f' = 1$, $d = 2$. The trigonometrical trace shows that $\delta = 5° - 43'$ and $\delta' = 6° - 10'$, the difference being 27′. With the above values for the foci, equation (i.) shows that d ought to be $2 \cdot 051$. Therefore the condition neither for achromatism nor for equal deviations is satisfied. Of course the equivalent foci are the same in both examples, but it is remarkable that there should be so great a difference in the results when the value of p is so large.

Finding the foci of the lenses and the distance between them is only half the battle, the other half being to find the most suitable form for the lenses. The mathematical analysis of this part of the subject was investigated by Sir George Airy, and his results are given both by Coddington and Potter; it is rather long, and unfortunately, when done, will not serve our purpose, for the following reasons:—(α) One may calculate a form that will give the best field, but any one with a trained eye using such an eye-piece becomes painfully conscious of the great falling off in the definition of details. (β) If the calculation is made with a view to secure the best definition, then the outer portions of the field become so woolly that they have to be cut out by a diaphragm, and the remaining central part becomes too small for practical purposes. In brief, the conditions are antagonistic; therefore one must be content with a compromise. This has often been stated before; and as you are all perfectly familiar with this phenomenon it will be needless to enlarge further upon it. The analysis shows that for field the lenses should be menisci, and for definition biconvexes; the plano-convex, which is a mean between these forms and also the cheapest lens, is the one generally used. It will be understood that for rigid accuracy a different form of lens must be employed for different values of p; if therefore a plano-convex is a mean form for a telescope, where p is large, it will no longer be so with a Microscope, where p is small.

I had the curiosity some time ago to calculate and try various forms for a Microscope eye-piece, but nothing particularly new beyond the conclusions stated above was discovered; but it seemed that something better than the plano-convex form might be constructed. It will be generally conceded that sharp definition is of primal importance in critical work both with the Microscope and telescope, and that this quality is to be preferred to a large field; and further, we have seen that it is possible to attain this advantage by reducing the size of the field. The best English Microscopes have what is called a ten-inch field, by which expression is meant, that the apparent diameter of the field is 10 in. at a distance of 10 in. In Continental Microscopes, however, the field is restricted to about 5 or 6 in.; so then by reducing the size of the English field to that of the Continental we shall have it in our power to improve the central definition. After several experiments the form which appeared to yield the best results was a field-lens giving minimum aberration for the direct pencil, combined with an eye-lens with a ratio of radii of 3:1, having its flatter curve next the eye, the glass of which the lenses were composed being of low dispersive crown. In conclusion, the formulæ necessary for computing the radii of the lenses will now be given.

Field-lens.—Let

$$\frac{2f}{p} - 1 = c, \quad \text{and} \quad \frac{-2(\mu^2 - 1)}{\mu + 2} = e;$$

then

$$r = \frac{2(\mu - 1) f}{c\, e + 1};$$

$$s = \frac{2(\mu - 1) f}{c\, e - 1}.$$

Example.—When $\mu = 1 \cdot 5$, $p = 10$, and $f = 1$, then $c = -0 \cdot 8$, $e = -0 \cdot 7143$, and $c\, e = 0 \cdot 5714$.

$$r = \frac{1}{0 \cdot 5714 + 1} = \frac{1}{1 \cdot 5714} = 0 \cdot 636;$$

$$s = \frac{1}{0 \cdot 5714 - 1} = \frac{1}{-0 \cdot 4286} = -2 \cdot 333.$$

Therefore $r : s :: 1 : -3 \cdot 666$, the lens is biconvex with its flatter curve towards the eye; when p is infinite, then the ratio of the radii is $1 : -6$, but when p is equal to $2 f$ the lens becomes equiconvex; if p is less than $2 f$, the flatter curve must face the object-glass, but this latter case will hardly ever occur.

Eye-lens.—To find the radii when the focus, the refractive index, and the ratio of the radii are given. Let κ be the ratio of the radii, then $\kappa\, r = s$, and $s = (\mu - 1)(\kappa - 1) f$;

$$r = \frac{s}{\kappa};$$

Example.—Let $f = 2$, $\mu = 1 \cdot 5$, and $r : s :: 1 : -3$; then $-3\, r = s$, and $\kappa = -3$.

$$s = 0 \cdot 5 \times -4 \times 2 = -4;$$

$$r = \frac{-4}{-3} = 1 \cdot 333.$$

The lens is therefore biconvex.

The following is the trigonometrical method of tracing a ray:—h is the distance from the axis where the incident ray meets the field lens, and h' where it meets the eye-lens (fig. 43). The angles corresponding to the natural tangents can be found in *Chambers' Mathematical Tables*, and to trace the ray no knowledge beyond that of simple arithmetic is required.

$$p' = \frac{p\, f}{p - f}; \quad q = d - p'; \quad q' = \frac{q\, f'}{q - f'}; \quad h' = \frac{q\, h}{-p'}; \quad \tan \theta = \frac{h}{p};$$

$$\tan \phi = \frac{h}{p'}; \quad \tan \beta = \frac{h'}{q'}; \quad \delta = \theta + \phi; \quad \delta' = \beta - \phi.$$

Example (2 *ante*).—$p' = 4 \cdot 050$, $q = -1 \cdot 683$, $q' = 0 \cdot 6898$, $h = 0 \cdot 3$, $h' = 0 \cdot 1247$,

$$\tan \theta = 0 \cdot 03,\ \theta = 1^\circ - 43';\ \tan \phi = 0 \cdot 0741,\ \phi = 4^\circ - 14';$$
$$\tan \beta = 0 \cdot 1807,\ \beta = 10^\circ - 15';$$
$$\delta = 5^\circ - 57',\ \delta' = 6^\circ - 1'.$$

EXPLANATION OF FIGURES.

Fig. 40 is an enlarged picture of an aplanatic homogeneous-immersion front of N A 1·3, the refractive index of the glass being 1·5, and of N A 1·3. O is the object, and V its virtual image. $AO = 1 \cdot 0$; $AV = 1 \cdot 5$; radius $AC = 0 \cdot 6$; $COH = CHV = \theta = 60^\circ - 4'$; $CVH = CHO = \phi = 35^\circ - 18'$; $\sin \theta = \mu \sin \phi$; $AV = \mu AO$: radius $= \dfrac{\mu AO}{\mu + 1}$.

Fig. 41 shows the barrel-distortion of the image represented by the small arrow in fig. 44.

Fig. 42 illustrates a pincushion-distorted virtual image, which would be formed by the eye-lens if the image at the small arrow in fig. 44 were rectilinear.

Fig. 43. B and C represent the positions of the lenses, and B C the distance between them, $= d$. $AB = p$, $BE = p'$, $CE = q$, and $CD = q'$.

Fig. 44 represents a 10 power eye-piece for the short tube. The large arrow is the objective image, the curvature of which is exaggerated; the small arrow illustrates the objective image reduced in size and rendered more curved by the influence of the field-lens. Note:—The curvature of this smaller arrow is in the same direction as that of the large arrow, and not in the opposite direction as often represented. The principal points of each lens are represented by dots, and those of the entire eye-piece by the lines H and H′, while the lines F and F′ indicate the focal points; the focal lengths being of course H F and H′ F′. The positions of the principal points of each lens, as well as those of the cardinal points of the eye-piece, are drawn to a scale of 2 : 1, and are correctly placed. The diaphragm of the eye-piece is close to H′.

OBITUARY.

William Thomas Suffolk.

Born February 18, 1831; died January 1, 1900.

Mr. Suffolk became a Fellow of the Microscopical Society of London as far back as 1863, and was for years a Member of the Council, before he was appointed Treasurer in 1893 in succession to Mr. Frank Crisp. Of singularly retiring and undemonstrative nature, his labours on behalf of this Society, beyond those associated with the supervision of its finances, were probably known to but few outside the Council among the general body of Fellows. These were very largely devoted to the somewhat thankless task of classifying, cataloguing, and keeping in repair, the very miscellaneous collection of preparations in the Society's cabinets; and over 7000 of these have in recent years received his skilful and patient attention. Mr. Suffolk's boundless store of information on his special subject of preserving and mounting microscopical objects was always at the willing service of anyone who liked to ask for it, and to beginners especially he was ever ready to lend aid and advice. Not very long after the foundation of another Society for the encouragement, more particularly, of young amateur microscopists (the Quekett Microscopical Club), Mr. Suffolk undertook a series of demonstrations for the benefit of its members, which were greatly appreciated, and were afterwards published in book form under the title of 'Microscopical Manipulation,' a little work which went to a second edition in 1875. Mr. Suffolk also took a considerable share in organising the South London Microscopical and Natural History Club, the district with which he was all his life associated; and some lectures given before it were embodied in a small book entitled 'On Spectrum Analysis as applied to Microscopical Observation,' published in 1873. He was also the author of a memoir "On the Proboscis of the Blow-fly," printed in the Mon. Micros. Journal, i. 1869, p. 331.

Mr. Suffolk was unmarried; and, as many of the Fellows are aware, his niece has most kindly presented a great part of the work of his private life, viz. his collection of microscopic objects, to the Society, a very fitting monument to his memory. He was on the staff of the Bank of England from 1852 to 1896.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Correlation of Antlers and Reproductive Organs.‡—Herr A. Rörig asks five questions. The first is: Does the absence of antlers or the development of only one depend on an abnormality of the reproductive system? He answers that the condition may occur with both normal and abnormal gonads. The second question is: Can the occasional development of antlers in female Cervidæ be referred to the abnormal development of the reproductive organs? He answers that a diseased state on one side may be correlated with the development of one antler, on both sides with the development of two antlers, and that one-sided disease has a correlation operating transversely. If the ovaries are atrophied there are usually antlers. Hermaphrodites seem always to have antlers, and these are the more perfect the more the gonads incline towards maleness. Irritation of the appropriate place may also evoke antlers in females. The third question is: What effect has partial or total castration in the males? It is answered that the effect varies according to the age of the animal and the stage of antler development. In a young quite hornless male, castration entirely inhibits the growth of antlers. Fourthly, Rörig points out that atrophy of the testes is almost always followed by the formation of *Perrücken*-antlers, and injury to the testes by premature casting. Fifthly, the excision of the antlers has no deleterious effect on the reproductivity or health of the individual. It is obvious that this is a very important contribution to our knowledge of the correlation between gonads and soma.

* 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.

‡ Arch. Entwickmech. viii. (1899) pp. 382–447. See Zool. Centralbl., vii. (1900) pp. 39–40.

Castration and Growth of Bone.*—H. Sellheim finds that castration of ox, horse, sheep, goat, dog, fowl, in both sexes prolongs the period of bone-development, and has thus an effect on the shape of various parts.

Is there Parthenogenesis of the Microgamete in Metazoa? †—Prof. A. Giard suggests that the phenomena observed by Delage, and termed "merogonic," where a non-nucleated ovum-fragment, fertilised by a spermatozoon, proceeds to develope normally, may be regarded as cases where the microgamete or sperm-cell developes parthenogenetically. Siedlecki ‡ has observed the parthenogenetic development of the microgamete of the sporozoon *Adelea ovata*; and the same, as Klebs and others have shown, may occur in the lower plants. If this be the true interpretation of merogonic development, one would expect that the resulting organism should be like the male which furnished the spermatozoa, as might be tested, on the lines of Boveri's famous experiments, where the ovum and sperm belonged to distinct species. It may be, however, that the cytoplasm of the ovum will modify in some measure the expression of the hereditary characters in the sperm.

In some cases Delage found more embryos developing from fragments than from an equal number of intact ova in the control experiments. It is suggested that this may be explained by the intense phagocytic power of the immature ova, which engulf not only follicular cells but spermatozoa as well.§ In the case of the fragments, the absence of the nucleus prevents the assimilation of spermatozoa, and therefore facilitates fertilisation and development.

Giard's way of looking at the facts may also throw some light on the phenomena observed by A. Millardet,‖ in his "Note sur l'hybridation sans croisement ou fausse hybridation," where the hybrid (strawberry-plants, &c.) reproduced exclusively the paternal type. For it may be that for some reason the female pronucleus had in these cases degenerated, and that the "false hybrid" was the result of a parthenogenesis of the male element. The author applies the same idea to Héron-Royer's ¶ experiments on hybridising amphibians, where the paternal characters predominated in the offspring.

[It may be suggested, however, that these are simply cases of prepotency on the part of the male parent, which may be re-expressed in terms of germinal struggle between the paternal and maternal determinants, without any hypothesis of sperm-parthenogenesis.]

Experimental Embryology.** — Dr. V. Haecker finds that the developing eggs of *Cyclops* exposed for 2–3 hours to the influence of 5 per cent. ether solution show in their nuclear divisions phenomena like those of amitosis. After the ether is removed, the nuclear divisions take place after the normal mitotic type. He leaves it an open question whether

* Beitr. Geburtshilfe Gynäkol., ii. (1899) pp. 236–59. See Zool. Centralbl., vii. (1900) p. 106.
† Reprint from C.R. Soc. Biol. Paris, 1899, 4 pp.
‡ Ann. Inst. Pasteur, 1899, pp. 170 and 180.
§ See Iwanzoff, Bull. Soc. Nat. Moscou, 1898, pp. 355–67.
‖ Mem. Soc. Sci. Bordeaux, iv. (1894).
¶ Bull. Soc. Zool. France, viii. (1883) pp. 397–416.
** Anat. Anzeig., xvii. (1900) pp. 9–20 (16 figs.).

the artificially induced phenomena should be regarded as intermediate between indirect and direct nuclear divisions, and whether what have been described as genuine amitoses are not really more like the *pseudo-amitoses* seen in the etherised eggs. His suggestion is rather that the influence of the ether is to inhibit the cellular development and to allow more primitive conditions to express themselves, especially the tendency towards forming what might be called a composite nucleus out of several independent parts (*Teilkerne*) corresponding to the individual chromosomes.

Isolation of Blastomeres.*—Prof. R. S. Bergh takes a critical survey of the numerous experiments on the isolation of blastomeres—an experimental method which has now, in his opinion, reached the end of its tether. He points out that the controversy over the question whether an isolated blastomere of the two-cell stage yielded a hemi- or a holo-embryo has had the useful result of showing that neither result can be called typical, and that even in the same subject (the frog's egg) either result may occur according to the conditions of experimentation.

Ovulase.†—J. B. Piéri gives the name " ovulase " to a supposed new soluble ferment obtained by shaking spermatozoa of Echinoids for a quarter of an hour in a glass vessel. The fluid induced segmentation of ova to the morula stage, though no fertilisation by stray spermatozoa could be detected. But as the author recognises, the experiments require to be repeated with more rigorous precautions.

Bilateral Symmetry of Egg.‡—Dr. O. Schultze has re-investigated the developing egg of *Rana fusca*, with special reference to the question of the exact period when bilateral symmetry makes its appearance. He finds that, though it remains uncertain whether this symmetry does or does not appear before fertilisation, it is certain that it is distinct shortly before the appearance of the first segmentation furrow. The plane of symmetry is the median plane of the frog, and is distinct both in the intact egg and in sections. The point of entrance of the spermatozoon is usually exactly opposite the spot where the blastopore ultimately originates, and the pigment track occupies approximately the plane of symmetry ; but deviations from this norm are not infrequent. There is no evidence that the plane of symmetry is determined by the spermatozoon in eggs in general. Generally, it may be said that there is no fixed period when bilateral symmetry appears. It may in different forms appear either before fertilisation, just before the beginning of segmentation, during segmentation, or at the time of the appearance of the primitive streak. The fact that the first segmentation furrow and the median plane of symmetry sometimes appear at the same time does not justify the view that this constitutes a general developmental law. But it may be said that, at least in numerous cases, the segmentation of the egg in a bilaterally symmetrical animal does not consist in the division of the egg into an irregularly arranged mass of cells, but in a symmetrical grouping of cells about the median plane of the developing organism.

* Zool. Centralbl., vii. (1900) pp. 1–14.
† Arch. Zool. Expér., vii. (1899) Notes et Revue, xxix.–xxx.
‡ Arch. Mikr. Anat., lv. (1899) pp. 171–201 (2 pls. and 2 figs.).

Conditions of Development in the Frog.*—Dr. O. Schultze has re-investigated the question whether the power of rotation is an essential condition of development of the egg, or whether normal development may occur in an egg kept in a position of constraint. Two methods of experiment are available:—(1) that of Pflüger, consisting in removing the eggs from the ovary, fertilising them in a mere drop of water containing spermatozoa, so that the albuminous investment swells but little, and then allowing them to develope in a moist chamber; (2) that adopted by Roux and others, consisting in placing the egg between two glass slides, with sufficient pressure to prevent free movement of the egg within its membranes. Both methods gave the same results, and these may be summarised as follows:—The egg speedily dies if it is so placed that it cannot respond to gravity during the process of development by movements of rotation produced by the structural changes within it. The phenomenon of response to gravity is quite similar to the geotropism of plants, and may conveniently receive the same name. Secondly, eggs which are kept permanently fixed with the animal pole downwards may reach the end of gastrulation, but never display a medullary groove. This shows that the medullary canal does not develope in the colourless hemisphere of the egg, but above the dorsal lip of the blastopore, and the dorsal lip of the blastopore does not undergo displacement towards the upper surface of the egg, as has been supposed by Roux.

Physiology of Reproductive Elements.†—Dr. J. F. Gemmill has made a series of experiments on various points connected with the physiology of ova and spermatozoa, in organisms, such as sea-urchins and the limpet, where there is no pairing, and no means of ensuring fertilisation. First, as to vitality, sea-urchin eggs were tested as to capacity for normal development, after fertilisation at different periods after shedding. It was found in the first place that the vitality of the ova depends on the state of the urchin, being greatest when the urchin is perfectly ripe, least when it is only partially mature or nearly spent. Further, the best results were obtained when the eggs were fertilised about 1–4 hours after shedding, polyspermy and irregular development being commoner in eggs which were fertilised immediately after shedding than in those which were allowed to lie in sea-water for this period. Up to the ninth hour after extrusion the eggs show little loss of vitality, but after this a gradually decreasing number develope normally, until at the end of 28 hours all appeared dead. The life of the free egg is thus markedly limited. Much the same results were obtained with limpets, except that the life of the egg is somewhat longer. As regards the vitality of the spermatozoa, it was found that this varied with the number present in the sea-water. The sperms are nourished by the spermatic fluid; and if this be greatly diluted, death occurs more rapidly than it otherwise would. The most advantageous proportion is that of 1 part of spermatic fluid to 10 of sea-water, and in this the sperms will live about 72 hours. In the case of limpet sperms, the duration of vitality is slightly longer.

A number of experiments were made as to the limit of travel of spermatozoa in still water. In open vessels this limit was found to be

* Arch. Mikr. Anat., lv. (1899) pp. 202–30 (1 pl. and 6 figs.).

† Journ. Anat. Physiol., xxxiv. (1900) pp. 163–81 (6 figs.).

160–177 mm., but in capillary tubes only about 100 mm. There is no evidence that the ova attract the sperms at a greater distance than 1 mm. No evidence was obtained to show that the presence of one set of sexual elements in the water stimulated an animal of the opposite sex to discharge its elements, either in limpet or urchin, nor could the existence of any sexual attraction be demonstrated. It would appear that the active sperm possesses some power of nutrition; for sperms were found to live longer in water containing sterilised bouillon than in water without this addition.

Development of the Testis.*—Dr. J. Foulis has studied the origin of the seminiferous tubules, especially in the deer. The young testis is a sub-peritoneal outgrowth from the primitive germinal ridge, pushed out, as it were, into the form of an elongated body by certain continually growing tubules which pass into its base from the Wolffian body through the centre of a stalk-like connection of peritoneum. He seeks to show that the seminiferous tubules are thus derived from the terminal end of the Wolffian duct. If the Wolffian ducts are epiblastic in origin, the same will be true of the seminiferous tubules, and probably of the epithelial cells lining them.

Embryology of Marsupials.†—Mr. J. P. Hill has been enabled to make some further observations on this subject, which supplement his previous account of the process of parturition and the characters of the embryonic membranes. He has studied the genital organs of a female of *Perameles obesula* containing embryos of a stage later than that previously described by him as stage D; and as the female proved to have been in her first pregnancy, he was able to make some additional observations on the genital organs. As to the fœtal membranes, no strikingly new facts have been brought to light, save the demonstration of the fact that the yolk-sac wall persists throughout intra-uterine life. From the structure of the genital organs it appears that before the first parturition there are two vaginal cul-de-sacs; after parturition these two unite to form a common median vagina, opening into a narrow cleft —the median pseudo-vaginal passage—which lies in the connective-tissue between the lateral vaginal canals. Further, the author finds that in *Dasyurus viverrinus* there is a placental connection, probably of yolk-sac origin, which originates in a fashion similar to that seen in *Perameles.* The paper also includes a brief description of the fœtal membranes of *Macropus parma*, which in essentials is the same as those of other authors who have studied Macropods. The point of importance is the small size and rudimentary condition of the allantois—a condition which must now be regarded as undoubtedly secondary.

Development of Mouse.‡—Mr. J. W. Jenkinson has studied the early stages of development in this animal, of which an account had been previously given by Robinson,§ and criticises the statements of the latter author, which he believes are based on a misinterpretation of sections. The paper may be regarded as consisting of two parts:—(1) a detailed criticism of Robinson's statements and figures, and (2) a criticism of the

* Trans. Med.-Chirurg. Soc. Edinburgh, 1899, 20 pp. (7 pls.).
† Quart. Journ. Micr. Sci., xliii. (1900) pp. 1–22 (2 pls.). Cf. this Journal, 1898, p. 180. ‡ Tom. cit., pp. 61–81 (2 pls.). § Op. cit., xxxiii.

general views of mammalian embryology based by Robinson and others wholly or partly on his results. In both cases the points at issue are difficult to make clear without figures. According to Jenkinson, Robinson's observations may be stated as follows:—The blastocyst at its earliest stage consists of a hollow vesicle with a one-layered roof of epiblast, a many-layered floor of hypoblast, the cavity being the segmentation cavity. Later the thin roof becomes invaginated into the segmentation cavity, which is thus obliterated, and a space—the cavity of the yolk-sac—is formed in the thickened hypoblast by vacuolation. Jenkinson criticises these statements and the figures, and describes what he regards as the true state of affairs, which is essentially that described by other observers for different mammals. He then proceeds to the discussion of the views which have been held by different authors on the problems of mammalian embryology, and gives the general results as follows. It is impossible to institute homologies between the mammalian blastocyst as such and the segmented ova of other Vertebrata, because we have no clear idea how the mammalian ovum has been derived from an amphibian or reptilian ancestor. Until lately, two separate processes have been in Vertebrata confused under the term gastrulation. "The first is a movement of the vegetative cells towards the animal pole, inside the cells of which they may become included; the second is a backward and lateral overgrowth and ingrowth of animal cells to form a notochordal and mesodermal plate, and possibly the roof of the gut on the inside, and on the outside the medullary plate, which thus lies on what was originally the vegetative pole of the egg." It is thus not possible to speak of gastrulation without knowledge of the axes of the egg; and as we do not possess this knowledge for mammalia, it is better to avoid the term altogether.

First Directive Spindle in Ovum of Mouse.* — Herr J. Sobotta shows that the peculiarly large almost central spindle-figures which are seen towards the end of the maturation period of the follicle, and usually in the monaster stage, are the first directive spindles. More frequently seen, especially in atretic follicles, are the second directive spindles. In many cases, in the mouse and in other mammals, it seems as if the first directive division were wholly suppressed.

Suprarenals of Mammals.†—Dr. O. Aichel finds that in mammals up to rodents the whole mesonephros persists for a long time, and the earliest rudiment of the supra-renals appears within the upper third; while in mammals from insectivores upwards, the upper third disappears early. In the latter case the connection of the rudiment of the supra-renals with the mesonephric funnels, discernible in the lower mammals, is no longer to be seen, the organs appearing free in the mesenchyme without connection with mesonephros or cœlomic epithelium or vessels. The medullary substance is formed of the same blastema as the cortical part, without co-operation from the sympathetic nervous system.

Aichel distinguishes in man between the supra-renals which arise from the epoophoron and paroophoron, and the supra-renals of Marchand which appear casually beside the main organ, though both have their

* Festschrift Phys.-Med. Ges. Würzburg, 1899, pp. 187–92 (1 pl.).

† Anat. Anzeig., xvii. (1900) pp. 30–1.

beginnings in the tubules of the mesonephros. A detailed paper is promised.

Pelvic Plexus of Mustelus.*—Mr. R. C. Punnett has studied embryos of *M. lævis* and *M. vulgaris*, with special reference to the question of the ontogenetic history of the nervus collector, and a brief abstract of his paper is published. He finds that in the embryo there is a posterior collector, from which in the later stages the component nerves separate to run singly into the fin. This goes to prove that the collector condition is primitive. It has apparently arisen as the result of the rostral migration of the whole fin.

Ovarian Follicles in Cymatogaster.†—G. L. Mitchell considers that the structure of the follicles in this viviparous fish sheds light on the origin of the Graafian follicles of the mammalia. The eggs of the fish are very small, most of the yolk having been lost, and in the ovary, besides the normal single-layered follicles, aberrant many-layered follicles also occur. These resemble early stages in the development of the follicles of Metatheria and Eutheria, and are regarded by the author as the result of the reduction in size of the egg. The condition is thus analogous to that which occurs in the Metatheria and Eutheria, where the ovum has been reduced in size as compared with the ova of Monotremes and Reptiles. In the latter the follicle is single-layered, just as it is in the normal follicles of *Cymatogaster*, and in each case the reduction of the egg seems to result in an increase of follicular cells.

Development of Urino-genital Organs in Petromyzon.‡—Prof. W. M. Wheeler now publishes the results of observations made in 1893 on this subject, together with a historical survey, and a general discussion of the urino-genital system of the Anamnia, its origin, and the relations of its elements. He finds that in the lamprey the pronephric duct arises by the fusion of abortive pronephric tubules. These abortive tubules have not grown backwards from the functional pronephros, but originate in the region in which they remain. This the author regards as the primitive condition, a view for which he finds confirmation in isolated observations of other investigators for different Anamnia. As the mesonephric tubules open into the pronephric duct, or in other words, as both sets of tubules coexist in the functional condition in the same segments, there can be no question of serial homology between the two.

While in *Myxine* the mesonephros is of very simple structure, in *Petromyzon* it displays considerable complexity. A special peculiarity is that it shows no trace of metamerism, its tubules being always more numerous than the body-segments. This is to be ascribed to a hastening of events; for the author believes that it is in Selachians that the primitive condition of the mesonephros is to be sought, and that the conditions in Teleosts and *Petromyzon* are derivative. Apart from the absence of metamerism already mentioned, the most striking peculiarity of the mesonephric tubules in *Petromyzon* is their origin from solid peritoneal

* Proc. Roy. Soc. London, lxv. (1900) pp. 445–6.
† Proc. Indiana Acad. Sci., 1898, pp. 229–32 (7 figs.).
‡ Zool. Jahrb. (Abt. Anat.), xiii. (1899) pp. 1–88 (7 pls.).

outgrowths, which the author explains as due to the advanced state of development of the mesoderm at the time when they originate.

In *Petromyzon* the author finds a very simple form of pronephric glomus which hangs freely in the body-cavity, and can probably be traced phylogenetically to the pronephric capillary nets of *Myxine* and the lacunar nets of *Amphioxus*. As to the Gnathostome glomus, the author is so impressed with the difficulty of homologising the primitive retiform glomus with the so-called pronephric glomerulus of Ganoids, Teleosts, and *Ichthyophis*, that he is disposed to doubt whether the tubules bearing these glomeruli are really pronephric and may not rather be precociously developed mesonephric tubules.

The author assents to the view that the pronephridia of Vertebrates are homologous with the nephridia of Annelids, and notices that in Annelids, Mollusca, and Insecta there is a tendency for simple larval excretory organs to be replaced by more complex organs, which is analogous to the substitution of mesonephros for pronephros and metanephros for mesonephros in Vertebrates.

In spite of its length and the number and difficulty of the topics discussed, the paper is without either table of contents or summary.

Telegony.*—Prof. H. C. Bumpus gives a brief account of facts and theories of telegony, noting the contributions of A. L. Bell, Pearson, Finn, Bulman, and others, but of Ewart in particular. His conclusion is that "the vexed problems of heredity never will be solved until a great many individuals or institutions seriously undertake experimental breeding."

b. Histology.

Cell-Theory.†—Dr. G. Schlater has published a long essay—historical and critical—on the development of the doctrine of the cell. In the first period (Malpighi 1678, Wolff 1759, Mirbel 1809) the cell-wall was known as the boundary of a structural area; in the second period (Turpin 1826, Schleiden 1838, Schwann 1839) the cell was recognised as a structural unit; in the third period (Leydig 1856, M. Schulze 1861) the cell-content of protoplasm rose into greater prominence; in the modern period (Reinke, Waldeyer) the cell is recognised as an aggregate, a symbiosis, of several independent living substances forming a functional unit. Schlater pleads for a franker recognition of the visible *bioblasts* (granula, microsomes, cytoblasts), morphological and biological (i.e. structural and functional) units, themselves composed of the invisible vital units, which are built up of albuminoid molecules.

Structure of Nerve-cells.‡—Dr. Emil Holmgren expresses gratification at the similarity of results obtained by Dr. Studnička and himself independently from the study of nerve-cells, and describes some further observations of his own on *Petromyzon*, whose nerve-tissue he had begun to study before the publication of Studnička's paper. Before doing this, he gives a brief prefatory account of his observations in the case of the higher Vertebrata. He is convinced that the canaliculi, described by himself and Studnička, do not arise within the cell-body,

* Amer. Nat., xxxiii. (1899) pp. 917-22.

† Biol. Centralbl., xix. (1899) pp. 657-81, 689-700, 721-38, 753-70 (2 figs.).

‡ Anat. Anzeig., xvii. (1900) pp. 113-29 (17 figs.). Cf. this Journal, 1899, p. 580.

but penetrate it from outside. Further, by subjecting the nerve-cells of mammals to an induction current, he finds that the canaliculi become dilated, and it can thus be demonstrated that the whole cell-body is interpenetrated by an intricate network of canaliculi, of which those previously observed are merely the wider portions. As to the ganglion-cells of *Lophius*, he finds that intracellular canaliculi carrying blood-corpuscles are rare; indeed, he is disposed to believe that the canaliculi-containing capsular processes of the spinal nerve-cells are analogous to the intracellular canaliculi of the higher animals.

In regard to the nerve-cells of *Petromyzon*, he thinks that Studnička is mistaken in supposing that the canaliculi there are produced by the confluence of "alveoli" or vacuolar spaces; on the contrary, they have distinct walls staining red with toluidin-erythrosin. Otherwise his observations agree with those of Studnička.

A study of Crustacean nerve-cells has revealed canaliculi in them also, and there their lymphatic function and extracellular origin is unmistakable. The wide distribution of these structures shows that the nerve-cell is of much more complicated organisation than has hitherto been supposed, and that current views on its characters require to be greatly modified.

Vascular Apparatus of Ganglion-cells.* —Prof. A. Adamkiewicz recalls that in 1886 he maintained that a ganglion-cell, e.g. in the intervertebral ganglia of the brachial plexus in man, has a vascular system of its own. The arterial capillaries are continued into intracellular capillaries of a second order, too minute, of course, to have blood-corpuscles, but containing blood-serum. The veins also communicate with intracellular venous channels leading even into the nucleus. To this view he still adheres, and it has been recently re-affirmed by Holmgren and Studnička. Moreover, the author believes that the same holds good for other kinds of cell.

Plasmosomes.†—Prof. J. Arnold brings forward further corroborations in support of his conclusion that the plasmosomes and their modified products, the granula, cannot be regarded as unessential component parts of the cell. He does not deny fibrils, indeed he has himself described them; but he protests against the position of Flemming and others, who maintain that the fibrillar structure is the only important one. Experiments with *intra vitam* staining show that many living cells contain granules, which may be imbedded in threads, or may be linked together in thread-like structures; and it is maintained that the larger stainable granula-like bodies arise from the cell-microsomes or plasmosomes.

Moniliform Neurons in Invertebrates.‡—Dr. J. Havet finds that in earthworms, crayfishes, slugs, &c., the protoplasmic prolongations of the nerve-cells show tag-like appendices resembling those found on the prolongations of the neurons of vertebrates. The moniliform state of the nervous prolongations also exists in invertebrates; it has a more conspicuous expression after the animal has been subjected to the action of chloroform, ether, morphine, strychnine, or chloral.

* Anat. Anzeig., xvii. (1900) pp. 44–8. † Op. cit., xvi. (1899) pp. 607–15.
‡ La Cellule, xvi. (1899) pp. 37–46 (2 pls.).

Reissner's Fibre in the Canalis centralis of Vertebrates.* — Mr. P. E. Sargent finds a continuous rod or fibre lying within the lumen of the *canalis centralis,* apparently the same as Reissner saw in the lamprey in 1860, and apparently the same as an artifact described by various authors. After making sure that it was not an artifact, Mr. Sargent traced its course in various vertebrates, especially Teleosts. It extends through the whole length of the *canalis centralis* of the cord, and continues cephalad through the fourth and third ventricles to the anterior end of the optic lobes. Posteriorly the fibre can be traced with little diminution in size until near the extreme end. Since Sargent's paper was written, Studnička has also described the fibre,† which he regards (according to Sargent, mistakenly) as the result of secretion by the walls of the neural tube.

Nerve-terminations on Striped Muscles of Teleosts.‡ — Dr. F. Supino has examined a large number of Teleosts, and finds that the nerve-terminations on the muscle are not in the form of motor-plates, but branch freely in the muscle. The terminations closely resemble those which Retzius has described in *Astacus.* In Teleostean fishes the form of the termination is variable even in the same animal, and yet more so among different species.

Microcentrum in Smooth Muscle-cells.§ — Prof. M. v. Lenhossek describes in detail, what K. W. Zimmermann has also observed, the microcentrum in smooth muscle-cells (in the circular muscle-layer of the cat's small intestine). The occurrence of the microcentrum in this highly differentiated type of cell is of interest in corroborating the conclusion that the microcentrum is a typical component of the cell. The author suggests that it may act in the smooth muscle-cell as a kinocentrum, as it is supposed to do in some other cases.

Importance of Nucleoli.‖—Herr Rohde emphasises the importance of the nucleoli. In the large ganglion-cells of *Doris, Pleurobranchus,* &c., nucleoli pass from nucleus to cytoplasm, migrate to the periphery, and pass out with a constricted-off portion of cytoplasm. It is a process of ganglion-cell multiplication. In *Doris* the mother-cell persists, in *Pleurobranchus* it is sacrificed to making the daughter-cells, whose nuclei are formed from the nucleoli. In young dogs and cats the chromophilous cells of the spinal ganglion-cells behave in a similar fashion.

Development of Cilia.¶—Dr. A. Gurwitsch has studied this in the ciliary cells of the pharyngeal epithelium and tela chorioidea of salamander larvæ. In the former, the cilia appear first and the basal corpuscles later on, both apparently quite independent of the centrosomes. The second case is rather more difficult, but it seems probable that cilia and basal corpuscles arise as independent differentiations of the same plasma.

* Anat. Anzeig., xvii. (1900) pp. 33–44 (2 pls.).
† SB. böhm. Ges. Wiss., July 1899.
‡ Atti Soc. Venet.-Trent. Sci. Nat., 1898 (published 1899) pp. 382–8 (1 pl.).
§ Anat. Anzeig., xvi. (1899) pp. 334–42 (2 figs.).
‖ Jahresber. Schles. Ges., lxxvi. (1899) 2te Abth., pp. 23–7.
¶ Anat. Anzeig., xvii. (1900) pp. 49–58 (5 figs.).

Hæmolymph Glands.* — Dr. W. B. Drummond has studied these organs in sheep, ox, rat, and dog. While obviously closely related to ordinary lymphatic glands, the hæmolymph glands differ in mode of development, in distribution, and in many details of minute structure. Among these differences the chief are the (usually) comparatively large size of the sinuses, the constant presence of blood in the sinuses, the frequent presence, sometimes in very large numbers, of large hyaline cells containing red corpuscles or pigment in their cytoplasm. There is no sufficient evidence that hæmolymph glands share in the formation of red blood-corpuscles, but they appear to play a very active part in their destruction and in the liberation of pigment, and they are also centres for the formation of white blood-corpuscles. In some respects the structure agrees with that of the spleen, and it is very likely that some of the bodies described as accessory spleens are really hæmolymph glands.

c. General.

Revivification.†—Dr. L. Laloy regards most cases of latent life and subsequent revivification as adaptations either against cold or against drought. He points out that the phenomena are connected by gradations with other phenomena, e.g. the hibernation of plants and animals, and suggests that the secret of the power of reviving may consist in part in an unusually close connection between the water of combination and the protoplasm, and that this admits of the continuance of a minimal amount of molecular movement and metabolism.

Von Baer and Teleology.‡—Prof. Stölzle points out in an interesting historical note that it is erroneous to claim the authority of von Baer in support of the mechanical interpretation of nature, as Kölliker does, for instance, in his recent *Erinnerungen*. It is perfectly clear from von Baer's writings that he was a teleologist, an idealist, to whom purposiveness in organisms seemed ultimately the expression of a metaphysical principle, and therefore more than the necessary result of chemical and physical forces.

Vitalism.§ — Prof. J. T. Wilson devoted the greater part of his presidential address to the Linnæan Society of New South Wales to a consideration of Dr. J. S. Haldane's discussion of the problem of vitalism versus mechanism. Wilson does not dispute that physico-chemical theories of living process have broken down all along the line. Yet mechanism after mechanism has been displayed, through the operation of whose chemical and physical properties the functional activity of the organism is subserved. It is true that the residual phenomena unexplained by these mechanisms may in a sense be held to embody the very essence of the mystery of organisation. This is the penalty of the abstract character of the causal principle employed as the instrument of research. But vitalistic interpretation is not one which comes to our rescue when a physical interpretation fails us. It is present with us at every stage, forbidding us ever to mistake a possible mechanical inter-

* Journ. Anat. Physiol., xxxiv. (1900) pp. 198–222 (3 pls.).
† Biol. Centralbl., xx. (1900) pp. 65–71. ‡ Tom. cit., pp. 34–45.
§ Proc. Linn. Soc. N.S.W., xxiv. (1899) pp. 1–29.

connection of the phenomena of life for the real ground in thought of purposive adaptation.

Introduction to the Study of Organic Evolution.*—Prof. D. Kerfoot Shute has written an introduction to this study, primarily intended for medical students, but sure to be useful in a much wider circle. He hits the mean between over-simplicity and unnecessary technicality, and is clear and interesting in his treatment of protoplasm and the cell, maturation and fertilisation, segmentation and development, heredity and variation, natural selection and isolation, and so on.

The Story of Life's Mechanism.†—In this little book Mr. H. W. Conn gives a useful epitome, in popular language, of the phenomena connected with the living body of both animals and plants:—the structure of the cell and of protoplasm, the phenomena of growth and of reproduction, and other allied subjects. The illustrations are numerous and clear, though often too diagrammatic.

Normal Presence of Arsenic in Thyroid.‡—Prof. A. Gautier has demonstrated the presence of minute quantities of arsenic in the normal thyroid glands of man, dog, pig, sheep, &c. Apart from insensible quantities in the skin, arsenic is absent from the organs of the body except thyroid, thymus, and brain. In the thyroid it exists in combination with nucleins (*arsénonucléines*), along with the usual phosphoric nucleins. It is well known that arsenical medicines have been used with advantage in treating diseases of the thyroid, which adds to the interest of Gautier's discovery. No health apart from the thyroid may be translated no health without arsenic.

Reducing and Oxidising Diastases in the Animal Organism.§—J. Abelous and E. Gérard conclude that in aqueous macerations of the horse's kidney there is a coexistence of a soluble reducing ferment and a soluble oxidising ferment, the presence of the latter perhaps causing the disappearance of a certain proportion of the products due to the former.

Origin of Paired Limbs of Vertebrates.‖—Mr. J. Graham Kerr discusses critically the two hypotheses which have been proposed to account for the origin of the paired limbs of Vertebrates,—the view that the limbs are the persisting and exaggerated portions of a once continuous lateral fin-fold, and the view that the skeleton of the paired limbs and their girdles is derived by modification from a series of gill-rays attached to a branchial arch. He gives his reasons for regarding these suggestive speculations as unsatisfactory, and propounds a hypothesis of his own, that limbs may have been evolved from external gills. These arise (in Urodela) from knob-like outgrowths from the outer face of branchial arches, covered with ectoderm and possessing a mesoblastic core; the "balancers" seem to be serially homologous with them; they crop up in the Crossopterygii, the Dipnoi, and the Urodela, i.e. in three of the most archaic groups of Gnathostomes; they are provided with elevators, depressors, and adductors, and are thus potentially motor organs.

* 'A First Book in Organic Evolution,' London, 1899, 8vo, xvi. and 285 pp., 12 pls. (10 coloured), and 27 figs.
† London, 1899, 218 pp., 50 figs.
‡ Comptes Rendus, cxxix. (1899) pp. 929–36.
§ Tom. cit., pp. 1023–5.
‖ Proc. Cambridge Phil. Soc., x. (1899) pp. 227–35.

Variation and Sexual Selection in Man.*—Mr. E. T. Brewster seeks to show that there is a relation between the conspicuousness of any part of the body and its variability as measured by the coefficient of variability of its dimensions. He offers evidence to prove :—(*a*) that conspicuous dimensions tend to be more variable than other dimensions, e.g. the nose more variable than the rest of the face, the face without the nose more variable than the head ; and (*b*) that sexual selection has brought it about that parts of the body tend to be more variable in proportion as they are of greater æsthetic value.

Blind Rat of Mammoth Cave.†—Prof. C. H. Eigenmann and J. R. Slonaker have obtained specimens of this rat, and have studied the habits of the living animal, as well as the structure of the eye. They find no evidence that it is blind, and no marked macroscopic or microscopic difference between its eyes and those of the common grey rat. The retina seemed to be slightly thicker in the cave rat than in the grey rat ; but so far as the structure of the eye is concerned, there seems no reason why the animals should not see perfectly well.

Blind Fishes of North American Caves.‡—Prof. C. H. Eigenmann publishes a series of papers on certain points connected with these fish. He finds that there are at least six species of Amblyopsidæ inhabiting North America, of which three have well-developed and three vestigial eyes. Those with rudimentary eyes have been derived from normal-eyed forms, but even those with well-developed eyes have these of smaller size and simpler structure than in ordinary fish. The author believes that the condition of the eyes can only be explained as "the result of the transmission of disuse effect."

In association with A. C. Yoder, the same author has made observations on the ear and hearing power of *Amblyopsis*. The auditory organ resembles in all respects that of other fish, but the authors find that there is no evidence that the blind fish, any more than other fish, can hear noises in the strict sense.

Prof. Eigenmann has further studied the blind fish of the Missouri caves, which has been regarded as identical with the *Typhlichthys subterraneus* of Kentucky and Tennessee. He finds that the Missouri form constitutes another species, *T. rosæ*, its resemblance to *T. subterraneus* being merely a case of convergence, due to similar environmental conditions. Further, as it would appear from the structure of the eye that the Missouri form has had a different origin from the Kentucky form, the author proposes to erect for the former a new genus *Troglichthys*. The genus is not defined, and it is not expressly stated whether or not this has been previously done, but the author emphasises the existence of large scleral cartilages, absent in *Typhlichthys*.

Moravian Cave Fauna.§—Herr Karl Absolon considers that his observations on the fauna of the limestone caves of Moravia afford an answer to Verhoeff's ‖ views on cave faunas generally. These caves are especially characterised by their geographical isolation, and by the presence of members of the Thysanura and Acarida, rare in other caves.

* Proc. Boston Soc. Nat. Hist., xxix. (1899) pp. 45–61.
† Proc. Indiana Acad. Sci., 1898, pp. 253–7. ‡ Tom. cit., pp. 239–51 (14 figs.).
§ Zool. Anzeig., xxiii. (1900) pp. 1–6. ‖ Op. cit., 1899.

Verhoeff specially questions the statement that cave animals are blind as an adaptation to their habitat; he believes that, at least frequently, the cave animals are of low organisation, and the blindness is a primitive character. Absolon does not believe that the cave animals are less highly organised than the surface forms, and finds that they are very sensitive to light, and rapidly die when exposed to its influence. He believes that this proves that even where eyes are present they have lost their prime function. Again, Absolon declares himself unable to perceive the cogency of Verhoeff's reasoning in regard to the apparently anomalous distribution of *Brachydesmus subterraneus*; to him this distribution appears to afford a strong argument in favour of the existence of a true subterranean fauna. Further, in Moravia a cave which had not had any communication, direct or indirect, with the exterior for many centuries, was found on its discovery to possess the typical Moravian cave fauna.

In another communication * Absolon pursues the argument from the wide distribution of the cave fauna. The animals must be supposed to have originally reached the caves either actively, by their own movements, or passively by floods or as parasites, &c. Their subterranean distribution would thus depend upon their distribution, past or present, above ground. Thus *Lipura stillicidii* only occurs in caves, and occurs in such widely separated localities as Ireland, Carniola, and Moravia; it must be supposed to have had a former surface distribution over the whole of Central Europe, from Ireland to the Danube.

Again, other things being equal, the fauna of the caves of a district will depend upon the surface fauna of the district; hence the abundance of Thysanura and Acarids in Moravian caves, for these groups are specially abundant in Moravia generally. As the modification of surface forms into cave forms is still going on, there are many subterranean forms which also live at the surface, though often in diminished numbers. The author believes however that the Moravian cave fauna has been in existence since the deposition of the diluvium; for the Slouper cave, which he believes was entirely closed from that period till its opening in 1890, contained the typical fauna.

Eyes of Cave Salamander.†—Prof. C. H. Eigenmann and Mr. W. A. Denny have obtained larvæ and adults of *Typhlotriton spelæus*, and find that in the larvæ the retina closely resembles that of *Amblystoma*, all the layers being well developed, but in the adult the rods and cones and outer molecular layer appear to be absent.

Temperature of Fowls.‡—Dr. Ch. Féré has made observations on this with some interesting results. Hunter put it at 39·4–40° C., Davy at 42·2–43·9°, Prévost and Dumas at 41·5°, and there have been other estimates not less diverse. Féré made observations on birds which were accustomed to be handled.

The most frequent figure is 41° and a fraction, but the temperature rises with excitement, falls in hypnosis, and also during incubation, approximating somewhat towards that (38–39°), which is most favourable

* Op. cit., xxiii. (1900) pp. 57–60. † Proc. Indiana Acad. Sci., 1898, pp. 252–3.
‡ Journ. Anat. Physiol., xxxv. (1899) pp. 808–16 (9 tracings).

to the development of the chick. In cocks it is usually 42° and a small fraction, but they are more perturbed by the experiment.

Colour Variation in the Swan.* — F. A. Forel has an interesting note on this subject. In 1868 he noted the sudden appearance in a brood of cygnets of *Cygnus olor* L. hatched at Morges, of a well-marked colour variety. The cygnets displayed a white instead of a grey down, their first feathers were also white, the beak and feet a greyish-rose colour. The eye was normal, and no signs of weakness of any sort were apparent; this sport he described as false albinism. Since 1868 the variety has appeared in increasing numbers in the half-wild swans of the Lake of Geneva, and has also occurred, though less frequently, in the domesticated swans of the town. The origin both of the town swans and of those of the lake is known, and also the date of the first appearance of the variety. Since its first appearance it has reappeared each year in most of the broods of the different shores of the lake, so that there is every reason to believe that the variety will in the course of time become fixed as a new species. It is to be regarded as a progressive variation, for it is virtually a premature adoption of the adult tints. An interesting point is that the same variety has, although very rarely, made its appearance elsewhere, e.g. at Nîmes in 1898 in one cygnet in a brood of six typical forms.

Accessory Bladders of Turtles.† — Mr. F. W. Pickels finds these organs in semi-terrestrial and semi-aquatic Testudinata; they are wanting or greatly reduced in the strictly aquatic and strictly terrestrial forms. "The author believes that these bladders are receptacles for liquid stored up for the use of the animal, but he could not confirm the statement of earlier observers that the fluid was water taken in through the cloaca."

Peculiar Salamander.‡ — W. E. Ritter and Love Miller give an interesting account of some of the peculiarities of *Autodax lugubris* Hallow, one of the Plethodontidæ, confined along with two other species to western North America and almost entirely to California. It is entirely terrestrial, and seems to be indifferent even to a proximity to water; like many of the long-tailed amphibians it is lungless; the author's observations support the view recently defended by Bethge that, in the absence of both gills and lungs, respiration is performed by the mouth-epithelium and the integument together, each taking an essential part. In regard to the embryos, particular attention is directed :—(*a*) to the great quantity of yolk in the eggs and the abundant vitelline circulation; (*b*) to the very large three-lobed gills; and (*c*) to the entire absence of a larval period, even the gills having almost entirely disappeared at the time of hatching. It is to be hoped that we shall soon have full details in regard to the development of this interesting form.

Salamanders with and without Lungs.§ — Dr. E. Lönnberg adds two species to the list of salamanders that are normally without lungs,

* Arch. Sci. Phys. et Nat., viii. (1899) pp. 490–1.
† Zool. Bull., ii. (1899) pp. 291–301. See Amer. Nat., xxxiii. (1899) pp. 976–7.
‡ Amer. Nat., xxxiii. (1899) pp. 691–704 (7 figs.).
§ Zool. Anzeig., xxii. (1899) pp. 545–8.

namely *Spelerpes longicauda* Green and *Sp. guttolineatus* Holbrook. He gives a list of twenty-one species without lungs or with vestiges only. In regard to the forms with lungs, he divides them into two sets:—(1) those in which the lungs extend to the groin, and measure about 60 per cent. of the length of head and body; and (2) those in which the lungs extend only about half-way between axilla and groin, and measure only from 38 to 45 per cent. of the length of the head and body. Camerano's suggestion that the lungs may be important as hydrostatic organs is noticed, but it is pointed out that the lungless forms are not necessarily obliged to lead a terrestrial life.

Psychology of Fishes.*—Mr. E. Thorndike describes a simple but instructive experiment with *Fundulus*, which learned in a short time to find its way about in an aquarium where artificial obstacles, keeping it from the shady corner, were from time to time inserted. The fish, though its fore-brain lacks a cortex, clearly profited by its experience, and modified its conduct, to suit a situation for which its innate nervous equipment did not definitely provide. In common language, it *learned* to get out of a difficulty.

Electric Organ of Malapterurus.†—Mr. F. Gotch and Mr. G. G. Burch have measured the electromotive force of the organ shock, and the electrical resistance of the organ of *Malapterurus electricus*. The fish was anæsthetised by immersion in ice-cold water, and then killed, and the organ removed and kept in a moist chamber at a temperature of 5° C. One minor result was to show that the only excitable structures of the organ are the nerve-endings, the organ discs apart from the nerve-endings being inexcitable. Further, each disc with its nerve-endings constitutes an independent system, and the excitatory charge cannot be propagated from one system to another. The maximum electromotive force for the whole fish must be at least 200 volts. The electrical resistance of the organ was found to be two or three times greater in the longitudinal than in the transverse direction.

Habits of Polypterus.‡—The late Mr. N. R. Harrington made some interesting observations on the habits of this little known fish which he studied in the Lower Nile. It lives in the deeper depressions of the muddy river-bed, but is an active swimmer; it swallows living Siluroids and other Teleosts. In swimming it moves its head freely from side to side; there is no evidence that it uses its fins for walking or crawling. Although the fish was not often seen taking in air, there is evidence that a respiratory function is possessed by the swim-bladders or lungs, e.g. the marked peristalsis observed making its way along the larger (right) lobe when the fish is opened alive.

There are many reasons for believing that the fish does not migrate to salt water, e.g. a slight increase in salinity kills it. The males are smaller than the females and much less numerous. The breeding time is probably during or just after the inundation of the Nile. The anal fin of the male is used as a copulatory organ.

There is great practical difficulty in keeping *Polypterus* in confine-

* Amer. Nat., xxxiii. (1899) pp. 923–5 (2 figs.).
† Proc. Roy. Soc. London, lxv. (1900) pp. 434–45.
‡ Amer. Nat., xxxiii. (1899) pp. 721–8.

ment, for it is not a hardy fish. It will not survive more than three or four hours out of water, and then only under the most favourable conditions. "Physiologically at least, therefore, *Polypterus* has not evolved very far toward a land-living or even an air-breathing type, although morphologically, i.e. especially in its organs of respiration and circulation, it certainly presents the essential characters of the lower amphibia. . . . On the other hand, in the possession of spiracles and in primitive skeletal characters, it strongly resembles the oldest fishes (Elasmobranchii). Several writers have recently contributed very convincing evidence that crossopterygians were lineal ancestors of the higher vertebrates; but, judging from the conditions in *Polypterus*, they were also sufficiently remote in the phylum of vertebrates to have given rise to both dipnoans and amphibians."

Effect of Starvation on Fishes.*—Prof. E. Yung and Dr. O. Fuhrmann have investigated this subject by keeping fish under precisely similar conditions, save that while one set were furnished with abundant food, the other set were unfed. Thus two pike (*Esox lucius*) of the same size were kept under observation for eight months under these conditions. At the end of this time both were killed, and the gut in each case subjected to careful examination. In A (the fed specimen) the gut was invested by fat, totally absent in B (the starved specimen). Further, in B the gut was relatively shorter, the folds of the mucous membrane of stomach and œsophagus had become indistinct, and the whole tube had become greatly reduced. The reduction of its wall did not affect all the elements equally, but was greatest in the epithelium, whose elements were much reduced in size, while the other constituents were affected in the following order:—glandular elements, connective-tissue layer of mucosa and sub-mucosa, finally, least of all, the circular and longitudinal muscular layers. The liver in B was much reduced in size, and its constituent cells were 8–10 times narrower than those of A, but this reduction chiefly affected the cytoplasm, the nucleus being reduced only by about one-half.

Experiments on the Electric Organ of Torpedo.†—Herr S. Garten has observed the effects of cutting the nerve which supplies the electric organ, and of poisoning with curare and veratrin. Without going into details, we may note the general conclusion that all the phenomena are reconcilable on the view that the terminal nervous expansion or a structure intimately bound up therewith is the seat of electromotor activity. This is specially supported by the fact that after the nerve is cut the organ becomes rapidly unexcitable either directly or indirectly. The muscular origin of the electromotor activity is rendered improbable.

Function of Cæcum in Lancelet.‡—Herr Guido Schneider has made some experiments on living lancelets which go to show that the cæcum or liver has to do with excretion. Ammoniacal carmine, whether introduced through the alimentary canal or otherwise injected, is afterwards found in the liver-cells. These elements contain excretory vacuoles in the parts towards the lumen of the cæcum, and very minute pigment-granules

* Arch. Sci. Phys. et Nat., viii. (1899) pp. 483–5.
† Abh. K. Sächsisch. Ges. Wiss., xxv. (1899) pp. 253–366 (4 pls.).
‡ Anat. Anzeig., xvi. (1899) pp. 601–5 (2 figs.).

in the cytoplasm of the basal parts. Iron is frequently found in the cells of the lateral walls of the liver, and is always present after some solution of ferrum oxydatum saccharatum has been added to the sea-water.

Tunicata.

Oogenesis in Tunicates.*—Mr. F. W. Bancroft has made an elaborate series of observations on this subject, with special reference to a Californian species of *Distaplia*, apparently nearly allied to *D. rosea*. The development of the gonads conforms in general to the type first described by Van Beneden and Julin, and the zooids are always hermaphrodite, the organs being simultaneously functional. In regard to the incubatory pouch, it would appear that this has a direct connection with the oviduct, so that the ova can be passed into it without entering the peribranchial sac. As to the vexed question of the origin and function of the "test-cells" or kalymmocytes, the author finds no evidence for the view that they have an intraovular origin, while there is every reason to believe that they are migratory follicular cells, whose function is to feed the ovum. He opposes the old view, recently supported by Salensky, that they have anything to do with the formation of the test, and in a postscript to the paper adheres to this position after having had an opportunity of inspecting Salensky's sections.

As in *Distaplia magnilarva* according to Davidoff, the whole of the cytoplasm is converted into yolk-bodies, and the formation of yolk is associated with a gradual shrinkage of the germinal vesicle. In his interpretation of the changes in the vesicle the author differs markedly from Davidoff, who, as he thinks, has confused nucleolus and germinal vesicle. The process of maturation was not observed in detail.

Maturation and Fertilisation in Ciona intestinalis.†—Herr St. Golski notes the following points:—the germinal vesicle is very large and contains a very large nucleolus; the directive spindles are very small; the retraction of the spindle is subsequent to fertilisation; the directive spindles show distinct centrosomes, central spindle, and intermediate body; they are first tangential and then radial in position; the first polar body often divides into two; the sperm-centrosome comes from the middle portion and gives rise to the cleavage centrosomes; polyspermy sometimes occurs; the occurrence of central spindles and intermediate bodies was observed in the segmentation.

INVERTEBRATA.

Mollusca.

Bionomics of Mollusca.‡—F. N. Balch publishes a list of marine molluscs found in a somewhat isolated area (Coldspring Harbour, Long Island), the interest of which is its general bearing on the conditions of life of the littoral Mollusca. The physical conditions in the area are uniform, and the bottom deposit everywhere morainic mud with a few boulders and stones. Nevertheless, the mollusca are of distinctly varied

* Bull. Mus. Comp. Zool. Harvard, xxxv. (1899) pp. 59–112 (6 pls.).

† Anz. Ak. Wiss. Krakau, 1899, pp. 124–30. See Zool. Centralbl., vi. (1899) pp. 945–6.

‡ Proc. Boston Soc. Nat. Hist., xxix. (1899) pp. 133–62 (1 pl.).

type, rock-haunters, sand-dwellers, &c., being all well represented. It would thus appear that the actual bottom deposit is of less importance as a determining factor than such characters as absence of currents, specific gravity of water, percentage of organic matter, &c. The fauna shows an intermixture of northern and southern forms, the latter being about twice as numerous as the former.

Among the Nudibranchs a form occurred similar to the species of *Corambe* but without the anal notch, and therefore placed in *Corambella* g. n. as *C. depressa* sp. n.

γ. Gastropoda.

Glycogen in Snails and Slugs.* — Dr. Charles Creighton, in the course of his investigations on glycogen, has studied it in Invertebrates generally, and finds that it is abundant in Mollusca, especially the Pulmonata. In them it occurs in the "plasma-cells" of Brock which are so characteristic of these animals. These cells surround both the arteries and the venous sinuses, constitute a peritoneal endothelium, form a sheath round the nerves, and also occur in connection with the muscles. The author regards them as constituting a prototype of the lymphatic system of Vertebrates. Morphologically they may be compared to the glycogen-containing cells found investing blood-vessels in the embryo chick, which become actual lymphatic cylinders. Again they can be shown to be physiologically the equivalents of the Vertebrate lymph system.

Origin of Asymmetry of Gastropods.† — Prof. Karl Grobben has always been of opinion that the deep-seated torsion of the Gastropod and the superficial coiling of the viscera stand in intimate causal relation to one another. This is indeed the position which has been held by the majority of authors; it is the question as to which is cause and which is effect which has given rise to so much discussion. After summarising the views of others up to date, the author proceeds to the statement of his own conclusions. In the first places, he correlates the anterior position of the anus to the possession of a shell (cf. Bütschli and Lang); such cases as *Phoronis*, the Polyzoa, and *Sipunculus*, showing that this anterior position is a necessary adaptation to life in a tube or in sand. But in the Gastropod body there are, as it were, two points of fixation, the dorsal attachment of the visceral hump to the shell, and the ventral attachment of the foot to the substratum. In consequence, the shifting of the anus can only take place laterally, and its movement involves a twisting of the pallial complex. This usually takes place to the right, but may exceptionally be left-handed, and involves the production of asymmetry in the visceral hump. The spiral coiling of this is in the first place determined by an increase in size of the mantle cavity and of the visceral hump, and is favoured by natural selection on mechanical grounds. These views are illustrated by figures showing stages in these structural modifications, and lead to the conclusion that the ancestral Gastropod had a large visceral hump and a creeping sole. The deep-seated torsion and the spiral coiling arose simultaneously as the visceral hump increased in size.

* 'Microscopic Researches on Glycogen,' part ii., London, 1899, 127 pp., 9 pls.
† Arbeit. Zool. Inst. Wien, xii. (1899) pp. 25–44 (8 figs.).

Anatomy of Pleurotomaria.*—MM. Bouvier and Fischer have been enabled to dissect a specimen of *P. quoyana* obtained by the 'Blake,' and prefix to their paper a general account of the existing species, of the specimens hitherto obtained, which in most cases have been shells only, and of our previous knowledge of the structure, which is very scanty.

They find that the radula differs markedly from that of the other Scutibranchia, especially in the absence of a distinct division into central and lateral regions, for there is a gradual transition from central to lateral teeth. There are also remarkable and characteristic triangular and brush-shaped teeth. The eye is a simple cup open to the exterior. In the otocysts there are a large number of simple otoliths of very unequal size—a very primitive character. The nervous system in essentials resembles that of the Trochidæ and Fissurellidæ, but in its minor details seems to recall that of the Amphineura. Further, it appears to shed light on the vexed question of the origin of the pedal nerves, and the relation of pedal and pallial ganglia in Gastropods in general. In *Pleurotomaria* the pallial ganglia appear to be absent, but in reality lie side by side with the pedal. A detailed comparison of this condition with those obtaining in other Gastropods leads the authors to the conclusion that the "pedal" nerves, so-called, of all Gastropods are of mixed pedal and pallial origin, and that the "pallial" ganglia are merely an anterior portion of the true pallial ganglia, the posterior portion being fused with the pedals. In *Pleurotomaria* this anterior separation of a part of the pallial ganglia does not occur, and a deep groove separates the pedal from the undivided pallial ganglion at each side. Adopting this view of the homologies of the Gastropod ganglia, the authors discuss in detail the probable evolution of the Prosobranch nervous system, showing how the condition seen in *Pleurotomaria* may be regarded as transitional between that of the Amphineura and the Prosobranchs generally. The details of the argument cannot be rendered clear without figures, but the general result is to suggest that *Pleurotomaria quoyana* must be regarded as one of the most primitive of Gastropods.

Gonads and Nephridia of Prosobranchia.†—Prof. B. Haller criticises Pelseneer's ‡ recent paper on primitive Mollusca, and especially the views expressed in it as to the relations of nephridia and gonads. Haller's own views as to the phylogeny of the gonads of Mollusca are based on the assumption—admitted by Pelseneer—that these were originally paired organs, as they are in *Chiton*. In the absence of a connection between gonads and nephridia, however, *Chiton* shows a less primitive condition than the simpler Gastropods, where the right nephridium is connected with the reproductive organ. In both the Monobranchiate and Cyclobranchiate Docoglossa, according to Haller, there is a ventral cœlomic space divided into two by a sagittal mesentery. Pelseneer, on the other hand, regards the right half of this space as a part of the right nephridium, a view for which Haller believes there is no evidence. According to him, in the Cyclobranchiate Docoglossa the gonad developes directly from the epithelium of the secondary body-

* Bull. Mus. Comp. Zool. Harvard, xxxii. (1899) pp. 193–249 (4 pls. and 6 figs.).
† Zool. Anzeig., xxiii. (1900) pp. 61–6.
‡ Bull. Acad. Roy. Belgique, lviii. (1899).

cavity, and sheds its products into the cœlom, whence they reach the right nephridium. He believes further that there are or were Gastropods which had paired gonads related respectively to right and left nephridia. From such forms the Docoglossa originated by the union of the gonads and the degeneration of the left nephridium. In the forms from which the Rhipidoglossa arose the connection between right nephridium and cœlom was lost owing to the modification of a part of the latter to constitute a genital duct. Haller also criticises in detail certain of Pelseneer's figures and statements.

Relations of Land Molluscan Fauna of South America.*—Mr. H. A. Pilsbry has recently discussed this interesting question, but only a summary is published. The evidence of former austral land connecting South America with Australasia (derived from a study of Bulimulidæ, Macroögona, &c.) is discussed, and reasons are given for preferring the hypothesis of a former extension of Antarctic land to that of a South Pacific continent as advocated by Hutton and others. The present Polynesian fauna is not consistent with the supposition that these islands are outgrowths from or remnants of a submerged Pacific continent. It is maintained that the neotropical region of Wallace is composite, the Antillean and southern Mexican area representing a tract independent from North and South America in Mesozoic and perhaps earlier times, on which the faunal problems had been independently worked out.

Structure of Neritina.†—Prof. J. Lenssen describes, in this instalment of a proposed monograph on *Neritina fluviatilis*, the alimentary and reproductive systems. Considerable space is given to the bucco-pharyngeal apparatus, including the cartilage and muscles of the radula. The œsophagus shows two remarkable ciliated grooves which may perhaps represent the œsophageal salivary glands of other Prosobranchs. On the internal surface of the complex stomach wall there is an interesting ridge of doubtful function, and the minute structure of the whole region is very remarkable.

Claparède's description of the female apparatus is corrected. What is most remarkable, perhaps, is the occurrence of two apertures—one for impregnation and one for copulation. This arrangement is due to a bifurcation of the oviducal canal. Special attention is paid to the glands of the uterus, and to their process of cellular excretion. To the male apparatus there is but one opening; it has an interesting glandular annex, ciliated internally, and with parietal cells analogous to those of the uterus.

δ. Lamellibranchiata.

Affinities of Solemyidæ.‡—Dr. Walter Stempell has investigated the anatomy of *Solemya togata* Poli, as a supplement to his work on the Nuculidæ, with the special object of determining the value of Pelseneer's order Protobranchiata, constituted by these two families. The anatomy of the form is described in detail, and is illustrated by some admirable figures; but we can here only notice the bearing of the results on the general question.

The author accepts the order Protobranchiata with the following

* Proc. Acad. Sci. Philadelphia, 1899, p. 226.
† La Cellule, xvi. (1899) pp. 179–232 (4 pls.).
‡ Zool. Jahrb. (Abt. Anat.), xiii. (1899) pp. 89–170 (3 pls.).

definition:—Lamellibranchiata with a flattened sole, buccal tentacles, the atrial opening placed at the anterior end of the gill-axis, filiform gills, kidney-tubes of uniform histological structure, short nerve-connectives and distinctly separated pleural ganglia, and otocysts with a persistent connection with the exterior. The other elements of Pelseneer's definition he rejects as not exclusively characteristic, but these points are sufficient to justify the claim of the Protobranchiata to be the most primitive of the Lamellibranchs. The two families of the order show well-marked differences, the Solemyidæ differing from the Nuculidæ in regard to the following points:—The dermal musculature is well developed and the protractor pedis is absent; the ventral margins of the mantle folds show extensive union, and there is a characteristic branchic-anal siphon; there are numerous minute peculiarities in regard to the shell (position of ligament, &c.); the buccal processes and tentacles are rudimentary; the alimentary canal is short and simple; the ventricle of the heart is greatly elongated, and there is a pericardial gland on the wall of each auricle; the gills differ both in size and position from those of the Nuculidæ; the nephridia have no cæca, no cross communication, and compared with those of the Nuculidæ occupy a reversed position in the body. Further, the reproductive ducts open into a different region of the nephridia compared with those of the Nuculidæ, and there are some minor differences in regard to the anatomy of the nervous system. Many of these points have reference to the burrowing habit of *Solemya*, and are to be looked upon as adaptations to life in the sand, so that the Solemyidæ are more specialised forms than the Nuculidæ. This agrees with Pelseneer's conclusions, but the author is unable to accept the suggestion that the former have been derived from the latter. Apart from their adaptive modifications the Solemyidæ in some points display greater simplicity than even the Nuculidæ, facts which the author explains as resulting from the peculiar nature of the environment, which is such that the animals are in part protected from the struggle for existence. The two families are therefore to be regarded as having originated from a common ancestor of simple and primitive structure, and both retain many primitive characters, though adapted for very different habitats.

Arthropoda.

α. Insecta.

Segmentation of the Insect Head.*—Mr. J. W. Folsom has studied this question in Apterygota. He upholds the segmental character of the intercalary region between the antennary and the mandibular segment, which in certain adult Collembola bears what are interpreted as rudimentary appendages. The superlinguæ (paraglossæ of the hypopharynx) are also regarded as appendages, and it is stated that there are seven pairs of cephalic ganglia in the embryo of *Anurida*, a genus of Collembola. Dr. Heymons, in reporting on this paper, points out the need for caution in transferring conclusions drawn from a study of the Apterygota to other insects.

Rôle of the Adipose Tissue in Metamorphosis.†—Sig. A. Berlese has studied this question in a large number of cases, and has reached

* Psyche, viii. (1899) pp. 391–4. See Zool. Centralbl., vii. (1900) pp. 32–3.
† Rev. Patol. Vegetal., viii. (1899) pp. 1–155 (6 pls. and 42 figs.).

the following conclusions. In the less evolved Diptera (Tipulidæ, Culicidæ) the larval adipose tissue is preserved in the adult stage. In Brachycera and Pupipara the imaginal adipose tissue is a new formation, derived from mesodermic elements, namely from the larval muscular tissue which has been disrupted. In all cases the adipose tissue is the seat of the deposition of albuminoid substances during the nymph period, derived either from the food ingested at the very end of the larval stage or from the destruction of larval organs. In carnivorous forms the deposition of the albuminoid substance is very late, and does not commence until the larva ceases to feed and begins to dispose itself for transformation into the nymph. In vegetarian forms the deposition is earlier and begins during the maturation of the larva, sooner too in those which eat fresh vegetable stuff than in those which devour rotting food.

Egg-carrying Habit of Zaitha.* — Florence W. Slater has some interesting notes on the habit that certain bugs of the family Belostomidæ (e.g. *Zaitha fluminea* and *Serphus dilatatus*) have of carrying their eggs on the back until they are hatched. Those who have described this habit seem to have taken for granted that it is the female who carries the eggs. But in the case of *Zaitha* at least it is the male. The eggs are placed, not without much resistance, by the female on the upper side of the wings of the male; he is unable to fly, and chafes under his burden. Occasionally one was seen brushing the eggs carefully to free them from foreign particles, but most tried to kick them off.

Wing-Muscles.† — Dr. L. Petri has made an elaborate study of the musculature of the wings in Diptera and Hymenoptera; and, by means of a diagrammatic projection of these in three layers, makes it possible for the reader to get some glimpse of the differences and agreements that obtain between the various types.

Collembola and Thysanura of Edinburgh District.‡ — Messrs. G. H. Carpenter and W. Evans give a list of four species of Thysanura and fifty-nine of Collembola, and they compare their results with those from Scandinavia, Finland, and around Hamburg. Most of the Edinburgh species are widely distributed over the Palæarctic region. It is difficult to say exactly how many species have been recognised in the British Isles. Roundly, the number may be stated at about 75 Springtails and four Bristle-tails, of which all the latter, but only 63 of the former, have as yet been found in Scotland.

Is there Parallelism between Old and New World Odonata? § — Dr. P. P. Calvert notes that when the exclusively American genera *Dythemis*, *Paltothemis*, *Brechmorhoga*, *Scapanea*, and *Macrothemis*, are compared with *Schizonyx*, *Pseudomacromia*, and *Zygonyx*, genera confined to the Old World, it is evident that in spite of the resemblance in many peculiarities, no complete parallelisms in structure exist. "We do not yet know enough of the relationships of the Libellulinæ to enable one to form an opinion on this question: Have the peculiar forms of the

* Amer. Nat., xxxiii. (1899) pp. 931–3.
† Bull. Soc. Entomol. Ital., xxxi. (1899) pp. 1–45 (3 pls. and diagrams).
‡ Proc. Roy. Phys. Soc. Edinburgh, xiv. (1898–9) published 1900, pp. 221–66 (4 pls.).
§ Proc. Acad. Nat. Sci. Philadelphia, 1899, pp. 245–53.

tarsal nails and of the femoral armatures been independently acquired by these New World and Old World genera, or are they inheritances from a common ancestor? Of the physiological significance of these structures we know absolutely nothing."

Commensalism of Termites and Fungi.*—Herr C. Holtermann has found a new illustration of this phenomenon in Java. The walls of the chambers of the underground termite-nests are clothed with the mycele of a fungus, forming heads in which oidia are developed, which form a large part of the food of the termites. When cultivated independently the termite-nests give rise to an agaric belonging to the subgenus *Pluteus*, which, however, was not identified with the above-named fungus.

Stigmata of Rhynchota.†—Herr A. Handlirsch notes the extraordinary diversity of the answers given to the question: How many stigmata have the Rhynchota? He shows that the fundamental type has ten pairs of stigmata, two on the meso- and meta-thorax, and eight on the first eight abdominal segments. The exceptions, especially the reductions in parasitic forms, are discussed.

Digestion in Cockroach.‡—Herr A. Petrunkewitsch has studied the histology of the alimentary canal, and the physiology of digestion, in *Periplaneta orientalis* and *Blatta germanica*, with special reference to the crop, and has obtained some novel results. He finds that the intima of the crop consists of two layers, of which the outer is distinctly porous, while the inner shows no trace of pores. Nevertheless, the author believes that such pores must exist; for he finds that, both in the living animal and in the removed intima, oil-drops pass through it, and in the former case can be demonstrated in the epithelial cells. The epithelium contains three kinds of cell:—(1) polygonal cells with large nucleus and granular cytoplasm; (2) large polynucleated cells; and (3) vacuolated cells with 1–3 curved nuclei. These are not independent elements, for (2) and (3) arise from (1), and (2) may again by division give rise to several uninuclear polygonal cells. The crop is interpenetrated by fine tracheal branches, which end either in the lacunar spaces between epithelium and muscularis, or actually penetrate the epithelium. In the first case, the tracheal end-cells give off fine protoplasmic processes (tracheal capillaries), which are connected with the fibrillæ of the muscularis; in the second case, the end-cell usually insinuates itself between two epithelial cells, from which it can be readily distinguished histologically.

As to physiology, the author finds that the crop is the main organ in which digestion and absorption occur, the mid-gut playing a more insignificant part. Further, he finds that "tracheal digestion" takes place; in other words, the tracheal end cells directly absorb food from the crop, and transmit this to the tracheal lumina. Within the tracheæ it is subjected to a spiral movement, being swept round the grooves of the lining, and is gradually absorbed by the peritracheal cells. Thus the tracheæ are in large measure nourished directly from the crop, though they may also in part depend upon the blood.

* Festschr. f. Schwendener, 1899, pp. 411–20 (1 fig.).
† Verh. Zool.-bot. Ges. Wien, xlix. (1900) pp. 499–510 (2 figs.).
‡ Zool. Jahrb. (Abt. Anat.), xiii. (1899) pp. 171–90 (1 pl.).

Cricket's Chirps and Temperature.*—Mr. R. T. Edes corroborates what Prof. A. E. Dolbear previously noted in regard to the relation of the cricket's chirping to the temperature. He observed the tree-cricket, *Œcanthus niveus*, and found on the whole that Dolbear's formula fits. Let T = temperature in degrees Fahrenheit; n = number of chirps per minute; then $T = 50 + \frac{n - 40}{4}$. This would give 100 chirps per minute for 65°, and more when it is warmer. Keats was right in speaking of "the cricket's song, in warmth increasing ever." A comparison with the rhythm of the pulse as affected by temperature in fever is suggested.

Sexual Dimorphism in Beetles.†—Mr. G. T. Arrow, in publishing a systematic paper on the genus *Parastasia*, notices that sexual dimorphism is practically universal in the genus, and secondary sexual modifications occur to about an equal degree in both sexes. The author is unable to suggest any explanation of the meaning of this phenomenon, but believes that it is commoner in insects than has been supposed.

New Termitophilous and Myrmecophilous Beetles.‡—Herr E. Wasmann describes a number of new forms from India. Of especial interest are two Aphodia (*Chætopistes sulciger* and *Corythodorus gibbiger*) which have degenerate mouth-parts. Only the first maxillæ are developed, and the suggestion is plausible that these guests get their food from the mouths of the termites.

Pygidial Glands of Pheropsophus bohemani Chaud.§—Herr Fr. Dierckx has had an opportunity of dissecting this beetle, and finds that it has more elaborate defensive organs than any Bombardier beetle yet described. Each gland consists of twelve lobes, each with its own duct, and each lobe consisting of ten lobules. The twelve ducts open into a reservoir, which in its turn opens into a chitinous capsule communicating by a short broad canal with the exterior. The surface of the capsule is covered by unicellular glands, which appear to furnish the particles of solid matter (*mitraille*) ejected at the explosion, together with the volatile liquid. The author therefore abandons his original suggestion that these solid particles are produced by the pulverisation of fæcal matter.

Development of Wing-covers of Beetles.‖—Herr E. Krüger finds that the wing-covers of beetles arise from a primordium identical with that which gives origin to the posterior wings. The growth of the two structures is for a time parallel, and then the wing-covers diverge. The wing-lamellæ are further apart than in the posterior wings; the chitinisation is much more abundant; there is no venation; a secondary internal cavity, crossed by chitinous bridges, developes in communication with the cavity of the body. In short, the anterior wings in beetles are not to be regarded as wings inhibited at an early stage in their development, but as divergent structures specialised in relation to a new function. The author follows the development from the imaginal fold stage on-

* Amer. Nat., xxxiii. (1899) pp. 935–8.
† Trans. Ent. Soc. Lond., 1899, pp. 479–99 (1 pl.).
‡ Deutsche Entomol. Zeitschr., 1899, pp. 145–69 (2 pls.). See Zool. Centralbl., vii. (1900) p. 38.
§ Zool. Anzeig., xxiii. (1900) pp. 15–8 (3 figs.).
‖ Inaug. Diss. Göttingen, 1898. See Biol. Centralbl., xix. (1899) pp. 779–83.

wards, and also takes account of the development of the musculature, the glands (in *Lema*, &c.), and the chitinous spines.

Egg-laying of Hydrophilus piceus.*—Dr. Fischer-Siegwart describes the process of cocoon-formation and egg-laying in this beetle. A specimen kept by him in captivity produced three cocoons at intervals of three days, each cocoon giving rise to about fifty larvæ. The period of development is about five days, the larvæ quitting the cocoon on the sixth day. At the time of emergence the larvæ are 12–15 mm. in length.

Pygidial Glands of Carabidæ and Dytiscidæ.†—Fr. Dierckx gives a very detailed account of these structures. In Carabidæ the pygidial gland is situated on some part of the rectum; it always consists of a more or less compact group of pseudo-acini, a collecting canal, and a reservoir. The extremely volatile, indeed explosive, secretion was studied in *Brachinus crepitans*. In Dytiscidæ the pygidial gland is double; it consists of a long intestine-like secretory tube with one or two lateral diverticula, and of a slightly muscular ovoid reservoir communicating with the exterior by a tortuous canal of minute calibre. The discharging pores are found on the posterior fold of the pygidium, in front of the anal sphincter. It does not seem to be defensive, but rather an oil-gland, facilitating respiration. The true defensive structure is the rectal pouch. But this brief report does not sufficiently suggest the thoroughness of the study which Dierckx has made.

Larva of Eristalis tenax L.‡—Herr Bruno Wahl has made a special study of these "rat-tailed" larvæ, directing his attention chiefly to the respiratory system and the imaginal discs. In studying the tracheal system, it was found that beautiful preparations could be obtained by injecting glycerin into the body-cavity. The glycerin rendered all the tissues quite transparent, so that the whole tracheal system showed up clearly. The system is of the metapneustic type, the stigmata in the tail being the only ones open. The gross anatomy of the system is described in detail, the most notable point being that, in addition to the segmentally arranged tracheal branches, there are others which show no relation to the segments. The "anal gills" are also described in detail. They are twenty in number, and are blind tubular outgrowths of the hind-gut, so that they are ectodermal in origin. They can be protruded and retracted by special muscles, and contain tracheæ which are probably to be regarded as specially developed branches of the gut-tracheæ of the eighth segment. Apparently they function as accessory respiratory organs in cases where the surrounding mud is peculiarly foul; in the everted condition they exhibit rhythmic movements. In the "tail" or breathing-tube are two tracheal stems which expand into stigmatic chambers at the tip. These each open by two permanently gaping orifices to the exterior. Accompanying the tracheæ are two slender canals which open to the exterior beside the stigmatic openings, and are the ducts of certain remarkable unicellular glands placed in the breathing-tube. The secretion is oily, and seems to have a double function:

* Arch. Sci. Phys. et Nat., viii. (1899) pp. 494–5.
† La Cellule, xvi. (1899) pp. 63–176 (5 pls.).
‡ Arbeit. Zool. Inst. Wien, xii. (1899) pp. 45–98 (5 pls. and 2 figs.).

it probably helps to prevent the access of water to the tracheæ, and it also assists the larvæ in taking advantage of surface tension, enabling them to hang by their tails from the surface, the body swinging freely in the water while the stigmata are exposed to the air.

The fact that the author obtained specially clear preparations of the tracheal system enabled him to make minute observations on the tracheal capillaries. His conclusions, which he regards as true for insects in general, are stated as follows:—The tracheal system consists of spiral tracheæ, with flattened epithelium, intima, and spiral threads, and of tracheal capillaries, which are intracellular canals in the protoplasmic outgrowths of the tracheal end-cells. These capillaries branch and anastomose freely, forming the so-called capillary network, but the meshes of this network are in no way differentiated from the capillaries themselves. According to the author, the respiratory interchange occurs only in the capillaries; the spiral tracheæ are merely air-passages.

In regard to the imaginal discs, the author notes several points not hitherto observed by others, and especially emphasises their origin as ingrowths of the hypodermis, and the absence of any relation to the tracheal epithelium.

Streblidæ.*—Herr P. Speiser discusses this family of Diptera, parasites on bats, and probably derived from the Muscid stock. The forms with five wing-veins are the most primitive, those with six or four are more recent, those with reduced wings are youngest. Through *Paradyschiria* g. n., and *Megistopoda* there are in some features transitions towards Nycteribidæ. Two other new genera are established, *Nycteribosca* and *Lepopteryx*, and a key is given to the known forms.

Enemy of the Colorado Potato Beetle.†—Mr. C. E. Mead describes the behaviour of a beetle, *Collops bipunctatus*, which devours the eggs and larvæ of the Colorado beetle. There is good reason to believe that the main crop of potatoes in the vicinity (San Juan County, New Mexico) is annually saved by the predaceous habits of *C. bipunctatus*.

Mating in Moths.‡—Mr. A. G. Mayer has made some interesting observations and experiments on the mating instinct of *Collosamia promethia*, which he hatched out and watched on Loggerhead Key, one of the Dry Tortugas Islands, Florida. His general conclusions are the following:—The male is positively chemotactic toward some substance which emanates from the abdomen of the female, and which he perceives through antennary olfactory organs. Females thirty to sixty hours old are much more attractive to males than are young females five to ten hours old. Virgin females are somewhat more attractive than are fertilised ones of the same age. The male will mate at least four times, either with the same or with different females. Neither males nor females pay any attention to the coloration of their partners. The melanic colour of the male has not been brought about by sexual selection on the part of the female.

Colour-Variation in Pupæ.§—Mr. F. Merrifield, Prof. E. B. Poulton, together with some other observers, have continued previous observations

* Arch. Naturgesch., lxvi. (1900) pp. 31–70 (2 pls.).
† Amer. Nat., xxxiii. (1899) pp. 927–9. ‡ Ann. Nat. Hist., v. (1900) pp. 183–90.
§ Trans. Ent. Soc. Lond., 1899, pp. 369–433.

on the relation of the colour of the pupæ to that of the surroundings of the larvæ before pupation in various Lepidoptera. In the case of *Papilio machaon* the result is to show distinct susceptibility to the colour of the surroundings. In *Pieris napi* not only is there a high degree of sensitiveness but also a very wide range of controllable modification. A very extensive series of experiments were made on *P. brassicæ*, the result being to amplify and confirm the previous observations. Experiments with this species when placed on a particoloured background tended to show that under such conditions pupæ of uniform intermediate colour are obtained, not parti-coloured ones.

Food of Ants.*—Prof. C. Emery has experimented on the food-substances which can be utilised by *Messor structor*, a graminivorous species common in Italy. The ants consumed fungi and mycelia of various kinds supplied to them, and also mould growing in the plaster of the artificial nest. They also ate unripe grains, buds, dry cooked beef, grains of rice and other cereals, bread and raw Italian paste, but rejected raw starch. On an exclusive diet of Italian paste, the ants were able to rear their larvæ, which the author regards as proof that the saliva contains a peptonising ferment.

Hexagonal Structure in Cooling Beeswax.† — Messrs. Charles Dawson and S. A. Woodhead find that if a thin slab of beeswax be melted in a tray, and allowed to cool gradually in a warm atmosphere, hexagonal forms of the ordinary size of the cells of the hive-bee gradually appear in the wax. The process appears to be crystalline or pseudo-crystalline, and the authors believe that it explains, at least in part, the structure of honeycomb. When such plates of wax are supplied to the bees, they utilise the natural "cells," hollowing them out, building up their walls, &c. The particular crystalline form seems to be characteristic of beeswax.

β. Myriopoda.

Male Dimorphism in Diplopoda.‡—Dr. C. W. Verhoeff distinguishes what he calls *morphologische Doppelmännchen* (in some Amphipods and Arachnids) where dimorphic males, similar in development, are distinguished by some sexual characteristic, and *genetische Doppelmännchen* in Diplopoda (*Tachypodoiulus albipes, Iulus nitidus*) where small and large males occur, the latter having in their development one stage more (*Schaltstadium*) than the former. In maturity the two forms do not differ in special characters, but in size and number of segments and appendages. Moreover, the small males seem to be protandric, and the large males hysterandric.

New and little-known Lithobiidæ.§—Dr. Carl Verhoeff, in pursuing his studies in Palæarctic Myriopods, describes some new species of the genus *Lithobius*, some of which were found in caves. In the course of his descriptions he notes that one of these—*L. matulicii*, a blind form—is of simple organisation, and must have been blind before it reached a subterranean habitat; while another form, *L. leostygis*, though of higher

* Arch. Sci. Phys. et Nat., viii. (1899) pp. 488-90.
† Ann. Nat. Hist., v. (1900) pp. 121-6 (3 figs.).
‡ Zool. Anzeig., xxiii. (1900) pp. 33-46 (2 figs.).
§ Verh. Zool.-bot. Ges. Wien, xlix. (1899) pp. 446-59 (7 figs.).

organisation, has small unpigmented ocelli. This seems to him to support his view that subterranean life does not induce blindness.

γ. Prototracheata.

Habits of Peripatus capensis.* — Prof. E. L. Bouvier records his observations on a living specimen. He notes its lucifugous habits, its mode of raising the front of the body in tentative exploration, the mobility of the tentacles, the remarkable mechanism of locomotion, and the ejection of the mucus from the oral papillæ.

American Species of Peripatus.†—Prof. E. L. Bouvier continues his observations on the species of *Peripatus*, distinguishing in this communication two distinct American sections—the "Andicolous" from the Andes, &c., and the "Caraib" from the Antilles, &c., both well represented.

δ. Arachnida.

Spiders and other Arachnids of Edinburgh District.‡—Messrs. G. H. Carpenter and W. Evans have raised their list of Arachnids from the Edinburgh district to 191 species, the present communication accounting for twelve, six of which are new to Scotland. Perhaps the most interesting record is that relating to *Prosopotheca monoceros* Wid., the female of which has not previously been obtained in the British Isles.

Kedani-Disease.§—Dr. Keïsuke Tanaka has continued his study of this mysterious Japanese disease which is associated with the presence of a larval mite. He has now good reason to think that the disease may be due to the association (now proved) of a *Proteus* bacillus—like *Proteus hauseri*—with the mite.

Parasitism in Hydrachnida.‖ — Carl Thon has found a normal nymph of *Hydryphantes dispar* Schaub, parasitic upon *Paludina contecta*. The Hydrachnid was firmly fixed, and could not be removed without cutting the mantle of the snail. The author is inclined to believe that this parasitism—which has not been hitherto observed—must be common, and explains the peculiar form of the mouth-parts in *Hydryphantes*, *Diplodontus*, *Eupatra*, *Thyas*, &c. He has found the last-named genus on the shells of both *Paludina* and *Planorbis*, and believes that the absence of swimming bristles in it is a further adaptation to a parasitic life.

ε. Crustacea.

Regeneration in Hermit Crabs.¶—Prof. T. H. Morgan made, two years ago,** a series of experiments on the regeneration of the appendages of a hermit-crab (*Eupagurus longicarpus*), the conclusion of which was that there is no definite relation between the regeneration of a part and its liability to injury. He now reports upon a new set of experiments.

At the base of the walking legs, between the fifth and sixth segments,

* Comptes Rendus, cxxix. (1899) pp. 971–3.
† Tom. cit., pp. 1029–31. Cf. this Journal, 1899, p. 484.
‡ Proc. Roy. Phys. Soc. Edin., xiv. (1898–9) published 1900, pp. 168–81.
§ Centralbl. Bakt. u. Par., xxvi. (1899) pp. 432–9 (2 pls.).
‖ Verh. Zool.-bot. Ges. Wien, xlix. (1899) pp. 484–5.
¶ Anat. Anzeig., xvii. (1900), pp. 1–9 (19 figs.). ** Zool. Bulletin, i. (1898).

there is a "breaking-joint," where the leg, if injured, can be thrown off. The exposed surface left is covered by a thin cuticular membrane with a small central hole, through which the nerve and blood-vessels of the leg passed. If the leg be injured outside of the breaking-joint, except near the tip, it is thrown off at the breaking-joint. The special problems which Morgan has studied are two:—(*a*) If the leg is cut off proximal to the breaking-joint, will a new leg develope? and (*b*) If the leg is cut off distal to the breaking-joint, and can be prevented from being thrown off at the joint, will regeneration take place from the exposed end?

Under ordinary conditions of life, it seems almost impossible that a leg should be broken off proximal to the breaking-joint, yet if it be cut off in that region there is regeneration. Under ordinary circumstances, if a leg is injured distal to the breaking-joint, the leg is thrown off at the base, yet regeneration was observed from the cut end of a limb excised outside of the breaking-joint. These facts seem to Prof. Morgan to show in the clearest way that there is no relation between the regeneration of the leg and its liability to injury, but "perhaps a lively imagination may find some way of reconciling these facts with the popular dogma." [Why should Weismann's interpretation be called a dogma?]

Regeneration takes place more quickly from the breaking-joint than from inside or outside of it; i.e. the conditions are more favourable for regeneration at the joint than elsewhere. When the distal segment is cut off, the regeneration takes place beneath the old surface, and this might be regarded as the result of a process of adaptation; but the author would expect to find the explanation rather in the fact that the structure of the end of the leg is different from that of its base. The small fourth and fifth thoracic limbs, which do not seem to be often (if ever) injured, regenerate readily. The terminal abdominal appendages regenerate very quickly and quite normally,—while Weismann suggested that those of an ancestral type might be expected.

Eyes of Crustacea.* — Prof. G. W. Parker has studied the photomechanical changes in the retinal pigment of *Gammarus ornatus* Milne-Edwards. He finds that the changes are limited to the black pigment of the middle and proximal portions of the retinular cells. In light the abundant pigment of the middle part of these cells surrounds the rhabdome with a black sheath, while the proximal portion of the cells contains scattered grains of pigment only, except for masses of pigment near the nucleus. In the dark these conditions are reversed, and the absence of pigment round the rhabdome exposes the accessory pigment-cells, which may have some reflecting function. No changes occur in the distal parts of the retinal cells, and in this respect the eye of *Gammarus* is physiologically simpler than those of Decapods.

Monograph on Alpheidæ.†—M. H. Coutière publishes the first part of an elaborate memoir on this subject. It comprises a historical survey, an account of the internal and external morphology, a description of the larval forms, with chapters on bionomics and phylogenetic relations.

* Bull. Mus. Comp. Zool. Harvard, xxxv. (1899) pp. 143–8 (1 pl.).
† Ann. Sci. Nat. (Zool.), ix. (1899) pp. 1–559 (6 pls. and 409 figs. in text).

The material included the forms taken by most of the scientific expeditions, European and American, and the observations were supplemented by the study of living animals at Djibouti. In regard to affinities, perhaps one of the most interesting points is the existence of numerous structural characters showing resemblance to the Reptant Crustacea. The author emphasises the fact that these are to be regarded as an example of "adaptive convergence," and in no way as indications of affinity. There is clear evidence that the Alpheidæ are to be regarded as Natantia, and that among the Natantia they belong to the Eucyphota, being specially related to the Hippolytidæ. Nevertheless, in several respects they show direct relations to the Schizopods, thus affording evidence against Boas' view that all the Eucyphota are derived from a form resembling *Penæus*. The author is disposed to believe that the Penæidæ and Eucyphota have arisen independently from Schizopoda.

The author's personal investigations in the Red Sea resulted in a collection including 500 specimens, belonging to some forty species, whose habits are described in careful detail.

North American Astacidæ.*—Mr. W. P. Hay gives a synopsis of the 79 North American species and sub-species now recognised in the genus *Cambarus*, and the five known species of *Astacus*. In a first list the natural groups are given with their distinctive characters and with indications as to their distribution. The second list is a purely artificial key for purposes of identification.

New Argulidæ.†— Dr. J. Thiele describes *Chonopeltis inermis* g. et sp. n., which differs from the two known genera *Dolops* Audouin (= *Gyropeltis* Heller) and *Argulus* Müll. in the entire absence of the first antennæ. The specimen came from the branchial cavity of a species of *Chromis*. Three new species of *Argulus* are also noted.

Development of Penilia schmackeri Richard.‡—Mervin T. Sudler obtained a large amount of Crustacean material in the harbour of Beaufort, N.C., in June 1896, which proved to consist entirely of this species. The animals appeared suddenly, and after occurring in large swarms at the surface of the water for a few days, as suddenly disappeared. No males were found, but the brood-chambers of the females were filled with developing eggs. The eggs contain little yolk, and the author believes that each egg is the result of the fusion of four ovarian cells. No trace of a polar body was observed. Segmentation is total, and the first cleavage is transverse. Of the resultant two cells, the anterior appears to form the anterior region of the future embryo, and the posterior its posterior region. There was no indication of the early differentiation of genital cells described by Grobben for *Moina*. Gastrulation occurs by inwandering. In regard to the order of appearance of the appendages, *Penilia* differs from most Crustacea in that the second antennæ appear before the first, the latter being often late in development.

Antennal Glands of Lobster.§—Mr. F. C. Waite has investigated the structure and development f these organs in *Homarus americanus*

* Amer. Nat., xxxiii. (1899) pp. 957–66 (1 fig.).
† Zool. Anzeig., xxiii. (1900) pp. 46–8.
‡ Proc. Boston Soc Nat. Hist., xxix. (1899) pp. 109–31 (3 pls.).
§ Bull. Mus. Comp. Zool. Harvard, xxxv. (1899) pp. 151–210 (6 pls.).

Milne-Edwards. He finds that the gland itself consists of a dorsal end-sac and a ventral labyrinth, the two being connected by a single small orifice only. The labyrinth leads into the duct by a number of converging canaliculi, which open separately into it. The so-called vesicle is a dorsal diverticulum of the duct without direct connection with the gland. End-sac and labyrinth both take part in the formation of the secretion, and are lined by cells of distinctly different types. In development the end-sac is mesodermic, and originates in a syncytium which becomes hollowed out, the constituents ultimately developing cell-walls round this central vacuole. The duct and labyrinth are ectodermic, and appear before hatching. After hatching, the labyrinth obtains its complex adult form by the development of numerous evaginations which increase in size and form anastomoses. The vesicle arises late in larval life as an evagination of the ectodermic sac, and the adult position of parts is produced by differential growth. The author believes that the antennal glands represent the nephridia of an Annelid, but is unable to definitely homologise the different regions of gland and nephridium.

Colour-Physiology of Hippolyte varians.*—Messrs. F. W. Keeble and J. W. Gamble have investigated the nature, mechanism, and causes of the colour changes of this prawn, well-known for its colour variability. The colouring matter is contained in the chromatophores, which occur both in the superficial tissues and also between the muscle-fibres, and as an investment to gut, nerve-cord, liver, and other organs; they may contain red, yellow, and blue pigments. A very important observation is the demonstration that the prawns pass through a daily colour-cycle. At dusk they become a transparent blue or green colour, and at dawn recover the tint of the previous day. The changes are periodic, and to some extent independent of external agents, and expressive of a nervous rhythm. Another important point is that, while the prawns are very sensitive to alterations of light-intensity, they react very slowly to colour-change in the surroundings not accompanied by marked differences in intensity. Thus a dark prawn placed in a white porcelain dish became transparent in a few minutes, but a green prawn placed on brown weed preserved the green colour for a week or more. That is, sympathetic colour-change is very slow, and appears to act only through change of light-intensity, to which the animals are exceedingly sensitive. Colour-changes due to light-intensity occur in detached limbs and in blinded specimens. It would seem that in regard to mechanism:—(1) the periodic change is due to intrinsic rhythmic nervous change; (2) the eye is important in modifying nervous control; (3) local government plays a part. The paper is published as yet in brief abstract only.

Nauplius of Penæus.†—K. Kishinouye records larvæ of *Penæus* of all stages including the nauplius from Tokyo Bay and the Inland Sea; the nauplii have not been seen since the description of them by Fritz Müller in 1863. The youngest nauplius found was 1/4 mm. in length, and its three pairs of appendages were unsegmented and short. In the next stage they are elongated, divided into numerous minute segments, and furnished with numerous bristles. Rudiments of four new pairs of

* Proc. Roy. Soc., lxv. (1900) pp. 461–8.
† Zool. Anzeig., xxiii. (1900) pp. 73–5 (3 figs.).

appendages are visible behind the three original pairs. A little later the body becomes elongated, and divided into two distinct regions—the rudiments of future carapace and abdomen. The anterior region shows traces of segmentation. This stage may be described as the metanauplius, and after a moult becomes converted into a protozoæa.

Annulata.

Nephridium of Nephthys cæca.*—Mr. F. H. Stewart has confirmed Mr. E. Goodrich's results in all points except one, the position of the organ relative to the blood-vessels.

He describes the process of excretion in the following terms:—Whenever a particle of solid excretory matter appears in the cœlom it is immediately engulfed by one of the phagocytes. This, when it has become sufficiently loaded, passes into the neighbourhood of the ciliated organs, either by its own amœboid motion or by the agency of the currents raised by the cilia. Here it is swept down one of the grooves, and joins the little mass of its fellows raised against the barrier of the nephridial tube. Partial degeneration now sets in, and the phagocyte appears to enter bodily the protoplasmic wall of the canal, carrying the foreign matter with it. The latter then passes out either by the lumen of the canal, assisted by the cilia, or by passing along through the wall itself. The whole nephridium is constantly moving, the ciliated organ swaying up and down, the tube also moving upward and downward on the blood-vessels to a limited extent. These movements no doubt facilitate ingestion of refuse.

British Species of Siphonostoma.†—Miss M. I. Newbigin notes that the two most familiar species of *Siphonostoma (Flabelligera)* are *S. affinis*, the typical northern form, and *S. diplochaïtos*, the typical Mediterranean form. Specimens collected at Millport agreed most closely with *S. diplochaitos* Otto, specimens from Plymouth with *S. affinis* Sars, as defined by St. Joseph. But *S. diplochaïtos* changes in character during growth, the changes occurring in those special characters which serve to differentiate the adult from *S. affinis*; the young of the former approximates to the adult of the latter. In fact it seems probable that *S. diplochaitos* is a very variable species, exhibiting a strong tendency to run into local races, and that the three "species," *S. diplochaitos*, *S. affinis*, and *S. claparedii*, are only varieties of one species.

Epidermal Organs of Phascolosoma.‡—Miss Margaret Nickerson publishes a brief note on certain remarkable intracellular canals in the skin of *P. gouldi*. Certain of the epidermal organs consist of ovoid sacs surrounded by a membrane, and containing twenty to thirty very large gland-cells. In each of these gland-cells there is an intracellular ampulla which lies above the nucleus and communicates with a canal. The canals from the different cells unite together to form a main duct which opens to the exterior by a pore at the summit of the organ. The exact appearance presented is not constant, but varies with the different conditions of functional activity of the organ. Somewhat analogous structures occur in certain of the glands of Insects and Crustacea. A full account of all the epidermal organs of *Phascolosoma* is promised.

* Ann. Nat. Hist., v. (1900) pp. 161–4 (2 pls.). † Tom. cit., pp. 190–5 (1 pl.).
‡ Zool. Jahrb. (Abth. Anat.), xiii. (1899) pp. 191–6 (1 pl.).

South American Geoscolecidæ.*—Dr. W. Michaelsen gives a short description of *Fimoscolex ohausi* g. et sp. n., which is nearly related to *Geoscolex* F. S. Leuckart (with which *Tykonus* Mchlsn. should be united). It has, however, a single ventro-median male aperture (two in *Geoscolex*), a single pair of calciferous glands restricted to the 12th segment (extending into the 11th in *Geoscolex*), and no special blood-vessels to the calciferous glands (present in *Geoscolex*). The author also describes *Anteus columbianus* sp. n.

Encystment of Pachydrilus catanensis Drago.† — Dr. Umberto Drago replies to Cognetti's ‡ criticisms of his statements on this subject. Cognetti suggested that what Drago regarded as probable encystment was merely the ordinary process of cocoon formation. Drago replies that in composition the "cyst" resembles more closely the cysts of certain parasitic worms than the cocoon of an Oligochæte, and that, as the species is adapted to a commensal and almost to a parasitic life, there is nothing intrinsically improbable in the suggestion that encystation occurs. The fact that the "cyst" included two individuals is further not an argument against this view of its origin; for the cysts of certain worms (*Trichinella spiralis*, *Cysticercus megabothrius*, *Ascalabotes mauritanicus*) may contain from two to seven individuals. On the whole therefore Drago is of opinion that his hypothesis is the one which best fits the facts.

Genus Perichæta and Zoological Nomenclature.§ — Dr. R. Horst publishes a brief note protesting against Michaelson's recent proposal ‖ to substitute *Amyntas* for *Perichæta*, because the latter name had been used by Rondani for a genus of Diptera, before being applied by Schmarda to an earthworm. Horst reviews the somewhat chequered history of *Perichæta* as an Oligochæte genus-name, points out the confusion which must necessarily follow if it is now discarded, and notes that as Rondani's Dipteran genus was merely a synonym for *Phorocera* Macquart, the fact that he used the term does not vitiate Schmarda's use of it.

Non-sexual Reproduction in Dero.¶ — Mr. T. W. Galloway has been able to make observations on this subject in *D. vaga* (*Aulophorus vagus* Leidy). He finds that in the non-dividing animal there is an undifferentiated zone immediately in front of the anal segment, which continually gives rise to new segments anteriorly. When budding begins, a bud-zone is formed in one of these new segments, so that budding must be looked upon as a specialised form of segmentation. There does not seem to be any constancy as to the segment in which bud-formation occurs. Division always occurs midway between two dissepiments. Generally speaking the histology of bud-formation is the same as in *Chætogaster* according to von Bock, but there are certain minor differences. Thus in *Dero* newly formed ciliated endoderm unites old endoderm and body-wall in the anal segment, while in *Chætogaster* the old endoderm and the body-wall unite directly. There are also slight differences in the formation of mouth and pharynx and of the nervous system.

* Zool. Anzeig., xxiii. (1900) pp. 53–6. † Tom. cit., pp. 18–21.
‡ Cf. this Journal, 1899, p. 599. § Zool. Anzeig., xxiii. (1900) pp. 6–8.
‖ Beiheft Jahrb. Hamburg. wiss. Anstalt, xvi. (1899).
¶ Bull. Mus. Comp. Zool. Harvard, xxxv. (1899) pp. 115–40 (5 pls.).

Nematohelminthes.

Blood-inhabiting Species of Filaria.*—Dr. O. von Linstow gives a very useful summary of our present knowledge of the Filariæ infesting the blood-system of man. He recognises two well-defined species, *Filaria bancrofti* Cobbold (= *F. sanguinis hominis nocturna*), and *F. magalhãesi*, while the four following forms are probably stages in one life-history, *Filaria diurna* Manson (= *F. sanguinis hominis major*), *F. perstans* Manson (= *F. sanguinis hominis minor*), *F. demarquayi* Manson, *F. ozzardi* Manson. Of the two well-defined species, *F. bancrofti* lives in the larval stage in the blood, in the mature stage in the lymphatics. The fact that the larvæ occur in the capillaries of the skin at night but not during the day, the author ascribes to the fact that during sleep the capillary walls relax, and so allow the larvæ to enter, while during the day the lumen is too narrow for them to pass. The species is characterised by the extreme delicacy and slenderness, which is so great that an unbroken male has apparently not yet been obtained. It occurs in tropical Asia, Africa, America, and Australia.

The other species, *F. magalhãesi*, is stout, elastic, and transversely ringed. It infests the heart, and occurs in Brazil.

Strongyloides intestinalis in Man.—Dr. Pappenheim and Prof. M. Braun † report on a case in which a patient was infected with "anguilluliasis" due to the *Rhabditis*-like larvæ of this worm (= *Anguillula intestinalis* Bav. and *Ang. stercoralis* Bav.). The source of the disease was not discovered.

Dr. W. Zinn ‡ discusses the life-history of *Anguillula intestinalis*, which may be by direct metamorphosis or with the interpolation of a unisexual generation, the latter mode being that which he observed.

Platyhelminthes.

Head-glands in Tetrarhynchus. §—Dr. Theodor Pintner has discovered some remarkable glands of considerable size in the Cestodes which he calls the group *Tetrarhynchus attenuatus* (including *T. megacephalus*, *T. grossus*, &c.). The gland-system is distributed in the cortical layer of the whole head except in the region of the suckers, and consists of a number of large pouch-shaped tufted glands, which, in spite of their size, appear to be unicellular. These give off very numerous ducts which are filled with secretion, and at the apex of the head perforate the proboscis-sheath at four circumscribed spots. Thereafter they cross the rhynchocœl (inner proboscis cavity) as eight bands, penetrate the proboscis wall, and finally open into the rhynchodæum (outer proboscis cavity), filling it with their secretion. This secretion is remarkable in displaying a great affinity for nuclear stains, notably for hæmatoxylin. To this gland-system the author gives the name of the rhynchodæal glands. He notes briefly certain incomplete observations which he has made on its occurrence in other species besides the *T. attenuatus* group, and gives a list of the species in which previous

* Zool. Anzeig., xxiii. (1900) pp. 76–84 (2 figs.).
† Centralbl. Bakt. u. Par., xxvi. (1899) pp. 608–12, 612–5 (1 pl.).
‡ Tom. cit., pp. 696–702 (1 pl.).
§ Arbeit. Zool. Inst. Wien, xii. (1899) pp. 1–24 (3 pls.).

authors have without description noted the occurrence of more or less conspicuous glands apparently similar. He is unable to make any definite suggestion as to function, but compares the glands to the head-glands of Nemerteans and of some Turbellaria.

Genera of Bothriocephalidæ.*—Herr M. Lühe publishes some corrections and additions to his systematic survey † of these Cestodes. In his previous paper he described *Bothrimonus* Duv. as a synonym of *Diplocotyle* Kr., and therefore to be suppressed in favour of the latter. He has since obtained from the sturgeon what proves to be a new species of Cestode, which shows so much general resemblance to *Bothrimonus sturionis* Duv., that he is now prepared to admit Duvernoy's genus. The new form receives the name of *B. fallax*. This admission of the genus *Bothrimonus* produces certain modifications in the systematic arrangement of the family, and the author therefore replaces his previous definitions, &c., of the sub-family Cyathocephalinæ by new ones.

Rostellum of Tape-worms.‡—Prof. W. Blaxland Benham describes two new species of *Drepanidotænia* taken from *Apteryx*, and gives an account of the rostellar apparatus of the genus, one of the new species (*D. minuta*) proving an unusually favourable object for the study of this structure. Generally it resembles the same structure in other avian Cestodes, and consists of two concentric muscular sacs, in contradistinction to the rostellum of mammalian Cestodes, which is a solid mass of muscles. A series of figures is given showing the relation of the parts during movement.

Onchocotylinæ.§—Paul Cerfontaine continues his study of the Octocotylidæ, dealing in the present communication with the section for which he proposes the name Onchocotylinæ. Hitherto the old genus *Onchocotyle* has been referred, e.g. by Parona and Perugia, to the Oligocotylidæ family of the group Polystomeæ. But this was under the misapprehension that *Onchocotyle* has fewer than eight suckers. In reality, behind the fixing disc with its six suckers, there are two others borne on the bifurcations of the caudal appendage. The genus should therefore be referred to the family Octocotylidæ. Yet there are many peculiarities which appear to the author to justify a special section, which he defines. In this section of Onchocotylinæ he distinguishes three genera, *Squalonchocotyle*, *Acanthonchocotyle*, and *Rajonchocotyle*, the species of which all occur on the gills of Selachians.

Cestode with separate Sexes.‖—Herr O. Fuhrmann gives a brief account of *Diœcocestus paronai* g. et sp. n. from *Plegadis guarauna*, one specimen of which had double male gonads, while the other had ovaries—in fact a diœcious cestode. He describes some other new forms also from birds—*Acoleus armatus* g. et sp. n., and two new species of *Gyrocœlia*—referable to the family Acoleinæ, characterised by the disposition of the musculature and by the absence of a vagina.

* Zool. Anzeig., xxiii. (1900) pp. 8–14.
† Verh. Deutsch. Zool. Ges., 1899, pp. 30–55.
‡ Quart. Journ. Micr. Sci., xliii. (1900) pp. 83–96 (2 pls.).
§ Arch. Biol., xvi. (1899) pp. 315–478.
‖ Zool. Anzeig., xxiii. (1900) pp. 48–51.

Notes on Bothriocephalidæ.* — Herr M. Lühe discusses Bothriocephalidæ with marginal genital apertures, and in particular *Abothrium fragile* (Rud.) (= *Bothriocephalus fragilis* Rud.). *Fistulicola* (g. n.) *plicatus* (Rud.) (= *B. plicatus* Rud.), *Anchistrocephalus imbricatus* (Dies.) (= *Dibothrium imbricatum* Dies.), and *Triænophorus nodulosus* (Pall.) Rud. (= *Tænia nodulosa* Pall.).

Cestodes in Birds.—Herr O. Fuhrmann describes † two remarkable forms—*Gyrocœlia perversus* g. et sp. n., notable for the absence of a vagina, and *Acoleus armatus* g. et sp. n., also without a vagina, with a peculiarly formed receptaculum, and with an unusual disposition of the musculature. The hosts were *Himantopus autumnalis* and *Limosa rufa*. He also discusses ‡ *Tænia crateriformis* and *T. musculosa*, which he proposes to include in a new genus *Monopylidium*, beside *Oochoristica*, *Davainea*, &c. Herr K. Wolffhügel § criticises Cohn's proposed systematic arrangement of the Cestodes from birds, maintaining that it is much too soon to attempt this with success.

Genus Rhopalias.‖ — Herr M. Braun has some remarks on this apparently isolated genus, which was founded by Diesing as *Rhopalophorus* for two flukes found in *Didelphys*, and emended by Hassall. Braun has studied very many specimens belonging both to the species recognised by Diesing, and to a new species, and finds that all show a close internal resemblance to typical Echinostomæ, which makes the possession of the two characteristic bristle-crowned proboscis-like structures all the more remarkable. But careful examination shows that in *Rhopalias coronatus* a double row of bristles connects the orifices of the proboscides, and recalls the bristle-bearing disc of the Echinostomes. There can be no doubt that the *Rhopalias*-condition can be derived from the Echinostome, from which the species must be supposed to have arisen. The observation thus deprives *Rhopalias* of its apparently isolated position.

Trematodes of Egypt.¶—Prof. A. Looss describes a large number of new forms, many of which require new genera. He breaks up the genus *Distomum* into numerous sub-families. The general classification recognised is the following:—

A. Aspidocotylea.
B. Malacotylea.
  Metastatica, Fam. Holostomidæ.
  Digenea s. strict., Fam. Distomidæ.
   „ ? Rhopaliadæ.
   „ Schistosomidæ.
   „ Gasterostomidæ.
   „ Didymozoonidæ.
   „ Monostomidæ.

Studies on Distomidæ.**—Herr S. Jacoby describes some peculiar species of *Distomum*:—(1) *D. heterolecithodes* Braun from *Porphyrio*

* Centralbl. Bakt. u. Par., xxvi. (1899) pp. 702–19.
† Tom. cit., pp. 618–22 (6 figs.). ‡ Tom. cit., pp. 622–7 (2 figs.).
§ Tom. cit., pp. 632–5. ‖ Zool. Anzeig., xxiii. (1900) pp. 27–9.
¶ Zool. Jahrb. (Abth. Syst.), xii (1899) pp. 521–784 (9 pls.).
** Arch. Naturgesch., lxvi. (1900) pp. 1–30 (2 pls.).

porphyrio, with an unpaired yolk-gland lying to one side, with an occasional *situs inversus* of the genitalia, and with remarkable variations in the disposition of other organs, yet none the less nearly related to *D. lanceolatum*; (2) *D. fellis* Olsson from the gall-bladder of *Anarhichas lupus*, related to *D. pagelli*, and, in spite of its posteriorly placed testes, not to be placed in the genus *Opisthorchis*; (3) *D. megastomum* Rudolphi from dogfish, with minute hardly perceptible œsophagus, with no receptaculum seminis, with a *Genitalnapf* provided with a ring-like sucker-like muscular ridge—in fact too divergent to be readily ranked in the genus.

Trematodes of Birds.*—Dr. L. Hausmann gives a list of the Trematodes which he found in 31 species of birds. Over 30 per cent. were infected.

Liver-Fluke in Sheep's Spleen.†—Prof. St. v. Rátz reports what seems to be a very rare occurrence, the presence of a full-grown *Distomum hepaticum* in the spleen of the sheep. The spleen is comparatively free from parasites, but *Echinococcus*-bladders have been repeatedly observed in sheep, ox, pig, &c.

Trematodes from Chelonia.‡—Prof. M. Braun discusses *Monostomum renicapite* Leidy from *Sphargis coriacea*, and six new species of *Distomum* from other Chelonians.

Turbellaria of Geneva.§—Herr O. Fuhrmann supplements the previous lists of Du Plessis ‖ by some observations of his own. His list includes 27 species, of which 13 had been previously found by Du Plessis, while he has not encountered 10 of those named by that author. In addition to descriptions of new species, the paper includes various notes on habitat, structure, &c. With regard to *Microstoma lineare* Müller, an interesting point was noticed. Du Plessis stated that forms from deep water had no eyes, and sometimes no nematocysts, but Fuhrmann finds that both these structures show great variability in forms found in shallow water; in such forms the "eyes" present all stages of development, pigment being at times wholly absent, while at other times, in addition to pigment-spots, cells with refracting corpuscles are present.

New Turbellarians.¶—Prof. D. Bergendal describes three Triclad Turbellarians from Punta Arenas, namely, *Gunda ohlini* sp. n., *G. segmentatoides* sp. n., and an unnamed species of *Planaria*.

Habits and Development of Cerebratulus lacteus.**—Mr. Chas. B. Wilson has studied this large Nemertean, which occurs on the Atlantic coast of N. America in sand and mud, especially near clam and mussel beds. It is carnivorous, living chiefly upon "clam-worms" (*Nereis*). It is not clear how such an apparently defenceless animal can overcome a strongly armed form like *Nereis*, but it was found that the slime of the Nemertean is intensely bitter, and may be protective, preventing any attack from the *Nereis*. The Nemertean breathes by taking in water into the œsophagus, and then expelling it again; the cephalic slits seem

* Centralbl. Bakt. u. Par., xxvi. (1899) pp. 447–53. † Tom. cit. pp. 616–8.
‡ Tom. cit., pp. 627–32. § Rev. Suisse Zool., vii. (1900) pp. 717–31 (1 pl.).
‖ Op. cit., v. (1897). ¶ Zool. Anzeig., xxii. (1899) pp. 521–4.
** Quart. Journ. Micr. Sci., xliii. (1900) pp. 97–198 (3 pls.).

to take but little part in the process. Dismemberment appears to occur regularly at the close of the breeding season, when the posterior region of the body is thrown off. This is rapidly regenerated; and the process is probably explained by the fact that, in this posterior region, the organs—save the gonads—undergo degeneration during the development of the elements. The ordinary fission on irritation the author regards as protective. He is not of opinion that the posterior region can regrow a head, but its death occurs slowly, and the sexual products may ripen in it before death ensues.

Ova and sperms were obtained freely from specimens kept in confinement, and the process of fertilisation observed. The polar bodies do not appear till after fertilisation, and display that form of protoplasmic activity described by Andrews as "filose activities or spinning." The egg also displays spinning activities. From observations on the process in both cases the author concludes that in this species polar bodies and egg are physiological, as well as morphological, equivalents, and, from the activity of the polar bodies, it may be said that the oogenesis shows a much closer morphological equivalence to spermatogenesis than is usual. Segmentation is total and equal, and during it the spin-threads connect the blastomeres and prevent physiological separation. Gastrulation is embolic, and is speedily followed by the development of the apical plate and a covering of cilia. The pilidia were reared in large numbers, and were studied in the living condition. As they are exceedingly transparent, observations could be readily made on the origin of the muscles. It was found that the muscles of the pilidium are metamorphosed pseudopodia, the metamorphosis consisting essentially in a fibrillation of a portion of the cytoplasm and the gradual assimilation of the remainder. The fibrillation appears to begin in a rearrangement of the cytoplasmic reticulum, and occurs only when the pseudopodium has attached itself to something outside the cell.

For histological work, platinum chloride was found to be the best preservative, used either alone or with acetic acid. An important point in regard to histology is the apparent absence of any nervous tissue in the apical plate.

Cœlentera.

Longitudinal Fission in a Sea-Anemone.*—Mr. G. H. Parker summarises the evidence which leads him to believe that specimens of *Metridium marginatum* with double discs are not monstrosities, as has been supposed, but cases of incipient division. The process apparently produces monoglyphic or irregularly diglyphic specimens, and not regular hexamerous diglyphic specimens. It would appear that the latter must be the products of sexual reproduction, as there is no evidence that they can result from non-sexual processes. Such regular specimens constitute about one-fifth of all collected.

Medusæ of Millepora.†—Prof. S. J. Hickson, who discovered male medusæ in specimens of *Millepora* collected by Haddon in Torres Straits eight years ago, has now obtained immature and mature female medusæ from Jamaica, where Mr. J. E. Duerden actually saw them

* Bull. Mus. Comp. Zool. Harvard, xxxv. (1899) pp. 43–56 (3 pls.).
† Proc. Roy. Soc., lxvi. (1900) pp. 3–10 (10 figs.).

escape. A brief description is given. It is probable that they discharge the ova and die soon after liberation from the colony. Hickson corrects his previous description of certain cells in the cœnosarc of Millepora as ova; they ultimately give rise to the large kind of nematocyst.

Ancestry of Helioporidæ.* — Dr. J. W. Gregory suggests that *Heliopora*, the recent blue coral, has descended from the palæozoic Heliolitidæ by degeneration in size and increase in number of the cœnenchymal cæca, thus reviving the old view of the close affinity of *Heliopora* and *Heliolites* which F. Bernard and Lindström have denied. According to the author they are linked by a series of eocene and cretaceous corals, among which is the genus *Polytremacis*.

Regeneration in Gonionemus vertens.†—Prof. T. H. Morgan begins a notice of his recent experiments on this Hydromedusa with a reference to what Haeckel stated in 1870,‡ in regard to the regenerative capacity of some of the Thaumantidæ;—that if a medusa be cut up into more than a hundred pieces, each piece, provided it contains a part of the margin of the bell, will develope a complete little medusa. In 1897, C. W. Hargitt § noted that pieces of *Gonionemus* as small as one-fourth of the whole have a remarkable recuperative power leading to the production of the bell-like form, but he left it undecided whether these bell-like individuals would produce the missing organs if kept for a longer time. Morgan's experiments show that, although pieces somewhat smaller than one-eighth of the medusa may make new individuals having the medusa-form, yet these small individuals, as well as larger ones, lack the most essential features of the medusa. The remodelling extends only to the form of the entire piece, and does not include the internal organs.

Morgan is inclined to believe that there is something more in the remodelling than the fusion of the cut edges, and that the piece does in reality mould itself into the medusa-form, as Hargitt said. The entire process seems to be one of rounding-up of the piece in the direction of least resistance, but it is a complex process in which several factors take part. To try to analyse these is of more moment than to try to explain the regeneration by a theory of preformed imaginary "germs" set aside to bring about the result.

Protozoa.

Cyst-formation in Protozoa.‖—Herr Prowazek distinguishes three kinds of cyst:—(1) protective cysts, which enable the organism to withstand adverse conditions; (2) reproductive cysts, which protect the organism during the preliminary phases of multiplication; and (3) digestion cysts, induced by the superabundant ingestion of food. On account of the ease with which they are distributed, these cysts often occur in microscopic preparations of fresh material, especially of plants, and thus may constitute puzzling objects. The author then figures and describes the cysts of many of the common Protozoa. He adds to his paper a note on the macrogonidia of a marine *Zoothamnium* which appeared in an aquarium. The macrogonidia—the bulbi of Ehrenberg

* Proc. Roy. Soc., lxvi. (1900) p. 19.
† Amer. Nat., xxxiii. (1899) pp. 939–51 (12 figs.).
‡ Biologische Studien, Heft 1, 1870, p. 23. § Zool. Bulletin, i. (1897).
‖ Zeitschr. angew. Mikr., v. (1900) pp. 269–76 (1 pl.).

—are specially modified individuals whose function is to give rise to new colonies. Conjugation was not observed.

Movements of Flagellata and Ciliata.* — Mr. H. S. Jennings has extended to a number of infusorians the experiments (previously reported on) which he made on *Paramæcium*, and the general result is to show a similar "motor reaction plan" throughout. The more important conclusions are the following.

The motor reactions to stimuli in the Flagellata and Ciliata take the form of a reflex of definite character, the usual features of which are that the animal moves backward some distance, turns toward a structurally defined side, then moves forward.

This motor reflex is produced by chemical stimuli of all sorts, by fluids active through their osmotic pressure, by heat, by cold, and by mechanical shock; in fact, by all agents capable of causing a motor reaction.

The direction of motion throughout this reflex has to only a very limited degree a relation to the localisation of the stimulus. The direction of turning is determined by structural differentiations only, but whether motion shall take place backward or forward along the body-axis is to a certain extent determined by the localisation of the stimulus. The general effect of this reflex is to remove the organism from the sphere of influence of the agent causing the reaction, and to prevent it from re-entering.

Chemotaxis is not passive attraction or repulsion, but an active movement due to the production of this motor reflex by the chemical agent in question. There is no such thing as direct attraction or repulsion shown by these animals. They leave certain areas vacant because influences in these areas cause the motor reflex; they gather in certain areas when the conditions within these areas are not such as to cause the motor reflex, while the surrounding influences do cause it.

The motor reflexes through which the reactions are produced are of the same order as the motor reflexes in higher animals. But the behaviour of the infusorians shows them to occupy an extremely low place in the psychological scale, most of their activities being due to a single reflex. There is evidently no immediate analogy between the reaction movements of these unicellular organisms and the growth movements of higher forms ("tropisms"), so that the phenomena shown by the former do not justify the drawing of direct conclusions concerning the latter.

Conditions of Conjugation in Infusorians.†—Prof. R. Hertwig has made experiments which show that chromatin-reduction is induced both by starving and by over-feeding. In more general terms, a condition favouring the occurrence of conjugation is disproportion between nuclear and cytoplasmic mass.

Observations on Euglena gracilis.‡ — Herr Hans Zumstein finds that this form can thrive in either autotrophic or heterotrophic fashion,

* Amer. Journ. Physiol., iii. (1900) pp. 229–60 (15 figs.).

† SB. Ges. Morph. Physiol. München, 1899, 8 pp. See Zool. Centralbl., vii. (1900) pp. 44–5.

‡ Pringsheim's Jahrb. f. wiss. Bot., xxxiv. (1899) pp. 149–98 (1 pl.).

another piece of evidence showing that there is no hard and fast line between *Euglena* and *Astasia*. In darkness the chromatophores appear as small leucoplasts, in light as large chloroplasts; the colourless phase thus becomes green, and its heterotrophic diet becomes mixotrophic or autotrophic. The colourless form may arise from the green form:—(*a*) in organic nutritive solutions when the light is excluded; (*b*) in very rich organic fluid even in the light. The organism can endure relatively large quantities of free acid, and this quality was utilised in securing cultures free from bacteria. In fluids the cell-division always occurs in the mobile phase; it takes place in the resting stage only when there is a sufficiently firm substratum.

Capacity of Adaptation of the Lower Organisms to Concentrated Solutions.*—From experiments made on *Euglena viridis*, *Chilomonas paramæcium*, *Malloimonas ploslii*, *Colpidium colpoda*, and *Paramœcium caudatum*, Prof. A. Yasuda finds the power of resistance of Infusoria to concentrated solutions to be much less than that of the lower algæ and mould-fungi. In the case of *Euglena*, the optimum concentration was found to be,—for milk-sugar 17, for cane-sugar 15, for grape-sugar 11, for glycerin 6, for magnesium sulphate 6, for potassium nitrate 2·4, for sodium chloride 1·8 per cent. Somewhat different results were obtained with other organisms; but, in general, the optimum concentration was in proportion to the isotonic concentration of the medium.

Zygospore of Polyphagus euglenæ.†—Mr. H. Wager has followed out the formation of the spores and zygospores of *Polyphagus euglenæ*. In the latter a rhizoid is put from the passive to the active cell, which is larger than the former, and has a larger nucleus. The apex of the rhizoid swells up and becomes the zygospore, into which the small nucleus passes with its surrounding protoplasm. The large nucleus of the active cell then approaches the smaller one, passing through an opening in the cell-wall, but without fusion. The two again separate, and the small nucleus increases in size till it has attained the size of the larger one. Finally they unite after lying side by side for a time.

* Arb. a. d. Bot. Inst. k. Univ. Tokio. See Bot. Centralbl., lxxx. (1899) p. 169.
† Rep. 68th Meeting Brit. Ass., 1898 (1899) p. 1064.

BOTANY.

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

a. Anatomy.

(1) Cell-Structure and Protoplasm.

Centrosomes in Spermatogenous Cells. * — In opposition to the opinion of Shaw,† Herr W. Belajeff confirms, from a fresh series of experiments, chiefly on the microspores of *Marsilia*, the statement that the stainable bodies observed by him in the spermatogenous cells of the Characeæ, Filicineæ, and Equisetaceæ, are true centrosomes. As an explanation of the non-occurrence of centrosomes in the vegetative cells of Vascular Cryptogams and Phanerogams, the author suggests that probably the morphological and dynamical centre which we call the centrosome may exist in every cell; but that it is not always the case that a stainable substance is deposited in it which makes it easy to detect in preparations.

Periplasmic Membrane.‡—Replying to the criticisms of Tswett,§ Prof. R. Chodat and M. A. M. Boubier maintain their previous position that the periplasmic membrane (parietal utricle) is not a differentiated organ of the cell. The limiting zone of protoplasm is not merely the expression of a superficial tension; it is the result of a kind of coagulation from contact with the liquid medium, the result of physico-chemical reactions on living protoplasm.

Mannocellulose in Gymnosperms.‖—According to M. G. Bertrand, the woody tissue of Angiosperms (Dicotyledons and Monocotyledons) is composed of four principal substances, ordinary cellulose, the vasculose of Fremy, a resin probably of a phenol or lignol nature, and the wood-gum, which he terms *xylane*. In Gymnosperms (Coniferæ, Cycadeæ, and Gnetaceæ) the xylane is replaced by a different carbohydrate, *mannocellulose*, of which, however, the formula is not given.

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

Chlorophyll and its Derivatives.—Herr L. Marchlewski ¶ contests many of the conclusions arrived at by Kohl in his researches on this subject; to which F. G. Kohl replies,** charging Marchlewski with inaccuracies on diverse points. Dr. G. Bode †† also differs from Marchlewski in many of his conclusions, and contributes a theoretical and polemical paper on the constitution and properties of phylloxanthin.

To these criticisms Marchlewski ‡‡ makes a final reply, and gives a table of the suggested relationships to one another of the various derivatives of chlorophyll.

* Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 199–205 (1 pl.). Cf. this Journal, 1898, p. 550.
† Cf. this Journal, 1899, p. 58.
‡ Journ. de Bot. (Morot), xiii. (1899) pp. 379–83. Cf. this Journal, 1898, p. 637.
§ Cf. this Journal, 1899, p. 498.
‖ Comptes Rendus, cxxix. (1899) pp. 1025–8.
¶ Bot. Centralbl., lxxix. (1899) pp. 221–2. Cf. this Journal, 1898, p. 438; 1899, p. 404.
** Tom. cit., pp. 223–7.
†† Tom. cit., pp. 227–39.
‡‡ Op. cit., lxxx. (1899) pp. 340–9.

Formation of Resin in Plants.* —Herr A. Tschirch describes in detail the mode of formation of the oil-cells in *Cinnamomum Cassia.* They are developed from small cells filled with protoplasm, by the gradual suberisation of the cell-walls, accompanied by the formation of a layer of mucilage. Ultimately the inner strata of the mucilage-layer become absorbed, and the protoplasm fuses with the remainder of the mucilage; and the resinogenous layer results from their union. Small drops of oil are formed in it, which gradually pass into the cavity; and the resinogenous layer is finally almost entirely resorbed. Similar phenomena are presented by other resin-plants.

Excretion of Resin by the Leaves of Conifers.†—From the observation chiefly of species of *Pinus*, *Picea*, *Abies*, and *Juniperus*, Herr E. Schwabach draws the following general conclusions.

The resin is formed in the epithelial cells of the resin-passages of young leaves, and from them is excreted into the canal. This excretion begins as soon as the canal-cells are differentiated, so that the canal becomes at once filled with resin. In *Abies*, *Pinus*, and *Juniperus*, the walls of the epithelial cells do not thicken, and continue to pour out resin into the canal. In *Picea* the walls of the epithelial cells begin to thicken in the first year, so that the cell-cavity often disappears almost entirely. The thickened membranes subsequently become absorbed; in which process, in *Picea*, resin is sometimes formed as a secondary product.

Indican and Pseudindican. ‡— In the case of several indigo-producing plants—*Indigofera*, *Isatis tinctoria*, *Phajus grandifolius*, Herr H. Molisch has determined that the indican is produced chiefly, though not entirely, within the chlorophyll-grains. This affords the first example of the presence of a nitrogenous glucoside within the grains of chlorophyll.

In the cystolith-cells of a few species belonging to the Acanthaceæ, but not in others, the same author § finds a chromogen giving the same reactions as indican, but very unstable. For all such chromogens which, under similar conditions, produce blue or blue-green pigments, he proposes the term *pseudindican.*

Atropine in Datura-seeds.‖—Dr. J. Thomann has made a series of observations for the purpose of determining whether the atropine in the seeds of *Datura stramonium* is a waste product or a reserve food-material. He finds sufficient evidence that, during the germination of the seeds, the greater part of the alkaloid is absorbed even when the culture is entirely free from bacteria or mould-fungi.

(3) Structure of Tissues.

Crystal-Cells.¶—Prof. W. Rothert and Herr W. Zalenski apply this term to a peculiar kind of cell found only in Monocotyledons, and apparently confined to the Irideæ, Amaryllideæ, and some families of Liliaceæ. These cells differ in several respects from ordinary raphid-

* Festschr. f. Schwendener, 1899, pp. 464–70.
† Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 291–302 (1 pl.).
‡ Tom. cit., pp. 228–33 (1 pl.). Cf. this Journal, 1899, p. 181.
§ S.B. k. Akad. Wiss. Wien, cviii. (1899) 12 pp. and 1 pl.
‖ Bot. Centralbl., lxxx. (1899) pp. 461–5.
¶ Tom. cit., pp. 1–11, 33–50, 97–106, 145–56, 193–201, 241–51 (1 pl.).

cells. The crystals have the form of more or less elongated four-angled prisms; the cell-wall is suberised; the cells are entirely or largely filled by the crystals; they are dead, and usually contain, in addition to the crystals, nothing but air; each crystal is surrounded by a membrane-less envelope, which is often also suberised. The crystals are composed of calcium oxalate, and are probably an excretion product. The membrane usually consists of two lamellæ, the inner one of which is suberised, but not the outer one. It is probably formed by modification from the cell-wall. This membrane is not always present; when there is one it can be detected by dissolving out the crystal by hydrochloric acid. The distribution of the crystal-cells in the tissues varies in different species. A number of special cases of their occurrence are described in detail.

Interxylary Leptome of Dicotyledons.* — Herr B. Leisering has made an exhaustive examination of those exceptional cases where, in the vascular bundles of Dicotyledons, a portion of the phloem elements occur, as larger or smaller islands, enclosed in the xylem, and therefore within the cambium, with a view to determine the mode in which this has been effected. The phenomenon occurs in a very large number of genera scattered through many natural orders, the specialities of which are described in detail.

Of the three modes in which it has been suggested that these islands may have been formed, the author finds evidence, in his investigations, of two only, viz. :—(1) The phloem is formed, in the typical manner, on the outside of the bundle, but has been bridged over by an outer layer of cambium; (2) Subsequent differentiation of tissue formed endogenously, which at first partakes of the character of xylem-parenchyme. The first type occurs in the Chenopodiaceæ, Amaranthaceæ, Phytolaccaceæ, Nyctagineæ, Melastomaceæ, Loranthaceæ, Combretaceæ, Loganiaceæ, &c.; the second in the Cruciferæ, Cucurbitaceæ, Campanulaceæ, Solanaceæ, Gentianaceæ, Leguminosæ, Malpighiaceæ, Apocynaceæ, Asclepiadeæ, Acanthaceæ, &c. As a rule the "island" consists only of sieve-tubes with the accompanying thin-walled cells. Those of the first type are usually nearly circular in transverse section; while those belonging to the second type have a much more irregular form.

Fibrovascular System of the Female "Flowers" of Conifers.†— Mr. W. C. Worsdell has made a careful study of this subject in a number of species belonging to the Araucarieæ, Abietineæ, Podocarpeæ, Taxeæ, Taxodineæ, and Cupressineæ, but is not able to come to a conclusion from it of the true nature of the so-called female "flower." The Araucarieæ, Podocarpeæ, Taxodineæ, and still more the Abietineæ, afford illustration, in the structure of their vascular bundles, of the compound nature of the axial appendage of the female cone, the two foliar organs comprising it being, in the last order, distinct and separable except at the very base, where they are adnate to one another. The Taxeæ differ from the other groups in the fact that the sporanges occur in a terminal instead of lateral position with respect to the axis on which they are borne.

* Bot. Centralbl., lxxx. (1899) pp. 289–98, 321–331, 369–76, 414–22, 465–70, 497-503 (3 pls.).

† Ann. of Bot., xiii. (1899) pp. 527–48 (1 pl.).

Formation of Cork in the Chenopodiaceæ.*—From an investigation of the process in several genera, Herr B. Leisering states that, in the Chenopodiaceæ, the cork is formed either beneath the epiderm, or in the lowermost layer of the primary cortex, or in the uppermost layer of the secondary cortex beneath the primary phloem-cells. In the last case it originates either from the first cell which is separated outwardly from the cambium, or from a special layer of the pericambium formed before the extrafascicular cambium. The cork-cells vary in their form from those of an ordinary short-celled parenchyme to parenchymatous fibres exceeding the cambium-cells in length.

Tracheids and Resin-passages in the Pith of Cephalotaxus.†—Prof. W. Rothert has detected resin-passages in the pith of several species of *Cephalotaxus*, resembling those of *Salisburia*, but hitherto unknown in that position in the Coniferæ. In one species, *C. koraina* sp. n., he has also found in the pith tracheidal parenchymatous cells of very peculiar structure. They have bordered pits and fibrous thickenings like xylem-tracheids, and are empty, but their form completely resembles that of the adjoining parenchymatous cells of the pith. They soon become lignified. Their function is probably the storing up of water.

(4) Structure of Organs.

Floral Abnormalities in Linaria spuria.‡—Mr. L. Jost has collected the results of an enormous number of observations on irregular structures in this species, including peloria. He considers them as "belonging to the nature of the species," and therefore rather as variations than abnormalities.

Organs which Secrete Water.—Herr M. v. Minden § states that the secretion of aqueous fluids through the leaves of water-plants takes place either through water-clefts, or through openings destitute of an epitheme. These are usually the result of the absorption of cells lying above the ends of the veins, the last tracheids running free into a small pit at the apex of the leaf; in floating leaves they are placed on the under side of the leaf. Dicotyledonous aquatic plants have also water-clefts. The water secreted contains large quantities of calcium chloride. Water-clefts are formed on cotyledons at a very early period, their function commencing with the unfolding of the cotyledons. In *Tropæolum* the water-clefts are larger when the air is very moist. The trichomes of the leaves of *Nicotiana* and of *Glaux maritima* contain an active calcium or magnesium chloride.

Herr P. Weinrowski ‖ records a number of observations to the same effect on aquatic plants. The openings at the apex of the leaves furnish the means of escape of a current of water laden with mineral substances. In *Nuphar*, *Utricularia*, and *Elodea*, pores were detected in the leaf-sheaths.

Glands of Euphorbia.¶—M. L. Gaucher has studied the structure of the glands of the cyathium of *Euphorbia*. Each gland consists of a loose

* Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 243–55 (1 pl.).

† Tom. cit., pp. 275–90 (1 pl. and 1 fig.).

‡ Biol. Centralbl., xix. (1899) pp. 145–95.

§ Biblioth. Bot., Heft xlvi. (1899) 76 pp. and 7 pls.

‖ Beitr. z. wiss. Bot. (Fünfstück), iii. (1899) 41 pp. and 10 figs. See Bot Ztg., lvii. 2^te Abt., p. 309.

¶ Journ. de Bot. (Morot), xiii. (1899) pp. 368–70 (1 fig.).

parenchymatous tissue enclosing chlorophyll, and traversed by a few laticiferous tubes. The chromoleucites are of two kinds—yellow with a pigment closely resembling that of carotin or xanthin, and orange-yellow or red. The glands also contain two coloured fluids—one red, the cyanin of authors (turning blue by the action of bases), the other yellow.

Hairs of the Verbasceæ.*—M. G. Lavadoux finds the presence of peculiar glandular hairs to be a constant character of all the indigenous (French) species of the Verbasceæ, and of all the exotic species examined, in addition to the branched, stellate, or candelabra-like hairs.

β. Physiology.

(1) Reproduction and Embryology.

Embryology of the Calycanthaceæ.†—Sig. B. Longo argues in favour of the affinity of the Calycanthaceæ with the Rosaceæ. The receptacle is axile in its origin; all the parts of the flower originating on it distinctly from one another.

In the development of the pollen-grains the tapete has no uniform morphological character; its significance is simply physiological. It is the nutrient tissue of the pollen-mother-cells; karyokinesis goes on actively in its cells. The pollen-grain consists of one large vegetative cell with large nuclei and nucleoles, and a small generative cell.

The embryo-sac is usually the product of several mother-cells or primordial cells, although each of these may develope into an embryo-sac. In any case, only one embryo-sac attains full development. The author regards the existence of a number of collateral cells of the embryo-sac as a constant character of the Rosaceæ and Calycanthaceæ.

Hybrid-Fertilisation of the Endosperm.‡—By fertilisation of the endosperm, M. Hugo de Vries understands the fusion of the hindermost spermatozoid (nucleus) of the pollen-tube with the central nucleus of the embryo-sac, as demonstrated by Nawaschin and Guignard.§ He has been able to establish a hybridisation, both of the embryo and of the endosperm, in the case of a variety of Indian corn known as the "sugar-maize" (*maïs sucré*), characterised by the replacement of the starch by sugar in the endosperm. The stigmas of this variety were pollinated from a plant of the ordinary kind, but without preventing pollination from its own male inflorescence. The result was the production of seedling plants in which the spikes consisted of some seeds of the ordinary kind, while some were filled with sugar; but there were none of an intermediate description. That the embryos, as well as the endosperm, were of a hybrid character was shown by sowing the seeds thus produced, and impregnating the female flowers by pollen from the male inflorescence of the same plant. The result was that the seeds thus produced were filled partly with starch and partly with sugar, but again there were none of an intermediate character. Hybridisation, both of the embryo and of the endosperm, was thus established.

Peculiar Embryo-sac in Peperomia pellucida.‖—Prof. D. H. Campbell describes what appears to be a constant peculiarity in this

* Journ. de Bot. (Morot), xiii. (1899) pp. 216–8 (4 figs.).
† Ann. r. Ist. bot. Roma, ix. (1899) pp. 1–16 (2 pls.). See Bot. Centralbl., lxxx. (1899) p. 183.
‡ Comptes Rendus, cxxix. (1899) pp. 973–5.
§ Cf. this Journal, 1899, p. 409.
‖ Ann. of Bot., xiii. (1899) p. 626.

plant in the processes which take place before fertilisation. After the first division of the large primary nucleus of the embryo-sac, the two daughter-nuclei remain close together, and after the next division, the four resulting nuclei are arranged at equal distances from each other. This stage is followed by one with eight nuclei, arranged equally about the periphery of the sac, which is completely filled with granular cytoplasm without the usual central vacuole. No trace could be detected of the polarity usually characteristic of the embryo-sac, nor is there any sign of a definite egg-apparatus, of antipodals, or of polar nuclei. About this time the central vacuole is formed, and soon after another nuclear division takes place, resulting in sixteen free nuclei, distributed equally about the periphery of the sac in the rather thick cytoplasmic layer.

Filaments in the Protoplasm of the Mother-cell of the Embryo-sac.*—In several species of Liliaceæ—*Fritillaria imperialis, Lilium candidum, L. tigrinum, L. Martagon, Tulipa sylvestris*—MM. M. and P. Bouin find, in the cytoplasm of the embryo-sac mother-cell, at the time when this cell is three or four times as large as the adjacent cells of the nucellus, a fibrillar network which eagerly takes up staining substances. From this are differentiated, during the further development of the cell, separate fibrillæ, which are at first distributed irregularly through the cytoplasm, but subsequently assume definite positions with respect to the nucleus. In the pole facing the micropyle they are often collected radially round the nucleus; the equatorial plane of the cell becomes soon free from them; they accumulate, on one hand in the micropylar region, on the other hand in the chalazal region of the elongated mother-cell of the embryo-sac. At these poles the fibrillæ coalesce into a homogeneous body, and then break up and become diffused through the cytoplasm. These structures have nothing to do with the kinoplasm, and the author proposes to call them *ergastoplasm*, a name given by Garnier to similar structures in the gland-cells of the higher Vertebrata. He believes them to be connected with the production of substances which are used up in the subsequent division-processes.

Cellulose-Bands in the Embryo-sac of Pedicularis.†—The occurrence has long been known of peculiar strands of cellulose in the embryo-sac of *Pedicularis palustris* and *sylvatica*. Herr Tischler has traced their development from filaments of protoplasm. They occur at the micropylar end of the embryo-sac, in peculiar narrow blind-gut-like processes; this portion of the sac having been, before their formation, filled with starch. The protoplasmic strands are at first simple, but subsequently anastomose with one another; they are of a granular structure. The nucleus of the extended portion is much larger than those of the surrounding cells of the integument. It subsequently breaks up, and ultimately disappears. The conversion into cellulose is preceded by a fusion of the protoplasm granules. The cellulose-strands resemble those found by Buscalioni ‡ in *Veronica hederæfolia* and *Plantago lanceolata*, but are not surrounded by a cementing substance.

* Bibliographie anatomique, vi. (1898) 10 pp. and 5 figs. See Bot. Centralbl., lxxx. (1899) p. 225.

† Ber. Königsberg. Oecon. Gesell., 1899, 18 pp. See Bot. Centralbl., lxxx. (1899) p. 390.

‡ Cf. this Journal, 1894, pp. 225, 589.

Cross-Pollination and Self-Pollination.—The late Herr P. Knuth * describes the mode of pollination of several Javanese species of *Mussænda*, which is effected by Lepidoptera. In one instance the butterfly, with a proboscis 27 mm. long, obtains the honey from the bottom of the long tube without seating itself on the flower.

Dr. F. Ludwig † gives a detailed description of the relative position of the parts, and the changes in colour of the perianth, of the strongly proterogynous *Helleborus fœtidus*, which all promote cross-pollination by bees, making the inflorescence more attractive from a distance.

Prof. G. v. Lagerheim ‡ describes the adaptation to cross-pollination in the flowers of *Brachyotum ledifolium*, a shrub of Ecuador belonging to the Melastomaceæ. It appears to be pollinated almost entirely by two species of humming-bird, attracted by the insects which feed upon the nectar. The structure of the flowers is such that it is hardly possible for the pollen to be carried to the stigma by the insects themselves; while self-pollination seems altogether excluded. Other ornithophilous plants from Ecuador are also mentioned by the author.

Mr. R. C. McGregor § points out the adaptations in the flowers of the American *Salvia coccinea* to pollination through the agency of a humming-bird, *Calypte anna*.

Dr. E. Fisch ‖ gives a variety of interesting details respecting the adaptations to insect-pollination in a number of alpine and desert plants, naming the class (but not the genus or species) to which the visitors belong. Among alpine plants he finds, in opposition to the statement of H. Müller, that red and blue flowers on the one hand, and white and yellow flowers on the other hand, occur in nearly equal numbers.

In *Vicia lathyroides*, Herr E. Loew ¶ finds an example of retrogression in the development of xenogamous flowers in the direction of autogamy. Although it does not produce strictly cleistogamous flowers, the monadelphy of the stamens, the absence of honey-glands, the reduction of the standard and keel, all point to an adaptation to self-pollination.

Knuth's Handbook to the Biology of Flowers.**—The most recent part of the late Dr. P. Knuth's Handbook comprises the remaining orders of Dicotyledons, commencing with the Lobeliaceæ, as well as the Monocotyledons and Gymnosperms. All recent observations on the mode of pollination of the species belonging to these orders are referred to, whether by the author or by other observers, and a copious bibliography is appended. A third volume, referring to extra-european species, remained unpublished at the time of the author's lamented death; but arrangements have been made for its publication.

* Dodonæa, 1899, 8 pp. and 7 figs. See Beiheft z. Bot. Centralbl., viii. (1899) p. 509. † Bot. Centralbl., lxxix. (1899) pp. 153–9 (3 figs.).

‡ Bot. Notis., 1899, pp. 105–22 (1 pl.). See Bot. Centralbl., lxxx. (1899) p. 78.

§ Amer. Naturalist, xxxiii. (1899) pp. 953–5 (3 figs.).

‖ Biblioth. Bot., Heft 48, 61 pp. and 6 pls.

¶ Flora, lxxxv. (1899) pp. 397–403.

** 'Handb. d. Blüthenbiologie,' vol. ii. pt. 2, Leipzig, 1899, 705 pp., 210 figs., and 1 portrait-plate. Cf. this Journal, 1898, p. 647.

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

Migration of Food-materials in the Leaves.*— Mr. G. M. Tucker and Mr. B. Tollens find that (in the plane-tree), the weight and the amount of ash in the leaves increase until the death of the leaves, and then slightly decline. The same is the case with silica and lime, but the chlorine and sulphuric acid show a continuous increase; leaves gathered in November contained three times as much sulphuric acid as leaves gathered in June. Phosphoric acid and potassa increase very slightly until the death of the leaves, after which they diminish to less than one half their original quantity. The amount of nitrogen decreases continually to less than one-fourth of its original quantity. There appears to be but very little retrogression of the food-materials from the leaves to the stem or branches. Rain has very little, if any, washing out action on the food-materials in the leaves.

Chlorophyll-Assimilation in Solar Light which has passed through Leaves.†—M. E. Griffon has carried out a series of observations for the purpose of determining the extent to which the power of assimilation in leaves is affected by the light having passed through other leaves. As a rule, with the leaves of different trees, passing through a single leaf does not greatly affect the power of light to decompose carbon dioxide; while, if the light have passed through two leaves, this power is so weakened that respiration is more energetic than assimilation. The reduction in the assimilating power by passing through a single leaf varied between as 1 : 7 in the case of the beech to 1 : 20 in the case of the ivy.

Assimilation and Transpiration in Japanese Plants. ‡ — M. K. Shibata has investigated the phenomena attending metastasis in Japanese species of bamboo. Starch is the chief reserve-food-material in the haulm, rhizome, and root; its soluble product is cane-sugar. Tyrosin and asparagin were both found, but tannin only very rarely. Phosphorus, potassium, chlorine, and magnesium are stored up in the reserve-receptacles, the last especially in the sieve-tubes; calcium and sulphur were not usually to be detected directly.

M. S. Kusano gives statistics of the transpiration of evergreen trees in the winter in Japan. It attains its minimum at the end of January.

From an observation of over eighty evergreen trees and shrubs, Prof. K. Miyake derives the following results. The amount of starch in the evergreen leaves begins to decrease about the end of November, attaining its minimum about the end of January, and beginning again to increase by the end of February. As a rule Monocotyledons contain less starch than Dicotyledons, Gymnosperms, or Pteridophytes, and occasionally none at all. Starch is always present, even in the coldest period of the year, in the mesophyll and in the guard-cells. The stomates remain open in winter.

Influence of Nitrogen on the Growth of Roots.§—A series of experiments carried out by Herr H. Müller-Thurgau on the effect on the

* Ber. Deutsch. Chem. Gesell., xxxii. (1899) pp. 2575–83. See Journ. Chem. Soc., 1900, Abstr., ii. p. 35. † Comptes Rendus, cxxix. (1899) pp. 1276–8.

‡ Arb. Bot. Inst. k. Univ. Tokio. See Bot. Centralbl., lxxx. (1899) pp. 169–72.

§ VI. J.B. Deutsch.-schweiz. Versuchsst. Wädensweil. See Bot. Centralbl., lxxx. (1899) p. 74.

growth of plants of an extra supply of nitrogen to the roots, points to the following general conclusions. The roots are enabled to form an abnormally large amount of albuminoids when the nitrogen is presented to them in the form of a nitrate, but only if they can obtain a plentiful supply of sugar from the leaves or from reserve-food receptacles. This is manifested in the greater length and thickness of the roots, in their increased ramification, and in the increased amount of protoplasm in their cells.

Symbiosis.*—After a brief summary of the various known forms of symbiosis, Prof. H. Marshall Ward suggests the hypothesis that one symbiont may stimulate another by excreting some substance which acts as an exciting drug on the latter. One symbiont may also act on the other by removing the products of metabolism, the accumulation of which tends to inhibit its activity.

Function of Aerial Roots.†—Dr. A. Nabokich has undertaken an extensive series of observations for the purpose of testing the accuracy of the current interpretation of the function of the aerial roots of epiphytic Orchideæ, Aroideæ, and Liliaceæ, viz. the collection and absorption of atmospheric moisture. From a careful examination of the structure of the aerial roots of a number of Orchideæ, he has come to the conclusion that the air-containing velamen can absorb only large drops of dew which are brought to them by the cooling of other parts. He calls special attention to two instances of the localisation of these roots, viz. between the bulbs and the surrounding leaves, and in the furrow of fallen leaves; and to the occurrence of rosettes of leaves round the bulbs; as also to the fact that xerophilous plants growing on rocks, &c., are not provided with aerial roots. In the main the author confirms the accepted view of the function of aerial roots; but they are very often found in an active condition only on young shoots. The parenchyme of the root draws the water with great osmotic force out of the velamen. In many cases, however, the velamen is replaced by several layers of water-absorbing cells. One important function of the velamen is to serve simply as a protection to the roots against rapid refrigeration. This view is supported by the fact that the velamen is especially strongly developed in those orchids which are natives of subtropical climates and mountain regions.

Physiology of Tuberous Structures.‡—Herr H. Vöchting finds the tubers of *Oxalis crassicaulis* a convenient object for investigating the physiological processes connected with the storing-up of food-material. On germinating, the tuber produces apical buds, which develope into leafy shoots, from whose base proceed abundance of roots. Later, underground stolons spring from the leafy shoot, some of which develope into other leafy shoots, while others remain underground and develope new tubers at their apex. The mother-tuber yields up its food-material to the daughter-tuber like the endosperm to the embryo, and then perishes. A normally developed tuber has one small ring of vessels. The histological structure and the physiological processes in

* Ann. of Bot., xiii. (1899) pp. 549–62.

† Bot. Centralbl., lxxx. (1899) pp. 331–40, 376–84, 423–32, 471–7, 503–10 (1 pl.).

‡ Pringsheim's Jahrb. f. wiss. Bot., xxxiv. (1899) pp. 1–148 (5 pls. and 9 figs.).

the tuber of *Oxalis crassicaulis* are compared with those in the stem-tubers of the potato and artichoke, the root-tubers of the dahlia, and other examples. Light was found to exercise a remarkably prejudicial effect on the growth of tubers and rhizomes, whether belonging to the root or to the stem.

Biology of Helleborus fœtidus.* — Dr. F. Ludwig gives further details of the mode in which this plant protects itself against the cold in winter; and classifies those plants which have special contrivances for this purpose under three heads, viz.:—(1) Those whose aerial development has already begun when the frost commences,—*hemichimonophilous*; (2) those with thin herbaceous leaves which persist through the winter,—*chimonochlorous*; and (3) those in which the chief development takes place in the winter half-year,—*chimonophilous*. *Helleborus fœtidus* belongs to the third class.

Influence of Moisture on Germination.†—Herr. W. Kinzel finds a marked difference in different seeds in this respect. As a rule the moisture of the soil has a greater influence in promoting germination than the water absorbed by the seed itself.

Resistance of Seeds to Mercury.‡—M. Casimir De Candolle states that grains of wheat, after having been immersed in mercury for four years, germinated, and produced normal plants.

(3) Irritability.

Chemotropism of the Pollen-tube.§ — Herr B. Lidforss has made some interesting observations on the attractive force exerted by the stigma on pollen-tubes, the species chiefly observed being *Narcissus Tazetta*. He found that artificially prepared organic acids—formic, acetic, lactic, succinic, malic, tartaric, citric—also amides, glucosides, and tannins, had no undoubted influence on the direction of the growth of pollen-tubes; but that the almost immediate effect of introducing into the medium a few grains of diastase was a deflection of all the pollen-tubes towards the grains. Further experiment showed that the constituent element of the diastase which attracted the pollen-tubes was its proteid. Experiments on *Narcissus* confirmed the view that there are chiefly two classes of substances which attract pollen-tubes, viz. carbohydrates and proteids; in other words, that the object of the movement is simply the search for food-materials for their development. Similar results were obtained with other species of *Narcissus*. The pollen of most Liliaceæ was found to be much more sensitive to mineral salts than that of *Narcissus*. In the case of apopetalous Exogens, no attractive force of proteids on the pollen-tubes could be detected; but in the case of a few Gamopetalæ—*Viburnum Lantana* and *nitidum*—this was observed.

Localisation of the Sensitive Region in Geotropism. — From the results of a series of experiments made on the germination of the seeds

* Bot. Centralbl., lxxx. (1899) pp. 401–13 (1 fig.). Cf. this Journal, 1898, p. 179.
† Landwirthsch. Versuchsstat., li. (1899). See Bot. Centralbl., lxxx. (1899) p. 350.
‡ Arch. Sci. Phys. et Nat., viii. (1899) pp. 517–8.
§ Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 236–42.

of different grasses, Prof. F. Darwin * has been able to localise the geotropic sensitiveness chiefly, though not exclusively, in the cotyledon.

Miss D. F. M. Pertz † confirms Czapek's statement ‡ that the maximum of geotropic curvature is reached when an organ deviates from the horizontal at an angle of 45° in a downward direction.

Motile Apparatus of Mimosa.§—According to Prof. A. Borzì, the roots of *Mimosa pudica* are capable of transmitting movements of irritation although destitute of any special organs of sensitiveness; and the same is the case with the leaves of some Leguminosæ. In the tissue of the motile organs of the leaves of *Mimosa* is a structure not found elsewhere in the plant. The protoplasts are surrounded by peripheral fibrillar extensions, which penetrate through the delicate orifices in the cell-walls, placing them in intimate connection one with another. This motile apparatus is attached to every leaf of the plant, and sends out prolongations which extend to the whole plant, even to the root-system. But it is in the leaves only that the sensitive apparatus comes into contact with the environment. The only way here for the conduction of the irritation is through the epiderm, whether of the leaflets, of the mid-rib, or of the cushions. The minute structure of these various parts is described in detail. The protoplasm of the sensitive organ contains a large amount of saccharose in solution, which accounts for its high osmotic properties.

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

Synthesis of Albuminoids.‖ — Herr W. Palladin asserts that the nitrogenous organic substances in plants may originate in several ways. Besides the intermediate products of the primary synthesis of albuminoids, we may also have products of the decomposition of albuminoids; intermediate products of the regeneration of the decomposition-products; and various special products of the breaking up of albuminoids. The decomposition of albuminoids takes place only in growing organs. In *Ulva Lactuca* and *Enteromorpha intestinalis* he found asparagin, but no tyrosin. Tyrosin cannot, therefore, be the first stage in the primary synthesis of albumen. Asparagin and tyrosin are simply products of the decomposition of albuminoids. In *Salicornia herbacea* he found neither asparagin nor tyrosin; in the leaves of *Robinia Pseudacacia* very little asparagin and no tyrosin; in the leaves of *Dahlia variabilis* (in August) neither asparagin nor tyrosin.

Enzymes.¶—Herr J. Grüss gives further details of the properties of the enzyme of *Penicillium glaucum*. It possesses the power of energetically splitting up cane-sugar, but has a less powerful action on starch and reserve-cellulose; it has not the properties of an oxydase. Malt-diastase, on the other hand, plays the part of a γ-oxydase; it acts energetically on starch, less so on cane-sugar, and only very slowly on reserve-cellulose.

* Ann. of Bot., xiii. (1899) pp. 567–74 (1 pl.). † Tom. cit., p. 620.
‡ Cf. this Journal, 1895, p. 454.
§ Riv. Sci. Biol. Palermo, 1899, fasc. 4, 39 pp. See Bot. Centralbl., lxxx. (1899) p. 351. ‖ Russian, Charkow, 1898. See Bot. Centralbl. lxxx. (1899) p. 17.
¶ Festschr. f. Schwendener, 1899, pp. 184–201. (1 pl.).

Galactase or Milk-ferment.* — Messrs. S. M. Babcock and H. L. Russell give in more detail an account of galactase, the specific proteolytic ferment of milk, its properties, and its action on the proteids of milk. Though allied to other proteolytic enzymes of animal and vegetable origin, it is different therefrom, and it has received its name on account of its inherent relation to milk. It is present in all mammalian milk. Its action shows that the enzyme belongs to the class of which the best representative is trypsin. It acts powerfully in neutral and faintly alkaline solutions, and is less sensitive to acid reaction than trypsin. Its strongest effect is exerted between 37° and 42°. It rapidly decomposes H_2O_2. In milk it can be easily distinguished from other animal or bacterial proteolytic ferments by the character of its decomposition products, e.g. from trypsin it is distinguished by forming ammonia.

The close connection between the action of galactase on milk and the normal ripening of Cheddar cheese leads to the conclusion that these two processes are effected by the same agency.

Self-fermentation of Yeast.†—By the self-fermentation of yeast is to be understood, says Herr C. J. Lintner, the power possessed by yeast of forming alcohol and carbonic acid at the expense of their own body-substance and without any addition of sugar. The material for this self-fermentation is no doubt glycogen, which is first converted into grape-sugar and then into alcohol and carbonic acid. The amount of alcohol produced by fresh bottom yeast in 42 hours amounts to 5·6–7·7 per cent. of the dry yeast mass. The author's experiments and observations chiefly relate to the action of certain salts on self-fermentation. Starting with the idea that invertin must be easily extracted from plasmolysed yeast, and using a large excess of the salts in order to kill the yeast, he found, contrary to his expectation, that while certain salts inhibited self-fermentation others promoted it. The first set of experiments was carried out in small tubes, and the results are shown in four tables. Chlorides prevented self-fermentation. According to the nature of the base, sulphates excited or depressed the action; sodium and zinc sulphates promoted self-fermentation, while other sulphates repressed it. Acid phosphates hastened, and alkaline phosphates retarded the action. Ammonium salts always inhibited, and nitrates appeared to do so. Distilled water at first delayed self-fermentation. Experiments made with Hayduck's apparatus for the purpose of ascertaining the amount of carbonic acid developed in a given time gave confirmatory results.

Schizomycetic Fermentation.‡—Herr O. Emmerling communicates some observations on the fermentation of malic acid by *Bacillus lactis aerogenes*. The fermentation products were carbonic, acetic, and succinic acids. These results lead the author to suggest that previous observations (Fitz, Pasteur) as to the conversion of malic into succinic acid by Blastomycetes are incorrect, and that the changes found were probably due to contamination with fermenting bacteria.

* Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 17–21, 45–50, 79–88 (8 figs.). Cf. this Journal, 1898, p. 219. † Op. cit., v. (1899) pp. 793-800.

‡ Ber. Deutsch. Chem. Gesell., xxxii. (1899) pp. 1915–8. See Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) p. 24. Cf. also this Journal, 1899, p. 637.

γ. General.

Mosaic Disease of Tobacco.*—Herr C. J. Koning, after alluding to the great infectiousness of the disease, remarks that the anatomical changes in the earlier stages of the disorder are extremely slight. At first dark bluish-green streaks and vesicles appear, while later on the chlorophyll-granules break up and the cell-walls disappear. From the fact that the virus, even in minimal doses, easily reproduces the disease in healthy plants, it seems a fair conclusion that the exciting cause of the disease is a micro-organism; but even under the highest powers none were to be detected, and numerous cultivation experiments on different media were entirely negative. Hence there seems to be some resemblance in these respects to the virus of rabies and that of foot-and-mouth disease.

Megaloxylon, a new Genus of Fossil Vascular Plants.†—From a collection of fossil plants from the Coal-measures, Mr. A. C. Seward describes one which he regards as the type of a new genus of Cycadofilices forming a connecting link between the Palæozoic forms and recent ferns. The stem is probably monostelic; the primary wood consists of tracheids with multiseriate polygonal bordered pits, and parenchyme; the secondary wood is of the Cycadean type, with broad medullary rays; the exarch leaf-traces consist of long tracheids associated with xylem-parenchyme; each leaf-trace traverses the peripheral region of the stele through several internodes, and finally passes through the secondary wood in an obliquely horizontal direction.

Calamodendreæ.‡—Herr B. Renault regards the fossil Calamodendreæ as most nearly related to the Gnetaceæ among existing forms, being intermediate between them and the cryptogamic Calamariaceæ. The following is given as a diagnosis of the order:—Stem jointed; xylem-bundles separated by more or less broad primary medullary rays; secondary or xylem-rays composed of cells which are higher than broad; ends of the xylem-bundle usually with a lacuna on the pith-side; secondary xylem radiate; cambium-zone distinct in the stem, branches, and roots; branches and roots verticillate. The family comprises the genera *Bornia*, *Arthropitys*, and *Calamodendron*.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Epiphytic Ferns.§—Herr K. Giesenhagen proposes to place the epiphytic forms of the Polypodiaceæ hitherto known as the *Niphobolus*-form in a distinct genus with that name. They exhibit several special points of structure which adapt them to their epiphytic habit. The under side of the leaves is clothed with stellate hairs. Some species have hydathodes in the form of small pits on the upper side of the leaf often filled with calcareous scales. In some species the assimilating tissue on the under side of the leaf has a loose structure, and there is no water-

* Zeitschr. f. Pflanzenkrankh., 1899, p. 65 (1 pl.). See Centralbl. Bakt. u. Par., 2[te] Abt., vi. (1900) pp. 27–8. Cf. this Journal, 1899, p. 428.

† Proc. Cambridge Phil. Soc., x. (1899) pp. 137–74 (5 pls. and 9 figs.).

‡ Bull. Soc. d'Hist. Nat. Autun, xi. (1898) (12 pls. and 9 figs.). See Bot. Centralbl., lxxx. (1899) p. 485.

§ Festschr. f. Schwendener, 1899, pp. 1–18 (1 pl.).

storing tissue; in others the leaves are succulent, and there are no hydathodes. In this group the cuticle is strongly thickened, and the stomates are placed in depressions. All the species have a xerophilous structure.

Stem-structure in Schizæaceæ, Gleicheniaceæ, and Hymenophyllaceæ.*—Mr. L. A. Boodle calls attention to the fact that there is a wide diversity in the types of stem-structure shown by the different members of the Schizæaceæ. The four genera of which the order is composed—*Lygodium*, *Aneimia*, *Mohria*, and *Schizæa*—agree, however, in having a stem-protoxylem which is not well-marked, as it consists of elements which are not annular or spiral, and are usually not specially small. The Gleicheniaceæ and Hymenophyllaceæ include forms with a solid central mass of xylem; the protoxylem is well-marked, and is composed of annular and spiral elements in both orders. The author regards the solid stele as the primitive form, from which the *Aneimia* type has been derived.

Algæ.

Tendrils of Algæ.†—Herr M. Nordhausen describes the structures in certain algæ which have the appearance and function of tendrils. They are confined to the Florideæ, and are especially abundant in the genus *Hypnea*, but occur in several different families. Three species are described in detail as typical, viz. *Hypnea musciformis*, *Spyridia aculeata*, and *Nitophyllum uncinatum*. The hooked branch differs in its branching from the rest of the thallus, in accordance with the function of the hook, which is the same as that of a tendril, viz. to enable the plant to cling hold of other stronger plants, and thus to support itself in the water. Hook-like structures occur on the root as well as on the frond.

Notheia anomala.‡—Miss Ethel S. Barton has studied the structure and development of this seaweed, the only known parasite belonging to the Fucaceæ, found on *Hormosira* and *Xiphophora*. The growing point consists of three apical cells, and forms the topmost point of the thallus, not lying at the base of a depression. The development of the cryptostomates into conceptacles is described in detail. The antherids and oogones are found in the same conceptacle. The antherids are not formed on branched hairs, as is usually the case in the Fucaceæ, but spring directly from the wall of the conceptacle. Each oogone contains eight oospheres. It is a true parasite, rhizoids given off from the base of the pseudo-cryptostomate penetrating between the cells of the host-plant.

Polymorphism in the Phæosporeæ.§—Herr P. Kuckuck gives several other illustrations of heteromorphy in the Phæosporeæ similar to that of *Cutleria* and *Aglaozonia*.

Pogotrichum filiforme is parasitic on *Laminaria saccharina* near Heligoland, and occurs in January, in a branched monosiphonous prostrate form, with plurilocular sporanges, which might well be taken for an

* Ann. of Bot., xiii. (1899) pp. 624–5.
† Pringsheim's Jahrb. f. wiss. Bot., xxxiv. (1899) pp. 236–78 (1 pl.).
‡ Journ. Linn. Soc. (Bot.), xxxiv. (1899) pp. 417–25 (3 pls.). Cf. this Journal, 1893, p. 762.
§ Festschr. f. Schwendener, 1899, pp. 357–85 (1 pl. and 12 figs.).

independent species of *Ectocarpus*; but from which is developed the erect typical form of *Pogotrichum*. *Ectocarpus tomentosoides* is also heteromorphic; and other examples are given.

For the earliest condition of these polymorphic Algæ the author proposes the term *prostade*, with the corresponding terms *prosporange* and *prospore*.

Compsonema, a new Genus of Phæosporeæ.* — Under the name *Compsonema gracile* g. et sp. n., Herr P. Kuckuck describes a seaweed from the Adriatic which forms small brown cushions on stones. From a unilamellar basal disc there arise unbranched monosiphonous assimilating filaments about 1 cm. long. Only plurilocular sporanges were found, having the form of pods. Like the basal hairs, they are placed laterally on the assimilating filaments, and are stalked or sessile. In each cell is a chromatophore. The genus belongs, or is at least nearly allied, to the Myrionemaceæ.

Transference of Inorganic Substances in the Laminariaceæ.†— Herr N. Wille gives the result of analyses of different parts of the plant in two species of *Laminaria* (*Cloustoni* and *saccharina*). When thoroughly cleansed from sand and the valves of diatoms, the analysis shows only traces of silica. The amount of ash in the young leaves is much smaller than in the old leaves; the proportion of phosphorus, nitrogen, chlorine, sulphur, potassium, sodium, and magnesium decreases, while that of lime increases. The stipe agrees essentially in composition with the older parts of the leaf.

Asperococcus with two kinds of Sporange.‡—In the Adriatic Herr P. Kuckuck finds a new speceies of *Asperococcus*, *A. scaber* sp. n., with both unilocular and plurilocular sporanges. It is distinguished from the other known species of the genus by having a basal disc instead of a protonemoid horizontal thallus. The plurilocular sporanges are much the more numerous, and are collected into sori on erect filaments which exhibit the characteristic differentiation of pith and cortex.

Female Conceptacles of Sporolithon.§ — Herr F. Heydrich has found the hitherto unknown female conceptacles of *Sporolithon molle*, belonging to the Corallinaceæ. The structure of the thallus is also described in detail, as well as the nature of the so-called cuticle, the pits of the thallus-cells, the procarp, hymenium, gonimoblasts, and spores, and the mode of formation of the cystocarps.

Alternation of Generations in Cutleria.‖—Following out the development of *Cutleria multifida*, and the relationship to *Aglaozonia*, the conclusions arrived at by Herr P. Kuckuck coincide in the main with those of Church. From the non-sexual *Aglaozonia* spores he obtained:— (1) Normal *Cutleria* plants with oogones; (2) Confervoid plants with oogones, the vegetative portion being but little developed; (3) Confer-

* Beitr. z. Kenntniss d. Meeresalgen, Kiel, 1899, pp. 90–4 (1 pl.). See Hedwigia, xxxviii. (1899) p. 272. † Festschr. f. Schwendener, 1899, pp. 321–40 (8 figs.).

‡ Beitr. z. Kenntniss d. Meeresalgen, Kiel, 1899, pp. 47–53 (1 pl. and 1 figs.). See Bot. Centralbl., lxxx. (1899) p. 266.

§ Biblioth. Bot., Heft 49, 1899, 26 pp. and 2 pls.

‖ Beitr. z. Kenntniss d. Meeresalgen, Kiel, 1899, pp. 95–116 (2 pls. and 15 figs.). See Bot. Centralbl., lxxx. (1899) p. 26. Cf. this Journal, *ante*, p. 90.

void plants which, passing over the sexual stage, produced *Aglaozonia* lobes. Temperature appears to exercise a great influence over the development of the generations.

Structure of Padina Pavonia.*—Herr G. Bitter has carried out a series of experiments for the purpose of determining the effect of a reversal of position on dorsiventral seaweeds. When the light reaches it on the dorsal side only, the spirally rolled up margin first becomes flattened out, and then rolls up on the reverse side. Fructification appears on the upper side of fronds treated in this way, but not in such abundance as on the under side. Erect shoots are formed on both sides of the thallus in alternate zones; those on the upper are less developed than those on the under side.

New Mode of Formation of Colonies in Diatoms.†—Under the name *Cyclotella socialis* sp. n., Herr F. Schütt describes a diatom, found by him in the Lake of Constance, characterised by a novel mode of formation of colonies. From each cell-membrane there project towards the interior of the colony a large number of very fine parallel or somewhat divergent straight stiff needles or threads, which become interwoven with one another, and thus connect a number of individuals into a colony. The author argues against the multiplication of the genera of diatoms, especially on biological grounds.

Diatoms of Kiel Harbour.‡—In an exhaustive account of the section Pennatæ of the diatoms of Kiel Harbour, Herr G. Karsten enumerates 28 genera and over 200 species, about 20 of the latter being new. The earlier portion of the work comprises a general treatise on the structure and definition of the protoplasm-body of diatoms, the position of the nucleus, the number, form, and position of the chromatophores, the presence of pyrenoids, and the history of development of each species. He insists on the inadequacy of characters drawn from the valves alone for the determination of genera and species. Within each genus the number and position of the chromatophores may be used as the first character for classification. With regard to the movements of diatoms, the author follows O. Müller in regarding the raphe as a highly developed motile organ. He maintains his previous classification of the mode of formation of auxospores under four types, § giving further illustrations. The special home of the motile forms of diatoms is the shifting sea-bottom.

Rhopalodia.‖—From a study of a collection of diatoms from the soda-region of El Kab, in Upper Egypt, Herr O. Müller gives a fuller description of this genus, to which he refers several species hitherto placed under *Epithemia*. An important diagnostic character of the genus is that a canal-raphe runs along the ridge of the roof-shaped valve in the direction of the central node. The mode of division is described, and a monograph given of the section Epithemioideæ.

* Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 255–74 (1 pl.).

† Tom. cit., pp. 215–21.

‡ Wissensch. Mittheil.; Com. z. Unters. d. deutschen Meere in Kiel, iv. (1899) pp. 19–295 (219 figs.). See Bot. Centralbl., lxxx. (1899) p. 126.

§ Cf. this Journal, 1898, p. 514.

‖ Hedwigia, xxxviii. (1899) pp. 274–88 (3 pls.).

Mesogerron, a new Genus of Chlorophyceæ.*—Among other Algæ, in a ditch near Munich, Herr F. Brand finds a species which, under the name *Mesogerron fluitans* g. et sp. n., he makes the type of a new genus with the following diagnosis:—Thallus aquaticus, simplex v. parce ramosus, e cellularum serie simplici constitutus; cellulæ chlorophorum singulum, axile, rectangulariter laminiforme, et vario modo leviter curvatum, pyrenoidibus destitutum foventes; generatio ignota. In its double rhizoids, *Mesogerron* recalls the Ulotrichaceæ, but is distinguished from all the species of that group by its vegetative branching, by the central chlorophore, and by the absence of a pyrenoid.

Differentiated Proteinaceous Substances in Derbesia.†—Herr F. Noll confirms the statement of Küster as to the occurrence of well-developed sphærocrystals in the cell-sap of *Derbesia*; and he also finds them only in that genus and in *Bryopsis* among Siphoneæ. They are not, however, the result of the disorganisation of protoplasm, but are already present in the cell-sap. The fibre-like structures which accompany the sphærocrystals arise in the form of small needles, which swell up, become mucilaginous, and lose their definite outline. These structures and the sphærocrystal differ in their staining reactions.

Acetabularia.‡—From a study of *Acetabularia mediterranea* from the Luchu Islands, Prof. T. Ito concludes that the prototype of this alga probably consisted of a main axis bearing whorls of foliar appendages, which, after discharging its function as an assimilating organ, became converted into a gametange, which represents the cap. Thus the cap of *Acetabularia* serves a double physiological function, viz. in storing up food as an assimilating organ, and in producing and discharging gametes as a reproductive organ.

Microdictyon umbilicatum.§—Herr G. Bitter supplies a contribution to our knowledge of this representative of a little known genus of siphoneous algæ. The growing apices of filaments have a remarkable propensity to pass into a rhizoid-like condition. These growing apices are influenced in the direction of their growth by adjacent portions of the thallus, usually curving towards the nearest thallus-portion; and the same is the case also with protrusions from young tubes. The cause of this bending is probably chemotropic. The network of hyphæ has a strong tendency to become duplicated.

Vegetative Multiplication of Pandorina morum.‖—Herr B. Schröder has followed out the hitherto but imperfectly known mode of non-sexual propagation in this freshwater alga. In its unicellular condition (chlamydomonas stage) it loses first its vacuoles, then its eye-spot, and finally its cilia. It then divides successively into 2, 4, 8, and 16 (gonium stage) cells. Four of these cells occupy the centre of the colony, surrounded by the remaining twelve. In this condition the cells again acquire cilia, eye-spots, and vacuoles in succession, forming a mature colony which again breaks up into its constituent cells, each

* Hedwigia, xxxviii. (1899) Beibl., pp. 181–4 (1 fig.).
† Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 302–6. Cf. this Journal, 1899, p. 515.
‡ Hedwigia, xxxviii. (1899) Beibl., pp. 184–6 (English).
§ Pringsheim's Jahrb. f. wiss. Bot., xxxiv. (1899) pp. 199–235 (1 pl.).
‖ J.B. Schles. Gesell. Vaterl. Cult., 1898 (1899), Zool.-bot. Sect., pp. 27–30.

enveloped in mucilage. The process corresponds in all essential points to that already described in *Pleodorina californica* and *P. illinoisensis*. The alga is frequently infested by the parasitic fungus *Dangeardia mamillata* g. et sp. n.*

Chlamydomonadineæ.†—M. P. A. Dangeard gives an exhaustive monograph of this family,—consisting of the genera *Chlorogonium*, *Cercidium*, *Lobomonas* g. n., *Phacotus*, *Chlamydomonas*, and *Carteria*—together with critical remarks on the structure, mode of reproduction, and affinities of the lower Algæ. *Lobomonas Francei* g. et sp. n. is a lobed organism, somewhat resembling an amœba with its pseudopodes; the zoospores pass into a state of repose, and then divide into 4 or 8 new individuals; no sexual mode of reproduction is known.

The author regards the Chlamydomonadineæ as forming one of the lowest steps in the vegetable series, and marking a passage from the Flagellates to the Chlorophytes.

In the general portion of the paper the elements of the cell, the division of the nucleus, and cell-reproduction, are discussed at length. The disposition of the cytoplasm varies in the different species of Chlamydomonadineæ. It may be homogeneous or reticulated, and in both cases either chromatic or achromatic. There is, in this group of Algæ, a cytoplasmic network, the substance contained in the meshes being an inert fluid. The cytoplasm may be chromatophilous or uncoloured. The chromatin-granules are especially fuchsinophilous. The flagella are usually two in number, in *Carteria* there are four. Most species contain one or more pyrenoids of a homogeneous substance; they either multiply by division or originate directly in the chloroplasm. Wherever the presence of a nucleus has been demonstrated, it exhibits karyokinesis with its complex phenomena. The nucleus consists of a nuclear membrane, one or more nucleoles, and a nucleoplasm. Indirect division of the nucleus (in contrast to karyokinesis) has been observed only in *Chlorogonium*. A structure corresponding exactly to a centrosome was observed only once (in *Chlamydomonas monadina*). Karyokinetic division goes through its regular stages of prophasis and anaphasis.

Just as, in the cytoplasm, there is a differentiation of elements with definite functions, or, in a chlorophyllous cell, there are chloroleucites which subserve a holophytic nutrition, so, in karyokinesis, there is a differentiation from the protoplasm of bodies to which may be given the name division-leucite or *clasileucite*. They often possess corpuscles which are capable of multiplying by division or by new formation.

The paper concludes with some general remarks and theories on Sexual Reproduction. In the Chlamydomonadineæ the process consists of the conjugation of two sexual zoospores or gametes formed in a gametosporange; the gametes may be naked or enclosed in a membrane; the conjugation may be isogamous or heterogamous; and isogamy and heterogamy may both occur in the same species.

The author regards sexual reproduction as simply a modification of primitive autophagy. Its object is to re-establish in the nucleus the normal number of chromosomes which has, for the time, been reduced to one-half by chromatic reduction; this reduction is a necessary conse-

* Cf. this Journal, 1899, p. 309.
† Le Botaniste, vi. (1899) pp. 65-292 (20 figs.).

quence of sexual union, since otherwise the number of chromosomes would double in each sexual generation. Every gamete carries, in itself, from its origin and nature, the principle of parthenogenetic development. Before conjugation, gametes are nothing but hungry zoospores. If they can satisfy their hunger by direct nutrition, they do not conjugate, but develope non-sexually. Parthenogenesis is simply a continuance of non-sexual multiplication, where the food-supply is ample. When this fails, the gametes devour one another; and this is sexual reproduction.

De Toni's Sylloge Algarum.—We have received vol. iv. sect. 2 of this valuable work. It is devoted entirely to four families of the Florideæ, viz. the Sphærococcaceæ, Rhodymeniaceæ, Delesseriaceæ, and Bonnemaisoniaceæ; these four, together with the Rhodomelaceæ, constituting the order Rhodymeninæ, with the following diagnosis:—Cellula carpogonii fecundata fili seu processus brevis ope cum cellula auxiliari conjuncta (copulata) ita ut cellula auxiliaris ipsa fertilis evadat et in gonimoblastum versus exteriorem thalli regionem evolvatur; fila articulata carpogonifera et cellulæ matres cellularum auxiliarium binatim insimul disposita, sæpissime in procarpium proprium conjuncta. The characters of the genera and species are worked out with the usual care and copiousness of reference.

Fungi.

Position of Fungi in the Plant System.*—Dr. H. L. Bolley, in reference to the position of the Fungi in the vegetable system, puts the question whether, if putrefying organisms be true vegetables, that is, ones which live only on mineral elements, what place should be assigned to the Bacteria and Fungi in the system of plants? Shall we, he says, continue to call organisms which are so close in nature as to be able to live directly upon mineral elements, even in the absence of sunlight, degenerates? If these organisms do construct their bodies directly from mineral elements, would it not be a sounder principle to derive the Algæ from the Fungi, than *vice versa* by degeneration?

Sexuality of Fungi.†—Mr. H. Wager gives a succinct account of the knowledge hitherto obtained regarding a sexual process in the various families of Fungi, especially in the Phycomycetes, Ascomycetes, and Uredineæ, and gives the following general conclusions.

In the Phycomycetes we have a true sexuality, consisting in the fusion of two nuclei derived from separate more or less completely differentiated cells. In its essential character it does not appear to differ from that of higher plants and animals. Before fusion takes place there may or may not be a preliminary division of the sexual nuclei; there is not sufficient evidence whether or not this preliminary division is connected with chromosome reduction. Before fusion, the two nuclei, which at first may differ very much in size, attain the same size and staining reactions. Fusion may take place at once, or may be delayed until after germination has taken place. The fusion of nuclei takes place in the resting condition, or possibly in some cases in the chromosome stage. The formation of sexual organs depends, to some extent, on external conditions. Centrosomes have not been observed to

* Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 857–9.
† Ann. of Bot., xiii. (1899) pp. 575–97.

take part in the process of fertilisation. The sexual elements which unite in any given case are generally derived from one and the same individual, often from the same filament; in *Basidiobolus* they are derived from adjacent cells.

In the higher Fungi, nuclear fusions occur at a definite stage in the life-cycle, resulting in the production of spores, either directly (Ustilagineæ, Uredineæ) or indirectly (Ascomycetes, Basidiomycetes). These nuclear fusions are probably not morphologically sexual; but they replace the sexual act, and are physiologically equivalent to it. Among the higher Fungi, the simpler Ascomycetes only, such as *Sphærotheca*, exhibit a true sexual fusion, accompanied by a subsequent fusion of nuclei in the ascus.

Cell-division in Sporanges and Asci.*—Prof. R. A. Harper gives a summary of recent researches on the various modes of cell-division in the different families of Fungi, followed by the results of his own observations especially on *Synchytrium*, *Pilobolus*, *Sporodinia*, and *Lachnea*. The following is a summary of his more important conclusions.

There is a marked difference in the method of spore-formation in the ascus and in the sporange. In the ascus, as in the higher plants, the cutting out of the daughter-cell from the mother-cell is effected by the agency of the same fibrous kinoplasmic elements as were concerned in the division of the nucleus. In the higher plants the flat cell-plate is formed by the "cone principal" of the karyokinetic figure (as named by Van Beneden); while in the ascus the daughter-cell is cut out of the protoplasm of the mother-cell by an ellipsoidal plate formed from the fibres of the antipodal cone. In this process the daughter-cell is cut out of the interior of the protoplasm of the mother-cell, so that it remains surrounded on all sides by the material of the mother-cell. The daughter-cells do not contain all the protoplasm of the mother-cell, a considerable mass remaining in the so-called "epiplasm." In all the sporanges studied the cleavage is from the surface of the protoplasm or from the surface of vacuoles of the mother-cell. The daughter-cells are thus separated by cleavage-furrows, and the nature of the division from the surface inwards precludes the possibility of the formation of an epiplasm.

Prof. Harper corrects his previous statement that the one-celled ascospore is always uninucleate; he has since found ascospores in which nuclear division has occurred without cell-division.

The present researches do not settle the question of the origin of the Ascomycetes, but render it impossible to assume any very direct relationship between the Phycomycetes and the Ascomycetes.

Prof. Harper proposes to limit the term "free cell-formation" to the process which takes place in the ascus. The method of division by which the sporangiospores and conids are formed may be termed "cleavage by constriction"; and where the division proceeds to the ultimate separation of the energids as protospores, the process may be called "progressive and complete cleavage."

Inheritance of an acquired Character in a Fungus.†—Prof. L. Errera believes he has found evidence of this phenomenon in cultures

* Ann. of Bot., xiii. (1899) pp. 467–525 (2 pls.).
† Bull. Acad. Roy. Belgique, 1899, p. 81.

of *Aspergillus niger*. The conids adapt themselves to the concentration of the fluid in which they are grown more readily in the second generation than in the first. When they have adapted themselves to more highly concentrated solutions, they lose the capacity of thriving as well in those of lower concentration. Culture in a normal solution for a single generation does not destroy the influence of growth for one or two generations in more concentrated solutions.

Cell-membrane of the Mucorineæ.* — From a careful study of the structure of the cell-wall in representatives of different families of the Mucorineæ, M. L. Mangin states that it presents special characters which distinguish the members of this order from the other Oomycetes. While in the Peronosporeæ and Saprolegnieæ the membrane is partly formed of callose, this fundamental substance, characteristic of the mycele of a large number of Fungi, is usually wanting in the Mucorineæ. Both the aerial and the submerged mycele, as well as the sporiferous filaments, consist of cellulose associated with pectic compounds, and, as in flowering plants, the cellulose is in a larger proportion in the inner than in the outer layers of the cell-wall. The cellulose is more resistant to chemical agents (Schweizer's reagent) than that of Phanerogams and Vascular Cryptogams. In a large number of species, especially in the Mucoreæ, Piloboleæ, and Mortierelleæ, the outer membrane of the sporiferous filaments is covered by a mineral incrustation. This coating is entirely wanting in the Syncephalideæ.

In those species which have a deliquescent sporange, its membrane presents a special structure. Before the spores are formed, it becomes double from a thick internal layer composed of callose. As this layer thickens, the outer membrane becomes mineralised and the cellulose disappears; finally the mineral coating is in immediate contact with the layer of callose which forms the deliquescent part of the membrane. In the Syncephalideæ the membrane of the sporange does not deliquesce. The thick membrane of the endogenous spores, spores properly so-called, and chlamydospores, does not respond to the reactions of the membrane of the mycele; it consists almost entirely of callose. On the other hand, the membrane of the exogenous spores, stylospores, and zygospores, corresponds to that of the mycelial filaments.

New Pathogenic Mucorinea.†—M. Lucet and M. J. Costantin describe a fungus found in the larynx of a woman, which they name *Rhizomucor parasiticus*, the type of a new section of the genus *Mucor*. The mode of branching is that of a *Mucor*; but it is distinguished by the presence of rhizoids springing from the creeping mycele resembling those of *Rhizopus*. It is pathogenic to men and other animals.

Mortierella van Tieghemi sp. n.‡—Herr H. Bachmann describes a new species of this genus, found on horse-dung, allied to *M. candelabrum*. It is characterised by forming strongly warted stalked conids or stylospores, in addition to sporanges and ordinary conids; no zygospores were seen. The results of culture under various conditions and on various nutrient media are given in detail; the presence of nitrogen in

* Journ. de Bot. (Morot), xiii. (1899) pp. 209–16, 276–87, 307–16, 339–48, 471–8 (2 pls. and 7 figs.). † Comptes Rendus, cxxix. (1899) pp. 1031–4.
‡ Pringsheim's Jahrb. f. wiss. Bot., xxxiv. (1899) pp. 279–328 (2 pls.).

organic combination appears to be needful for its luxuriant development. It thrives better on solid than in fluid media.

New Mode of Formation of the Oosperm in Piptocephalis. * — Under the name *P. Tieghemiana* sp. n. M. L. Matruchot describes a new species of *Piptocephalis*, in which the mode of formation of the ovum (oosperm) differs from that in *P. Freseniana*, and indeed from that in any other species of Syncephalideæ in which it is at present known. Fusion of the two gametes takes place; but the septa which, in the conjugating branches, separate the gametes from the body of the plant, are placed high up, instead of dividing each branch into two nearly equal parts. Hence the ovum is developed between the two conjugating branches, instead of above the point of junction of the sexual elements, as in *P. Freseniana*. The author argues from this in favour of Van Tieghem's view that sexual characters are of subordinate importance in a natural classification of the Mucorineæ.

New Genera of Fungi.—In a collection of Fungi from Natal, Herr P. Sydow† finds a representative of a new genus belonging to the Discomycetes (Patellariaceæ), of which he gives the following diagnosis:—Ascomata superficialia (phyllogena), subiculo atro radiante conidiophoro inserta, applanato-disciformia, nigricantia, ambitu subanguloso, excipulo obsoleto, hinc non marginata; asci elongati, octospori; sporidia obovato-oblonga, 1-septata, fuliginea; paraphyses apice cœrulescentes, ibique stratum brunneum formantes; conidia obovato-oblonga, continua, fuliginea, catenulata.

Among a collection of Brazilian Uredineæ, Herr P. Dietel describes a number of new species, and the following new genera:—

Anthomyces. Capitula teleutosporarum e cellulis juxtapositis 3 v. pluribus composita, formam gemmæ imitantia, cellulis sterilibus haud inflatis, e pedicello simplici orientibus fulta; uredosporæ solitariæ. Nearly related to *Ravenelia*.

Didymopsora. Teleutosporæ bicellulares, in columellam cylindricam pseudoperidio non indutam ut in *Cronartio* arcte conjunctæ. Separated from *Æcidium*.

Prof. B. D. Halsted § has found on *Parnassia caroliniana* a parasitic fungus which he makes the type of a new genus *Erysiphopsis*, belonging to the Erysipheæ, nearly allied to *Erysiphe* and *Phyllactinia*, with the following diagnosis:—Appendages rigid, brittle, usually nearly straight, and frequently slightly swollen at the tip.

A new genus of Tuberaceæ, *Gyrocratera*, is described by Herr P. Hennings.‖ It is allied to *Genea* and *Hydnocystis*, but differs in having a single cavity with roundish orifice and brown coarsely warted spores.

Parasitic Fungi.—The first appearance of an *Uncinula* in Australia is recorded by Mr. D. McAlpine,¶ in a new species, *U. australiana*, on *Lagerstrœmia ovalifolia*. Also *Puccinia Calthæ* on *Caltha introloba*.

* Comptes Rendus, cxxix. (1899) pp. 1034–6.
† Hedwigia, xxxviii (1899) p. 133. ‡ Tom. cit., pp. 253–5.
§ Bull. Torrey Bot. Club, xxvi. (1899) pp. 594–5.
‖ Verhandl. Bot. Ver. Brandenburg, xli. (1899) p. 7. See Hedwigia, xxxviii. (1899) Beibl., p. 279.
¶ Proc. Linn. Soc. N.S. Wales, xxiv. (1899) pp. 301–3 (1 pl.).

A destructive disease of pinks has been determined by MM. E. Prillieux and Delacroix * to be due to a new species of *Fusarium*, which they name *F. Dianthi.* It occurs in three distinct forms—the fusarium-form with elongated hyaline conids, either straight or curved, and usually 3-septate; a form with rounded hyaline conids; and a form with globular hyaline chlamydospores.

Herr H. C. Schellenberg † deals in detail with a sclerote disease of the quince, attacking the leaves, due to a fungus to which he gives the name *Sclerotinia Cydoniæ* sp. n. Its life-history was fully followed out, with the exception of the formation of the ascospores in the perithece.

Species of Aspergillus.‡ — Herr C. Wehmer classifies the known species of *Aspergillus* under the following heads:—(1) White (*A. albus*); (2) Yellow-brown; sterigmas chiefly or entirely branched (*A. Ostianus* sp. n., *A. Wentii*); sterigmas branched, *Sterigmatocystis* (*A. sulfureus, A. ochraceus, A. Rehmii*); (3) Green to green-yellow or yellow-green; spores large, sterigmas unbranched (*A. glaucus, A. flavus, A. Oryzæ*); spores small, sterigmas simple or branched (*A. clavatus, A. varians* sp. n., *A. fumigatus, A. minimus* sp. n., *A. nidulans*); (4) Brown-black (*A. niger*). With regard to the fructification:—peritheces are known in *A. glaucus* and *A. Rehmii*; sclerotes with formation of asci in *A. nidulans* and *A. niger* (?); sclerotial formations without further development in *A. flavus, ochraceus,* and *niger*. In the remaining species no fertile stage is at present known. The new species are described in detail.

Onygena equina, a Horn-destroying Fungus.§—Prof. H. Marshall Ward has added to our knowledge of this fungus—belonging to the Ascomycetes, and most nearly related to the Tuberaceæ and Erysipheæ—which grows on feathers, hairs, horns, hoofs, &c. The sporophores arise as dome- or club-shaped masses of hyphæ, covered by a glistening white powder, consisting of chlamydospores formed at the free ends of the hyphæ. When the crop of chlamydospores on the outside of the young sporophore is exhausted, the hyphæ which bear the spores combine to form the peridium, clothing the head of the sporocarp. Minute tufts or knots of claw-like filaments are now developed, which are the ascogenous hyphæ. The asci disappear entirely before the spores are ripe. The author finds that the ascospores will not germinate until they have been digested in gastric juice; and this promotes also the germination of the chlamydospores. In nature it would appear that the spores must pass through the body of an animal before they can germinate.

Lichen-Substances.‖—In a further communication on this subject, Herr W. Zopf gives a number of additional details regarding substances extracted from lichens. Among these may be mentioned:—The orange-red pigment extracted by the author from *Sticta aurata*, and called by him stictaurin, which is a derivative of pulvinic acid. Lecanic acid has been found in a number of lichens in addition to those already named.

* Comptes Rendus, cxxix. (1899) pp 744–5.

† Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 205–15 (1 pl.).

‡ Bot. Centralbl., lxxx. (1899) pp. 449–61 (1 fig.).

§ Proc. Roy. Soc., lxv. (1899) pp. 158–9.

‖ Liebig's Ann. de Chemie, cccvi. (1899) pp. 282–321. See Bot. Centralbl., lxxx. (1899) p. 222. Cf. this Journal, 1895, p. 665.

The substance previously described by the author as parmelial acid is identical with lecanoric acid. A new colourless crystallisable substance, which he names glomelliferin, was obtained from *Parmelia glomellifera.*

Secretion of Oil by Calcareous Lichens.* —Herr M. Fünfstück maintains, in opposition to Zukal, his previous view that the oil secreted by calcareous lichens is an excretory product, rather than a reserve food-material. His observations were made chiefly on *Verrucaria calciseda* and *Opegrapha saxicola.* The oil-hyphæ retain their character after the lichen has been placed for some months in the dark. This nature of the oil-hyphæ is especially well seen in *Petractis exanthematica*, where the gonid-element is a *Scytonema*, and the hyphæ in question are scarcely distinguishable in appearance from the *Scytonema*-gonids.

Development of the Apothece of Physcia pulverulenta.†—Mr. O. V. Darbishire gives a preliminary account of the complicated processes connected with fertilisation in this lichen. He finds no evidence in support of Lindau's view that the trichogyne serves as a "terebrator" or borer through the soft tissues, the structure of that organ not adapting it for such a purpose. The carpogones occur in very large numbers in the lobes of the thallus, but only a few of them develope. The carpogone consists of from thirty to forty cells. Its lower part, the ascogone, is composed of a row of cells, which is coiled or irregularly serpentine. The trichogyne makes its way between two clusters of gonids, its apex passing through the cortex. Spermatia (pollinoids) were found attached to the apex of the trichogyne; but, owing to their minute size, the actual process of impregnation could not be followed out. After the carpogone has been impregnated, the central cells of the ascogone become connected with one another by wide bridges of protoplasm. Lateral branches are formed, the apices of which develope into asci surrounded by paraphyses.

Rusts of Cereals.‡—Mr. M. A. Carleton has brought out an exhaustive monograph on the cereal rusts of the United States, the nature of the injuries which they inflict, and the best remedies. They are six or probably seven in number:—*Puccinia rubigo-vera Tritici*, the orange leaf-rust of wheat, *P. rubigo-vera Secalis*, the orange leaf-rust of rye, *P. coronata* Corda, the crown-rust of oats, *P. graminis Tritici* Eriks. and Henn., the black stem-rust of wheat and barley, *P. graminis Secalis* Eriks. and Henn., the black stem-rust of rye, *P. graminis Avenæ* Eriks. and Henn., the black stem-rust of oats, and *P. Sorghi* Schur., the rust of maize. By far the most destructive of these fungi are the black stem-rusts of wheat and oats. The uredospores of the orange leaf-rusts of wheat and rye do not appear to attack hosts outside the genera *Triticum* and *Secale*; while the black stem-rust of wheat occurs also on barley and on *Hordeum jubatum.* A useful bibliography is appended.

Rabenhorst's Cryptogamic Flora of Germany (Fungi Imperfecti) Lief. 67–69.§—The latest three parts of this important work (by A. Allescher) complete the account of *Vermicularia* (54 species in all), and

* Festschr. f. Schwendener, 1899, pp. 341–56. Cf. this Journal, 1896, p. 95.
† Pringsheim's Jahrb. f. wiss. Bot., xxxiv. (1899) pp. 329–45 (1 pl.).
‡ Bull. No. 16 U.S. Dptmt. Agriculture (Div. Veg. Phys. and Path.), Washington, 1899, 74 pp. and 4 pls. § 1899–1900. Cf. this Journal, 1899, pp. 192, 633.

then dispose of the genera *Dothiopsis* (4 species), *Dothiorella* (39 species), *Rabenhorstia* (6 species), *Fuckelia* (1 species), *Placosphæria* (-3 species), *Fusicoccum* (36 species), *Cytosporella* (14 species), *Cytospora* (146 species), and *Ceuthospora* (14 species). The second section of the Sphærioideæ, the Hyalodidymæ, is then commenced, characterised as follows:—Spores elliptical, ovate, or elongated, bicellular, hyaline or greenish-yellow. It comprises nine genera,—*Ascochyta*, *Robillarda*, *Diplodina*, *Darluca*, *Tiarospora*, *Actinonema*, *Cystotricha*, *Rhynchophoma*, and *Cytodiplospora*. Of these the following are dealt with:—*Ascochyta* (157 species), *Robillarda* (3 species), *Diplodina* (100 species), and 4 species of *Darluca*.

Lamination and Staining of Yeast-cell Membrane.* — Dr. C. Becker records experiments with yeasts which yielded results quite different from those obtained by Casagrandi.† Casagrandi maintained that the yeast-cell membrane was not a single homogeneous sheath, but was composed of two or more layers, visible in young as well as in old cells. He found that the membrane was stainable by means of anilin dyes, the most suitable being methylen-blue and Hanstein's anilin. At the instigation of Herr H. Will, the author cultivated yeasts with thick membranes, but after fourteen days' growth no lamination was detected, though by means of chemical reagents (1 per cent. chromic acid and 1 per cent. osmic acid) this appearance was produced in some cells. In ordinary brewer's yeast and in young cells the lamination was not observed even when successively treated with alcohol, ether, and chloroform, alcohol and chlor-zinc iodide, 3 per cent. hydrochloric acid, and stained with iodine-green and fuchsin. Hence lamination of the yeast-cell membrane is not an ordinary phenomenon, though it may occur when the membrane is unusually thick, as in resting-cells and in yeasts which have fermented very strong worts. The author was no more successful in his attempts at direct staining of the membrane, though Casagrandi's method was carefully followed After about three weeks' treatment with Hanstein's anilin, a more or less clear staining of the membrane was obtained. The stain was, however, easily removed by means of water, and still more easily by alcohol. Methylen-blue failed to impart any stain to the membrane, even after a treatment lasting several months. Thus the cell-membrane was stained only by means of prolonged treatment with Hanstein's anilin and the previous action of hydrochloric acid (about 4 per cent.).

Utilisation of Pure Yeasts in Wine Fermentation.‡ — In a communication on the utilisation of pure yeasts in the fermentation of wines, Prof. R. Chodat explains the advantages of adopting this method, and details the results obtained from a red wine of Crete.

Six species of *Saccharomyces* were isolated from this wine. One (v.) belonged to the *S. apiculatus* group; the rest were true yeasts. Yeast i. produced in sterile must containing 19·35 per cent. glucose, 5·78 per cent. alcohol (vol.), 0·833 per cent. tartaric acid; ii. must, 19·35 per cent. glucose, 8·18 per cent. alcohol (vol.), 0·66 per cent. acid; iii. must, 17·86 per cent. glucose, 5·39 per cent. alcohol, 1·04 per cent. acid;

* Zeitschr. f. d. ges. Brauwesen, xxii. (1899) p. 597. See Centralbl Bakt. u. Par., 2te Abt., vi. (1900) pp. 24–6. † Cf. this Journal, 1897, p. 422, and 1898, p. 224.
‡ Arch. Sci. Phys. et Nat., viii. (1899) pp. 588–9.

iv. must, 17·86 per cent. glucose, 13·43 per cent. alcohol, 11·7 per cent. acid; v. (*apiculatus*) must, 19·35 per cent. glucose, 1·34 per cent. alcohol, 0·495 per cent. acid; vi. 19·35 per cent. glucose, 5·78 per cent. alcohol, 0·819 per cent. acid. The quantities of glucose destroyed by the yeasts in the production of alcohol, or in their own maintenance, were: i. 11·21 per cent.; ii. 84·4 per cent.; iii. 31·25 per cent.; iv. 90·4–96·6 per cent.; v. 15 per cent.; vi. 7·1–9·6 per cent.

New Variety of Ray Fungus.* — Dr. B. Schürmayer describes a variety of the ray fungus under the name of *Oosporus proteus* or *Streptothrix proteus*, which was isolated from the astragalus and os calcis of a man supposed to be suffering from tuberculosis. The morphological appearances were very polymorphic, and varied with the medium, true branched forms and spores being found only in old liquid cultures and in the mouse. When young the shorter elements were motile. The parasite was easily stained, was strongly aerobic, but also a potential anaerobe. The optimum temperature was 37°. It was cultivated on glycerin-agar, glycerin-gelatin, gelatin-bouillon, and on potato. The growth was often yellow or yellowish, and old fluid cultures became brownish. Gelatin was liquefied. It formed spores (oidia) and chlamydospores.

Sections of the diseased tissue presented the histological appearance of sarcoma. In these all the stages of growth and club-shaped elements were observed. Infected mice died from septicæmia, the anatomical appearances being those of pseudo-tuberculosis.

Mycorhiza of Tipularia unifolia.† — Julia B. Clifford has studied the anatomical and physiological relations between this orchid and its mycorhiza. The principal anatomical features in the roots attacked are the absence of a root-cap, the development of a many-layered epidermal tissue, and the formation of a special sheath from the external layer of the cortex. The general organisation of the fungus, and its relation to the host-plant, agree with those of the mycorhiza of *Corallorhiza*. The hyphæ in the epidermal tissue constitute the vegetative mycele, which sometimes branches. These traverse the root-hairs and penetrate the soil, constituting the absorbing organ of the mycorhiza. Starches and other carbohydrates are taken from the host-plant, and proteids are formed from these and the products brought from the soil.

Blastomycetic Dermatitis.‡ — Mr. L. Hektoen reports a case of chronic dermatitis caused by a pathogenic blastomycete. Sections having demonstrated an organism, cultures were made from scrapings of the tissue, and from these was isolated a blastomycete, recognised by its morphological and other characters. In size it varied from 7 to 12 μ, and in shape was round or oval. Budding forms were frequent at all stages, and vacuolation of the cells was a prominent feature. The organism grew well on all the usual substrata, but did not ferment saccharated media. In two out of fourteen experiments on animals the organism was found to have disseminated itself throughout the body. In one of these instances the organism was introduced by intravenous injection.

* Centralbl., Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 49–61, 101–7 (9 figs.).
† Bull. Torrey Bot. Club, xxvi. (1899) pp. 635–8 (1 pl.).
‡ Journ. Experim. Med., iv. (1899) pp. 261–78 (4 pls.).

Ripening of Backstein Cheese.*—Herr O. Laxa found in two kinds of Backstein cheese various microbes, among which an *Oidium*, lactic acid bacteria, Saccharomycetes, and four bacilli were constantly present. In the cheeses examined, symbiotic and metabiotic processes took place, and these had a direct influence on the aroma of the cheese. The *Oidium* was found to consume a part of the free acid, and in this way prepared the ground for other microbes. It was also responsible for the production of the intense aroma of the slimy portions of the cheese. The power of peptonising casein was found to be possessed, not only by certain species, but this power could be exerted by the symbiotic action of microbes which individually could liquefy casein only with difficulty. The aroma of the lardaceous portions of the cheeses examined was found to be a product of the symbiotic action of different microbes.

Though a short description of the various microbes isolated is given, a more detailed account, with special reference to their share in the ripening, is promised later.

Myxomycetes.

Myxomycetes as the exciting cause of Tumours in Animals.†—In a preliminary report, Prof. W. Podwyssotzki communicates the results of experiments on guinea-pigs and rabbits, which were inoculated with *Plasmodiophora Brassicæ*. In 15–18 days after inoculation, tumours appeared, and these on microscopical examination were found to present the appearances of sarcoma or endothelioma or granuloma. Within the tumour-cells spores of the parasite were frequent. The spores excite a nuclear proliferation, and a metamorphosis of the nuclear substance. Giant-cells were not uncommon, but, though surrounded by spores, did not contain any. The tumour-cells are, as seen in sections, much vacuolated, and appear to be filled with fat-globules.

Plasmodiophora Brassicæ.‡—Dr. S. Nawaschin records a series of observations on the minute structure of this parasite, and on the changes which it undergoes during its intercellular life. It presents the phenomenon which he terms dimorphism of the nucleus. In the amœba-stage it exhibits a decidedly abnormal kind of indirect division; while in the spore-forming plasmode the division of the nucleus is of a typically karyokinetic character.

The differentiated group of infected parenchymatous cells of the host, the seat of the root-swelling, arise by repeated division of the cells first infected. In the course of the growth of this swelling there arise in the infected cells a number of multinucleated amœbæ which do not at first coalesce into a plasmode. The formation of the plasmode is preceded by characteristic changes in the structure of the amœbæ and in their nuclei. It takes place only after the complete exhaustion of the nutrient cell. In the mature plasmode the spore-formation is prepared for by repeated mitotic division of the nuclei. During the vegetative period of its development the parasite does not kill the nutrient cell, but simply causes hypertrophy.

* Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 755–62.
† Op. cit., 1te Abt., xxvii. (1900) pp. 97–101.
‡ Flora, lxxxvi. (1899) pp. 404–27 (1 pl.).

Mycetozoa.* — Under the title *The Mycetozoa and some Questions which they suggest*, Sir Edward Fry and Miss Agnes Fry have brought out a very useful little account of the structure and mode of propagation of the Myxomycetes, together with some speculations as to their place in nature.

Protophyta.

α. Schizophyceæ.

Pleurococcus and Pseudo-pleurococcus.†—Prof. R. Chodat dissents from the conclusion of Dr. Julia W. Snow that the two forms described by her should be regarded as types of a new genus *Pseudo-pleurococcus*. They are but varieties of *Pleurococcus vulgaris*.

β. Schizomycetes.

Duration of Bacterial Existence.‡—Dr. H. L. Bolley records some interesting observations on the vitality of bacteria. Agar tube cultures were hermetically sealed up above the slant and kept for some years (1–9) before they were opened and tested as to viability. The observations show that even non-sporing bacteria may retain not only their fresh appearance and normal morphological characters, but also their viability, for a number of years. Even when dead, the germs were not disintegrated. The non-disorganisation of living or possibly dead germs in a moist organic substratum, and in the probable absence of oxygen, is a highly important observation. The results are given in detail in tabular form.

Reducing Power of Bacteria.§ — Dr. F. Müller has amplified his previously recorded experiments and observations on the reducing power of bacteria by using acetate of rosanilin in addition to methylen-blue and litmus, and increasing the number of bacterial species. The results do not differ materially from those previously recorded, and may be summarised as follows. The pigments to be used for demonstrating the reducing properties of bacteria should be of known composition, and the behaviour of the medium should be previously ascertained; e. g. while agar exerts a considerable reducing action, that of bouillon is slight. It was found that ordinary test-tubes gave better results than fermentation flasks for observing the reduction. The reduction of the pigment is due to the metabolic products excreted by the bacteria, and takes place outside the bacterial organism. These products of metabolism exert a reducing action, not only directly after excretion, but even after considerable lapse of time; they are however gradually destroyed by atmospheric oxygen. All bacteria are capable of reducing suitable pigments; as the excreted reducing substances are apparently of different nature, the reduction processes may be determined not only quantitatively but qualitatively. Many bacteria are able to incorporate pigments; those which form pigment do not as a rule show that they pick up pigment from the medium, e. g. *B. anthracis*, hay bacilli, and *Proteus*.

* 'The Mycetozoa and some questions which they suggest,' London, 1899, viii. and 82 pp. and 22 figs.
† Bull. Herb. Boissier, vii. (1899) pp. 827–8. Cf. this Journal, 1899, p. 634.
‡ Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 33–8.
§ Op. cit., 1te Abt., xxvi. 1899) pp. 801–19. Cf. this Journal, 1899, p. 634.

Classification of Lactic Acid Bacteria.* —Herr H. Weigmann makes an attempt to classify lactic acid bacteria which occur in the milk industry. Six groups are suggested, the first of which has for its type *Bacterium acidi lactici* and the second *Bacillus acidi lactici*. In group 3 are placed bacteria which form lævolactic acid. Group 4 consists of lactic acid bacteria which liquefy gelatin. In group 5 the bacteria are chiefly characterised by surface growth, aerobism, and non-production of gas. In group 6 are placed bacteria which, while capable of producing lactic acid, are only occasionally found in milk.

It is suggested that some importance should be attached to the taste and flavour of milk acidulated by pure cultures, and six different kinds of flavour, taste, or aroma are mentioned. These differences might aid in distinguishing between varieties or races in doubtful cases.

Bacteria of the Female Genitalia.† —M. Hallé describes several previously unknown microbes which were isolated from the vulva, vagina, &c. One of these, an unnamed aerobic bacterium, is a largish rodlet, occurring either in clumps or pairs. It is not stainable by Gram's method. On agar the growth is barely visible, though the colonies resemble *Pneumococcus*. It grows better on serum, best on agar ascites, badly in bouillon, and not at all on potato. It is not pathogenic. *Micrococcus fœtidus* is an anaerobe occurring in pus as cocci or diplococci, and in bouillon in short chains. It does not stain by Gram's method. The cultures exhale a fœtid odour. The results from inoculating animals were very variable; sometimes there was no result, at others there formed abscesses filled with stinking pus and containing the *Micrococcus* in pure cultivation.

Bacillus fundibuliformis is a very pleomorphic organism, occurring in pus as a slightly bent rodlet. In cultures similar forms are present, but the size may be larger and the shape spiral, clubbed, spherical, or swollen at the ends. Sometimes there are filaments, branched forms, and free rodlets It is stained with very great difficulty, no method giving good results. It is an essential anaerobe; grows well in saccharated ascitic fluid, and in bouillon exhales a fetid odour. Subcutaneous injection was followed by suppuration and gangrene, but intravenous and intraperitoneal inoculation failed.

Bacillus nebulosus is a rodlet of variable length and size, is frequently swollen in the centre, and its ends are pointed. It does not stain by Gram's method. It is an essential anaerobe, and grows slowly. Its pathogenic properties were found to be very variable, sometimes being negative and sometimes causing suppuration or gangrene.

Bacillus caducus is morphologically like the last bacterium, but it stains by Gram's method. Its cultural characters and pathogenic properties were not thoroughly examined.

Coli-like Bacteria.‡ — Dr. M. Deelemann describes some coli-like bacteria which were derived from pus (3), urine (1), and fæces (1). The morphological and biological characters of four of these are given

* Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 825–31, 859–70 (9 figs.).

† Ann. de Gynécol. et d'Obstét., li. (1899). See Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 645–9.

‡ Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 501–4, 541–6, 819–23 (2 pls.).

in detail. *Bact. coloides virescens* is about 1–2 μ long and 0·4 μ broad; is flagellated and motile; is easily stained, but not by Gram's method. It is an aerobe, but is potentially anaerobic. It grows on the usual media and also in Uschinski's solution. The colour of the growth is mostly whitish on solid media, but on potato yellowish. The cultures exhale an aromatic odour. It forms gas and acid in saccharated media. Milk is coagulated and acidulated. It does not form indol; it produces H_2S, and is pathogenic to mice and guinea-pigs.

Bact. coloides rubescens is 1–2·5 μ long by 0·4 μ broad. Its morphological and cultural characters are much the same as those of the preceding. It does not, however, ferment cane-sugar, and forms indol freely and also H_2S. It is not pathogenic to mice, but guinea-pigs die after twenty-one days.

Bact. vesicæ is 0·5–1 μ long by 0·3–4 μ broad; isodiametric elements frequent. It is flagellated and motile; is easily stained and also by Gram's method. It is aerobic, but potentially anaerobic. Growth on culture media is whitish, except on potato, where it becomes brownish-yellow. Cultures exhale a disagreeable odour. It does not ferment saccharated media. It forms indol and H_2S. It is not pathogenic to mice, but "pigs" [guinea-pigs] die in about twenty-one days.

Bact. fæcale alcaligenes is 1–3 μ long by 0·5–0·8 μ broad. It is flagellated and motile. Is easily stained, but not by Gram's method. It is an aerobe, but is also to some extent anaerobic. The growth is mostly whitish, but on potato yellowish-brown. The cultures exhale a disagreeable odour. Lactose bouillon is not fermented, but cane and grape-sugar bouillons are. Milk is not coagulated, and its reaction is alkaline. It does not form indol, but produces H_2S. It is pathogenic to mice and guinea-pigs.

In all four bacteria the gelatin-plate colonies, when inspected under a low power, are seen to be reticulated and ribbed like a leaf. The appearances of these dictyodrome colonies of *B. vesicæ* and *B. fæcale alc.* are well shown in the illustrations.

New Spore-bearing Bacillus.*—Mr. F. P. Denny has isolated from sputum a polymorphic bacterium, the measurements of which in bouillon cultures are 3–5 μ in length and 1·2 μ in breadth. In other media it is considerably smaller. It grows in chains, singly and in pairs. It is easily stained by the ordinary anilin dyes, and also by Gram's method. It has numerous flagella, and forms centrally placed spores which, when fully developed, measure 3–4 μ in diameter. It is actively motile. It liquefies gelatin. It is aerobic, and grows well in and on the usual media. It forms acid and coagulates milk, the clot of which is subsequently slowly digested. It is not pathogenic to rabbits or guinea-pigs, though the serum of these animals gives a well-marked clump reaction.

New Pleomorphic Bacterium.†—Herr Hashimoto describes a micro-organism, under the name *Bacterium Fraenkelii*, which was found on a badly sterilised agar plate. On simple or sugar serum it is a small motile flagellated rodlet. In bouillon it grows as motionless spherules

* Journ. Boston Soc. Med. Sci., iii. (1899) pp. 308–12 (5 figs.).

† Zeitschr. f. Hyg. u. Infekts., xxxi. part 1. See Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 777–8.

which resemble *Streptococcus* in appearance; but a closer examination reveals that fission takes place not only in the plane at right angles to the long axis of the chain, but also in that parallel thereto. Hence the appearance of pseudo-ramification may arise. But as multiplication also takes place in a third plane, the so-called woolpack arrangement of eight or sixteen cells is produced.

If the observation be confirmed—and it is supported by Fraenkel and Sobernheim—then there exists a polymorphic bacterium which may present itself in the form of a motile rodlet or in that of *Sarcina*.

Bacillus of Cerebrospinal Meningitis.*—Herr Stadelmann describes a microbe which was isolated from cerebrospinal fluid obtained by lumbar puncture from a case of cerebrospinal meningitis. The bacterium is very polymorphic, varying in shape from bacilli to cocci, and sometimes showing also bulbous extremities. The rodlet is thick, and possesses one flagellum. It is motile, a potential aerobe, does not stain by Gram's method, and often shows a bright central part. On agar, colonies were first seen in 5–6 days, and were the size of pins'-heads on the seventh. Cultivations were also successful in bouillon, grape-sugar bouillon, gelatin, and milk. The gelatin is not liquefied; milk is not coagulated or acidified; and gas is not produced. The results from inoculation of animals were negative.

Anthrax in the Dog.†—M. H. Martel diminished the natural resistance of full-grown dogs by means of subcutaneous injections of alkaline solutions of phloridzin in doses of 0·2–0·5 grm. per kilo., and of pyrogallol in doses of 0·2 grm. per kilo. weight of animal. Rabid animals were found to be very sensitive to anthrax, and full-grown dogs succumbed to the subcutaneous injection of anthrax which had passed through the ox.

After one passage through a rabid dog, the virulence was so increased that successful transferences were made from dog to dog. The virulence of anthrax of bovine origin, after passing through a full-grown dog, was sufficiently increased to kill a considerable proportion of the dogs injected therewith, so that after thirty to thirty-six passages, the virus was always fatal to dogs of every kind. When fortified by numerous passages through the dog, anthrax undergoes morphological variations; it becomes shorter, more stumpy, and does not form long filaments in liquid nutritive media.

Morphology and Biology of the Pseudodiphtheria Bacillus.‡—Dr. A. De Simoni describes exhaustively the characters, morphological and cultural, of sixteen varieties of the pseudodiphtheria bacillus. The original sources were ozæna, conjunctivitis, rhinitis, eczema, pock pustules, otitis, rhinoscleroma, and the mouth. The morphological characters, and the appearances in the different cultivation media, are given in tabular form, for which the original should be consulted. The effect of dry and moist heat, of direct sunlight, of subnormal temperature, and of the action of disinfectants, is also given in tables. Experiments on animals led to

* Deutsch. med. Wochenschr., 1899, No. 39. See Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 114–5.
† Ann. Inst. Pasteur, xiv. (1900) pp. 13–22.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 673–93, 757–64 (1 pl.).

the conclusion that the pseudodiphtheria bacilli were by themselves quite harmless to animals, though by symbiosis with other germs they may acquire a moderate degree of toxicity, which, however, was soon lost. The most prominent features of the pseudodiphtheria bacilli are the luxuriant growth in glycerin-agar, the production of acid, the turbidity of the bouillon cultures, and the tolerance of low temperatures. A consideration of the characteristics in plate-cultures, the general cultural appearances exhibited in the media used, and especially agar slants, suggests a division into four groups. Group one is chiefly distinguished by scanty growth, by small non-confluent colonies, and by relatively copious production of acid. In the second group the colonies are thick, dry, raised, and white; the production of acid is less than in group one. In group three the growth is raised, white, moist, and shiny, and is extremely luxuriant in oblique agar; the acid production is slight. The fourth group includes chromogenic pseudodiphtheria bacilli, the growth being dry or moist. The pigment is usually yellow, but may be red.

Bacteriology of Ozæna.*—Dr. F. Perez claims to have found the specific organism of ozæna, and has designated the microbe *Coccobacillus fœtidus ozænæ*. It is easily stained, but not by Gram's method. It is non-motile. It is polymorphic, presenting itself in the same preparation as long and short bacilli and as cocci of variable size. In its natural ozænic mucus and in most artificial media it is a small coccobacillus, while on gelose long sinuous filaments may be observed. It does not liquefy gelatin, does not ferment saccharated media, and does not coagulate milk. It forms indol, and excites the ammoniacal fermentation of urine. It is cultivable on most media at incubation temperature, the cultures evolving a characteristic fœtid odour. It is pathogenic to guinea-pigs, mice, pigeons, and rabbits. The experiments on rabbits showed that the microbe exerted a specific action on the pituitary mucosa: in some cases the atrophic rhinitis so characteristic of true ozæna was reproduced.

The organism was isolated by inoculating tubes of gelose, gelatin, serum, and peptonised bouillon with ozænic secretion. The detection of the microbe was facilitated by the characteristic odour developed in capped tubes. Peptonised bouillon appears to have given the best results. Occasionally intravenous inoculation of rabbits was had recourse to.

Micrococcus intertriginis.†—Dr. Max Meyer claims to have isolated the exciting agent of erythrema intertrigo. It is an aerobic coccus which stains well with ordinary anilin dyes, but is decolorised by Gram's method. It grows well on most media, and best at the body temperature. Gelatin is liquefied. Inoculation of animals with pure cultures reproduced the disease.

Experimental Yellow Fever.‡—In a study on experimental yellow fever, Dr. A. Bruschettini records his agreement with Sanarelli as to the morphology and biology of *B. icteroides*. The experiments on animals

* Ann. Inst. Pasteur, xiii. (1899) pp. 937-50.
† New York Med. Journ., lxx. (1899) pp. 873-6 (18 figs.).
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 764-80.

indicated that the virulence of *B. icteroides* could be increased by repeated passages, and that infection through the stomach was practically impossible. The author's results with the toxin were more marked and more constant than Sanarelli's; on these results a communication is promised later. With regard to the action of serum of immunised animals, the author is of opinion that it possesses a bactericidal and also an antitoxic action, the latter being the more powerful. Most of the immunising substance was found in the liver and spleen, and emulsions of these organs protected animals against yellow fever infection, even when the blood had not yet acquired a protective power. The author claims that his experiments lead him to the conviction that *B. icteroides* is peculiarly adapted for infecting animals with yellow fever, and that, as the symptoms during life and appearances of the organs after death so closely resemble those in man, the disease can be most easily studied.

Bacteriology of Typhus Fever.*—Dr. A. Balfour and Dr. C. Porter examined the blood of nineteen living cases of typhus fever, and in every instance found large numbers of a diplococcus after the blood had been incubated for 24–48 hours; no other organism was found in the cultures, and the diplococcus presented the same characters as the diplococcus the observers had previously found in seven cases examined post mortem.

The organism is about 2 μ in transverse diameter. It stains well with the usual anilin dyes, and also by Gram's method. It grows well in broth and milk, coagulating the latter in 24–48 hours. It is easily cultivated on agar, blood-serum, and potato. Gelatin is liquefied in 5–8 days. The growth on agar and potato is white. The optimum temperature is 37°.

Streptococcus amylivorus.†—Sig. L. Macchiata has observed in macaroni flour, which may be made of wheat, rye, and pulse, starch-grains which seemed corroded, and only faintly reacted in polarised light. In these affected grains were noticed coccus forms with rosette arrangement. The diameter of the individual cells was 1–1·25 μ. The cocci stained well with basic anilin dyes. The author considers the cocci to be the cause of the changes in the starch-grains, although he admits that certain bacilli were also present. The action of the streptococcus is a solvent one, for the affected meal showed 3·9 per cent. glucose, while normal macaroni flour contained only 1·86 per cent. The quantity of acid in the meal was also greater than in the normal. Pure cultures of *Str. amylivorus* were obtained.

Formation of Chinon in Streptothrix Cultures.‡—Prof. M. W. Beijerinck had his attention drawn to the formation of chinon ($C_6H_4O_2$) by *Str. chromogena* Gasperini, owing to the fact that the gelatin browned by *Str. chromogena* in a culture introduced into pepton solution was turned black by ferric salts. It was also found that the culture-gelatin of old gelatin-cultures is insoluble in boiling water, just as when free chinon or a chrome salt had been allowed to act on the gelatin in the

* Edinburgh Med. Journ., v. (1899) pp. 141–4 (5 figs.).

† Bull. Soc. Bot. Ital., 1899, pp. 48–53. See Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 821–2.

‡ Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 2–12.

presence of light. These reactions received additional confirmation from the fact that in the presence of hydrochloric acid, *Str. chromogena* cultures set free iodine from potassium iodide, which is easily demonstrated by means of the iodine-starch reaction. In successful cultures, so strong is this reaction that it might lead to the suspicion of the presence of nitric acid; but this is easily set aside, as the other tests for nitric acid, e.g. the diphenylamin reaction, are completely absent.

Almost any medium appears to be agreeable to *Str. chromogena* as far as growth is concerned, but the richness of the cultures in chinon depends on the presence of albumen or pepton in the substratum. It is, in fact, an example of catabolism, and its production is analogous to that of alcohol by yeast. For from yeast is derived invertin which may be described as autobolic; the invertin yields glucose and levulose which are telebolic; while the alcohol which is formed by the catalytic action of the living protoplasm on the sugars is a catabolic product.

Bacterium Trambuti and its Zooglœa Membrane.* — M. Radais describes a bacterium which forms on the surface of nutritive media a tough leathery zooglœa which externally is shagreened and bristles as it were with mossy points. Carefully compressed beneath a cover-glass the jelly spreads out, and shows that it is composed of ovoid particles which average 8 by 10 μ. These are colonies or families of bacteria ($0 \cdot 6 \times 0 \cdot 8\ \mu$) lying without any apparent order in the jelly, which at the circumference of each mass seems to be slightly thickened and to form a sort of capsule.

The organism is cultivable in the usual media, but thrives best in the presence of sugar, especially saccharose. Its development is favoured by an acid reaction, and Raulin's fluid mixed with gelatin or gelose forms an excellent substratum for observing the morphological characters of the zooglœa. The optimum temperature is 25°–30°. The cells are provided with a thick membrane which externally passes insensibly into the zooglœa jelly. The contents stain well, but not by Gram's method. The bacterium is designated *Bacterium Trambuti*, and the species is characterised not only by the zooglœa membrane and the appearances of the individual, but also by the mode of growth of the families, which takes place in simple or branched chains.

The bacterium was isolated from a piece of blighted sorghum, but has no connection with this disease.

Antitoxin in the Bile of Rabid Animals.†—Dr. J. Lebell's experiments lead him to agree with Frantzius that the bile of rabid animals does exercise an attenuating action on the hydrophobic virus not only *in vitro* but also in the organism. This action is due very probably to an antitoxic substance formed in the bile of rabid animals. Hence, while agreeing with Frantzius, the author collides with Vallée,‡ who came to the opposite conclusion, owing, as is suggested by Lebell, to not having used fixed virus, and not having maintained a constant proportion of the emulsions of the virus used.

* Comptes Rendus, cxxix. (1899) pp. 1279–81.
† Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 635–9.
‡ Cf. this Journal, 1899, p. 525.

BIBLIOGRAPHY.

ABEL, R.—**Taschenbuch für den bacteriologischen Prakticanten, enthaltend die wichtigsten technischen Detail-vorschriften zur bacteriologischen Laboratoriums-arbeit.** Würzburg, 1900, viii. and 106 pp.

DUCLAUX, E.—**Traité de Microbiologie.** Tome i. Microbiologie générale. Tome ii. Diastases, Toxines et Venins. Tome iii. La Fermentation alcoolique.
Paris, 1899, 7 volumes grand in-8vo, avec figures dans le texte.

GAMALEIA, N.—**Elemente der allgemeinen Bacteriologie.**
Berlin, 1900, iv. and 242 pp.

MIGULA, W.—**System der Bacterien. Handbuch der Morphologie, Entwickelungs-geschichte, und Systematik der Bacterien.**
Jena, Band i. 1897, 6 pls.; Band ii. 1900, x. and 1068 pp., 18 pls. and 35 figs

THOINOT, L. H., & E. J. MASSELIN—**Outlines of Bacteriology. A Practical Handbook.** Translated by W. St. Clair Symmers. London, 1899, 330 pp.

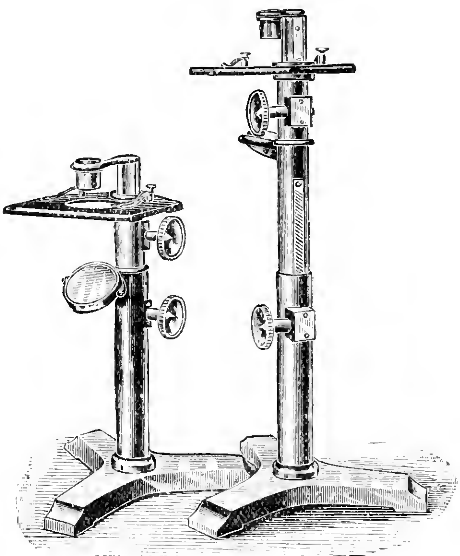
MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Bogue's Adjustable Dissecting Microscope.† — Fig. 45 shows the form of dissecting Microscope invented by Mr. E. E. Bogue, of Oklahoma Agricultural College, U.S.A. The intention is to provide an instrument at which the dissector can work more comfortably than at dissecting Microscopes of the ordinary low form. The instruments are of two heights, to accommodate observers of different stature. Each Microscope is provided with two racks and pinions; one for adjusting the

Fig. 45.



lens, the other for raising and lowering the mirror stage and lens. In the left-hand instrument the lens, when in focus, is 260 mm. from the table, about the average height of compound Microscopes. In the right hand one the lens is 360 mm. from the table. The lower rack-and-pinion permits of all intermediate heights according to the needs of the operator. The instrument weighs 69 oz., which is sufficient to give it stability even when racked up to the highest point.

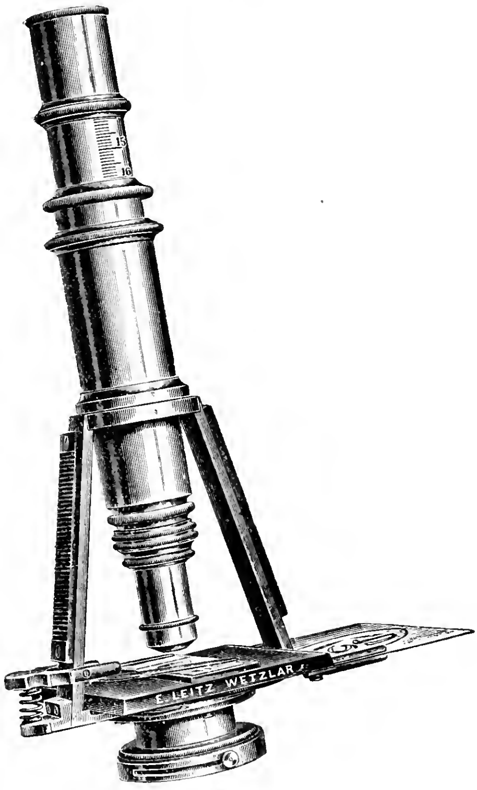
Leitz' Demonstration Microscope.—This is seen in fig. 46. It is adapted for low and medium power, and the square stage is fitted with

* 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. Appl. Micr., 1899, pp. 558-9 (1 fig.).

a wheel-diaphragm. The adjustment is by sliding tube, and, after adjustment, the tube may be fixed by a ring-clamp. A clip is attached to one side of the stage to receive a sketch or label. The instrument can also be fitted with an adjusting screw for focussing high-power objectives; a condenser and iris-diaphragm are provided, if desired.

FIG. 46.



(2) Eye-pieces and Objectives.

Leitz' Revolving Eye-pieces. — This class of fitting has only recently been manufactured by the Wetzlar firm, who consider that their design corrects many of the defects usually found in this accessory. The lower lens (figs. 47 and 48) is so placed that it is permanently fixed, the eye-lens of each combination alone moving in the revolver. So accurate is the construction of the revolver, and so carefully are the lenses adjusted, that the eye-pieces may be changed whilst a specimen is in focus on the Microscope stage without a readjustment of the focus.

The revolving eye-piece is also particularly well adapted to use as a micrometer ocular; for when the eye-lens is turned aside a micrometer scale may be inserted, resting upon the diaphragm of the eye-piece. Once adjusted in this way, the micrometer values are the same for all the eye-lenses of the combination.

Fig. 47.

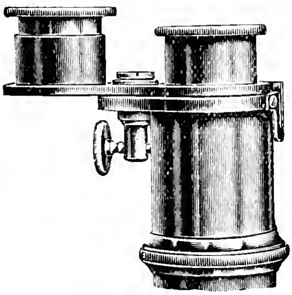
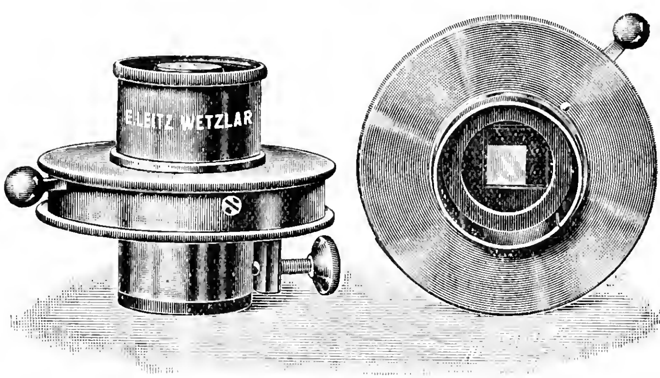


Fig. 48.

Ehrlich's Eye-piece.—This ocular (fig. 49), made by Herr Leitz, is intended to facilitate the estimation of the relative numbers of red and white blood-corpuscles in dry preparations. It is provided with a diaphragm having a square opening, the size of which is regulated by a small lever.

Fig. 49.



Leitz' Achromatic and Apochromatic Objectives.—Leitz' objectives, both achromats and apochromats, are manufactured out of Jena glass. The difficulty at one time experienced from the deterioration of this kind of glass, thereby prejudicing microscopists against it, is overcome by using only glass whose durability has been thoroughly well tested.

The makers have full confidence in their objectives and guarantee them. Figs. 50–52 show three of their achromats. Fig. 50 represents a power about 2/3; it consists of a triplet front and a doublet back, each carefully corrected. Fig. 51 is a dry 1/6 power. A hemispherical front lens is combined with a doublet middle and triplet back, the front lens being the chief magnifier of the combination, and the other lenses correcting the various aberrations. Fig. 52 is an oil-immersion; it consists of a hemispherical front lens, behind which is a meniscus, in its turn followed by a doublet and a triplet; these latter act as correcting lenses.

The apochromats are made of a different kind of glass, and of course give a more perfect correction of chromatic aberration. This advantage is not gained without a certain sacrifice of simplicity in construction,

Fig. 50.

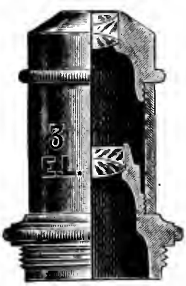


Fig. 51.

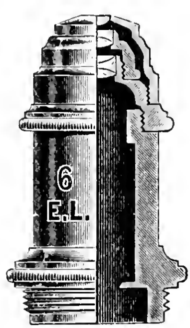
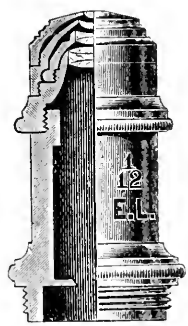


Fig. 52.



as a result of which the apochromat is more likely to suffer from careless handling and from atmospheric changes than the more simple achromat.

As regards sharpness of definition and brightness of field, there is little choice between the two classes of objectives of the same magnification. The apochromats do, as a matter of fact, resolve the fine markings of test objects somewhat more clearly than achromats, but the difference is slight, and in ordinary stained microscopic preparations is hardly detectable.

The correction of both classes of objectives is complete. The ordinary Huyghenian eye-pieces are consequently well adapted for use with either.

The achromats and Huyghenian eye-pieces are also well adapted to the requirements of photomicrography.

One very important recommendation of the achromats is their remarkably low cost.

Leitz' Objectives for the Edinger Apparatus.—Figs. 53–55 show the objectives of respectively 64, 42, and 24 mm. focal distance designed for the Edinger projection apparatus. In manufacturing these objectives, use has been made of the principles involved in the makers' new photographic objectives, thereby gaining much in the size of the picture.

HOVESTADT, PROF. — **Jenenser Glas und seine Verwendung in Wissenschaft und Technik.** (Jena Glass and its application in Science and Technique.)
[The author discusses the construction and experience of telescope objectives made of Jena glass.]
Laboratorium et Museum, No. 1, 1900, pp. 5–9 (2 figs.).

FIG. 53.

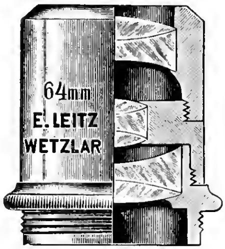


FIG. 54.

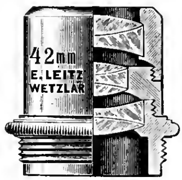
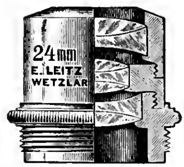


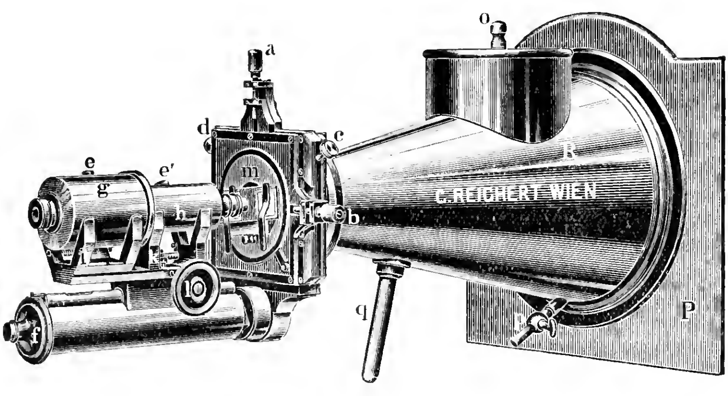
FIG. 55.



(3) Illuminating and other Apparatus.

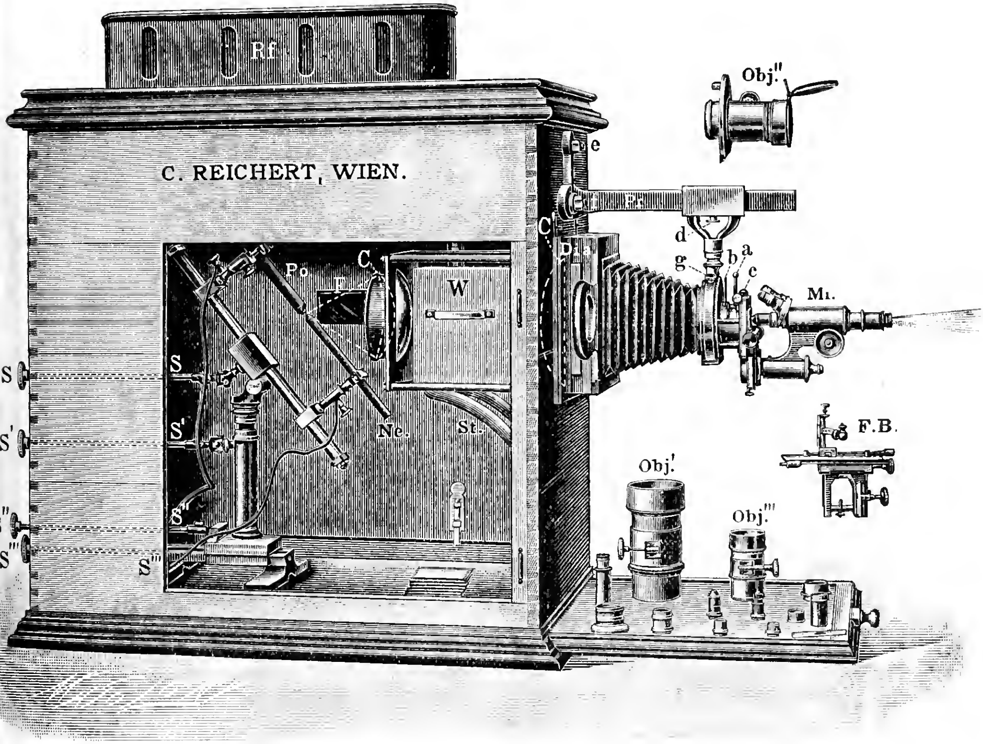
Reichert's Large Projection Apparatus.—This apparatus (fig. 56) is adapted for the strongest currents up to 60 and more ampères, and is suitable for use in an Institute for experimental pathology. The case is of strong oak lined with asbestos, and is fitted with ventilation and diaphragm arrangements. The arc lamp is for hand regulation, and is

FIG. 56.



easily controlled from the outside in all its movements. The three-lensed condenser system has an aperture of 200 mm. The water-chamber carries the Microscope with the iris diaphragm. The Microscope is so constructed that objective and ocular, each of which has its own tube, can be easily exchanged for others, whilst the position of the tubes is retained by means of the V-shaped carrier, thus giving absolute security of centering. A specimen of such a microscopic arrangement has been in use at the Vienna Pathological Institute since 1893, and has given great satisfaction. The coarse adjustment of the objective is by rack-and-pinion of sufficient path with long focus, and the fine adjustment is by micrometer screw. The object-stage is easily removable, and is adjustable in two directions by screws; the upper plate is rotatory. Abbe's illuminator is centred by two screws. The Microscope with water-chamber is fastened by two bolts to the condenser system, and is easily detached. In its place a shorter water-chamber, a bellows, or a frame for diapositives can be inserted.

Fig. 57.



Reichert's Medium Projection Apparatus.—This apparatus (fig. 57) consists of an oak case lined with asbestos, a three-lensed condenser system of 160 mm. aperture with a large easily slided out water-chamber between the two front lenses, and an arc lamp for rather strong currents up to 40 ampères. The carbon adjustments are done by hand by means of the screw S; the lamp is regulated by movements vertically and horizontally as well as forwards and backwards, so as to be able from outside to get the most favourable light-point in this way for any description of projection, whether microscopic or for demonstration of blood circulation in the living frog. The optical bench is placed above the light condenser, so that the space between the condenser and the draw-out shelf remains free and can be made use of. The frame is for slides of 12 by 16 cm. There are a number of accessories, such as an episcope for projection of opaque objects with oblique light, a frog-table, &c.

Beck's New Wide-Angle Oil-Immersion Condenser.— Messrs. R. and J. Beck, encouraged by the success of their dry achromatic condenser, have brought out the above (fig. 58), which, although manufactured on a different formula, has equal advantages as to correction. The aperture is 1·4 N.A., which is the full maximum obtainable without the use of special slides and media. It possesses an aplanatic cone, that is to say, the whole of the light in that cone is brought accurately to one point. The optical combination consists, as will be seen from fig. 58, of four systems of lenses, and is constructed on a new principle. The front lens may be removed when the condenser is to be used for low-power work. The working distance is sufficient for so large an angular aperture, being about 0·06 of an inch. Messrs. Beck strongly recommend this condenser, in conjunction with their latest 1/12 1·4 N.A. objective, for work requiring critical resolution, and for all branches of photomicrography.

FIG. 58.

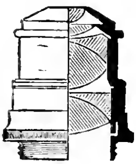
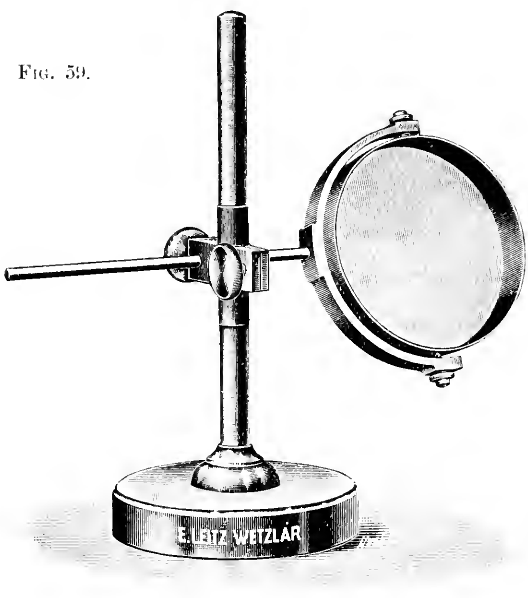


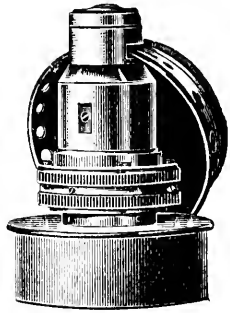
FIG. 59.



Leitz' Bull's-Eye Condenser.—This illuminating lens on a new form of stand is shown in fig. 59, and will be clearly understood therefrom.

Gillett Achromatic Condenser.—Fig. 60 represents the Gillett achromatic Condenser, with fine adjustment, presented to the Society by the President at its Meeting in December 1899 (see this Journal, 1899, p. 679).

FIG. 60.



Leitz' Apparatus for drawing Macroscopic Objects.
[This is, in fact, Dr. Wollaston's camera lucida, which was invented before 1807, and which has been in use ever since.]
Centralbl. Bakt. u. Par., 1899, pp. 765–6 (1 fig.).

(4) Photomicrography.

Cobalt Blue Glass in Photomicrography.*—Dr. James Wallace, of Philadelphia, points out that by the use of blue glass in photomicrography the advantage of increased contrast is often obtained. Sometimes, even, contrast is obtained where none seemed to exist. Thus, for example, in the case of a transparent body, such as a mosquito sting, the yellow light of an ordinary lamp is very little affected by transmission through the already yellow object. The yellow tint could in the first place be increased by staining; and then, by the use of the blue colour screen, it will be found to give a strong contrast in the photographic plate. Dr. Wallace has found the following method useful for dealing with specimens mounted in balsam and improperly stained. After removing the cover-glass he soaks the slide for a few minutes in chloroform, then dips it into a solution of picric acid in chloroform, then places it in pure chloroform for five minutes, then in turpentine long enough to get rid of the volatile chloroform, and finally remounts in balsam. The strong contrast afforded by the picric acid staining and the blue glass will give great satisfaction, and is highly recommended for transparent objects. Potassium bichromate stains a good yellow in aqueous solution, and brings out red corpuscles in a very marked manner. The advantage of picric acid is that it is soluble in chloroform, and can be used for objects that have been already mounted in balsam.

BRINCKERHOFF, W. R.—**A Non-vibratory Bench for Photomicrography.**
Journ. Boston Soc. Med. Sci., III. (1899) p. 257.

GEBHARDT, W.—**Die mikrophotographische Aufnahme gefärbter Präparate.** (The Photomicrographic Reception of Coloured Preparations.)
Internat. Photogr. Monatsschr. f. Med., 1899.

MATHET, L.—**Traité pratique de photomicrographie. Le microscope et son application à la photographie des infiniment petits.** Paris, 1899, 8vo, 267 pp.

WALMSLEY, W. H.—**Photomicrography of Opaque Objects.**
[The author recommends the cultivation of this somewhat neglected subject.]
Micr. Bull., XVI. (1899) pp. 45–6

(5) Microscopical Optics and Manipulation.

BROWN, THEODORE—**Teaching the Laws of Binocular Vision.**
[The author describes an ingenious little apparatus for demonstrating to a class the changes in the eye when an object is viewed.]
Eng. Mech., LXX. No. 1814, pp. 439–40 (3 figs.).

* Micr. Bull., xvi. (1899) pp. 33–4.

(6) Miscellaneous.

Strehl's Theory of the Microscope: the Pleurosigma Image.*—Herr Karl Strehl produces an article on the pleurosigma as a further contribution to his writings on the theory of the Microscope.† He desires to show that a knowledge of the diffraction theory is necessary to the proper comprehension of microscopic perception, and also that the theory may lead to the detection of some of the most delicate features of the image. Although the article does not readily lend itself to abstraction, an idea of it may be gathered from the following account. He considers the question under the influence of (1) direct light; (2) oblique light. With direct light the normal image is given by an equation:

$$M^2 = \left(\frac{d\,F}{\lambda\,p}\right)^2 \left\{ i + 2\,h \left[\cos Y + 2 \cos \frac{Y}{2} \cos \frac{X\sqrt{3}}{2} \right] \right\}^2.$$

This equation takes slightly different forms when applied to oblique light and to some of the points specially considered. His object, of course, is to show that theory and observation agree. In the course of the article he discusses,—normal image, hexagonal formation, ideal image, depth of image, quarter-phase image, lozenge-formation, chequer-formation, photomicrography. He also gives details of some experimental ratifications.

BEHRENS, H.—**Anleitung zur mikrochemischen Analyse.** (Introduction to Microchemical Analysis.)
[Second edition of this important work.]
Hamburg (L. Voss), 8vo, 242 pp., 96 figs.

Laboratorium et Museum.
[A new monthly scientific journal, with articles in English, German, and French.] English agents, Sampson Low, Marston & Co.

B. Technique.‡

(1) Collecting Objects, including Culture Processes.

Apparatus for Spore-sowing.§—Herr F. Noll describes the following apparatus (fig. 61), which he found suitable for the regular distribution of spores over a culture-surface. It consists of a wire gauze tube *z*, which is fitted at its lower end into a hole in a circular piece of cork R. Round the rim of the cork is fastened a roll of paraffined paper *p*, the same height as the wire gauze. The interspace is filled with calcium chloride. The upper end of the apparatus is closed with a cork K, having a hook N and a wire to which a piece of the plant with sporanges *s* is attached.

The culture medium is composed of a level layer of sterilised garden earth, which is damped and placed in a plate. The apparatus is suspended within a bell-jar, and the latter inverted over the culture layer.

* Zeitschr. f. Instrumentenk., 1899, pp. 325–35.
† Cf. op. cit., 1898, pp. 301–17; also this Journal, 1899, p. 94.
‡ 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.
§ Flora, lxxxvi. (1899) pp. 386–7 (1 fig.).

As the calcium chloride mantle dries the air, the sporanges open quickly, and it is only necessary to alter the position of *s* from time to time to

FIG. 61.

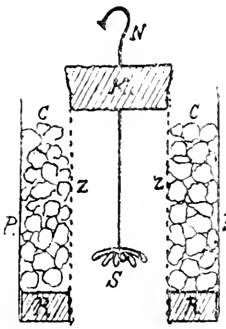
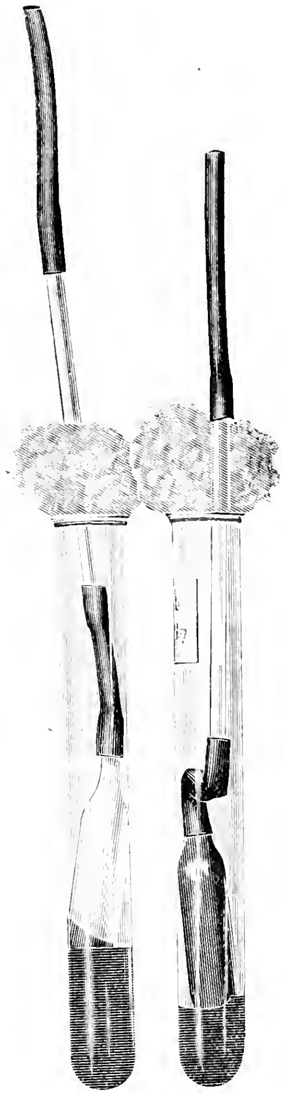


FIG. 62.



disseminate spores over all the surface of the culture medium. When the sowing of the spores is finished, the culture layer may be moistened without removing the bell-jar.

Warm Cupboard for Germination Purposes.* — Herr F. Noll describes a warm cupboard, the object of which is partly to act as a protective screen against the heat of stoves, and partly to make use of the surplus heat for germination and other similar purposes. The cupboard is made of sheet iron, has six shelves, and is divided into upper and lower compartments, each of which is closed by doors. At the end of each shelf is an aperture which may be closed by a sliding-panel. The cupboard is 118 cm. high, 60 cm. broad, and 18·5 cm. deep. The cupboard, when in the vicinity of a stove burning throughout the night, is found to keep at a temperature of 20°–25°, and is therefore very suitable for the cultivation of roots, fungi, and bacteria.

Simple Method for Anaerobic Cultivation in Fluid Media.†—Dr. C. H. Wright describes a method which depends on the fact that a flexible rubber tube closes itself air-tight when it is bent beyond a certain

* Flora, lxxxvi. (1899) pp. 382–3 (1 fig.).
† Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 74–5 (1 fig.).

angle. As is seen in the illustration (fig. 62), the apparatus consists of glass and rubber tubing, which are placed inside a test-tube together with a suitable amount of culture fluid. The apparatus and contents are sterilised in the usual way; but just before using, the culture fluid should be boiled to drive off the absorbed oxygen. When a culture is to be made, the medium is infected in the usual way; the lips are applied to the projecting piece of rubber tubing, and the culture fluid sucked up into the inner tube somewhere above the top of the lower rubber tubing. This done, the upper tubing is compressed by the fingers (or pinch-cock), and the tubes are then pushed down so as to bend the lower rubber tubing in the way shown in the illustration. The upper ends of the glass tubes should be plugged with cotton wool. The excess of culture fluid left outside the inner tube affords opportunity of ascertaining whether an organism is an essential anaerobe or aerobe, and also whether it is potentially anaerobic or aerobic. If it be desired to make a cover-glass preparation, the bends of the rubber tubes are straightened out by lifting the glass tube; the culture fluid then flows out into the outer tube.

The apparatus has given good results with the tetanus bacillus.

Procedure for Easily and Rapidly Distinguishing Cultures of Bacillus Typhosus from Bacillus Coli.*—Dr. A. Mankowski employs the following coloured nutrient medium for distinguishing between the bacillus of typhoid fever and *Bacillus coli communis*. The staining mixture is made in two solutions, A and B. Solution A is a 1 per cent. solution of caustic potash saturated with acid fuchsin (the pigment is added until the solution assumes a blackish-brown colour). Solution B is a saturated solution of indigo-carmin in water. Two ccm. of solution A, 1 ccm. of solution B, and 22 ccm. of distilled water, are mixed together, and the mixture should be dark blue in colour and of slightly alkaline reaction. To the nutrient medium the solution is added, drop by drop, until the substratum is of a blue or violet hue. The reaction must be neutral. It is sometimes advisable to add a drop of the indigo-carmin solution to the already coloured medium, in order to intensify the blue, and render the reaction of the typhoid bacilli more evident. The typhoid colonies change the blue to a raspberry or carmin-red colour, and the coli colonies to green or greenish-blue at first, and later on discharge the colour. The medium used was agar, with the addition of 1/2–1/3 per cent. glucose.

New Substratum for Isolating Typhoid Bacilli and Bacillus Coli Communis.†— Dr. A. Mankowski recommends a medium, the chief constituent of which is decoction of "mushrooms," for the differential diagnosis of *Bacillus coli communis* and the typhoid bacillus. To the mushroom decoction 1·5 per cent. agar, 1 per cent. pepton, and 0·5 per cent. NaCl are added. When the mushroom-agar has been boiled, and clarified by means of white of egg, it forms a firm transparent dark brown mass, with neutral reaction and a distinct odour of mushrooms. *B. coli* grows quickly, and forms a silvery-white firm deposit. The typhoid colonies develope less rapidly, and form a transparent shiny moist streak. In six hours gas-bubbles are visible in the *B. coli*

* Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 21-3. † Tom. cit. pp. 23-4.

colonies. If the medium be stained with the author's indigo-fuchsin solution, the typhoid bacilli change the blue to red, while the coli bacilli decolorise the substratum.

For making the decoction poisonous or edible mushrooms may be used.

New Method for Cultivating Tubercle Bacillus.*—Dr. W. Hesse describes a nutrient medium which is made by dissolving 5 grm. Heyden's nutriment, 5 grm. salt, 30 grm. glycerin, and 10 grm. agar, in 1000 ccm. water, and alkalised by the addition of 5 ccm. mineral soda solution. Plates are made in Petri's capsules, and tubercle bacilli grown thereon from direct inoculation with sputum. On this medium tubercle bacilli almost invariably grow, and in the exceptional cases where the culture is overgrown by other bacteria, impression preparations invariably disclose their presence. The author believes that this method will supersede the animal test in many doubtful cases.

Cultivating Water Bacteria in an Atmosphere Saturated with Moisture.†—Mr. G. C. Whipple has shown, by a series of experiments, that in order to obtain the greatest possible development of water bacteria on the gelatin-plate, a ventilated dish should be used, and the cultures should be incubated in an atmosphere saturated with moisture. The observations were made on cultures placed in (1) moist chamber, (2) ice-chest, (3) incubator, (4) closed chamber, and (5) desiccator. The largest number of bacteria were always obtained from plates developed in the moist chamber, and the least from those in the desiccator. It was also found that there was a direct relation between the humidity and the number of bacteria developed, and that the supply of oxygen had a marked effect on the growth of the water bacteria on the gelatin plate. The practical outcome of these observations was that satisfactory results were obtained by making small notches on the lower edge of the Petri plate, or by extending the sides of the lower plate upwards at four points so as to allow of free circulation of air. These ventilated dishes, placed in an atmosphere saturated with moisture, were not only successful, but were perfectly free from danger of contamination. Cultivation in a moist atmosphere has the further advantage of bringing the bacterial growth to maturity in a shorter time. The incubators should be well ventilated, and their atmosphere kept at or near saturation point. They should be provided with dry and wet bulb thermometers, and the relative humidity should not be allowed to fall below 95 per cent.

Cultivating and Demonstrating the Micro-organisms from Tumours.‡—Dr. Nils Sjöbring has cultivated the microbes of cancer in a medium composed of ordinary pepton-gelatin (8 per cent.) and strong aqueous solution of potash-soap made with human fat (1·5 per cent.). To this 1 per cent. cane or grape-sugar is added, and then the mixture is sterilised. Usually 50 per cent. sterile ascitic fluid was added, but this is not an absolute necessity. The amount of free alkali should be much greater than in bacterial substrata; even 2 per mil. is not unfavourable. Pieces of tumour freshly excised were placed in the tubes and

* Zeitschr f. Hygiene, xxxi. p. 502. See Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) p. 119. † Technology Quarterly, xii. (1899) pp. 276–82.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 129–40 (4 figs.).

incubated at 37°, and in about a week the microbes developed freely, though not on the surface. Pure cultures were also obtained occasionally from the dead body. Microbes were obtained from thirty different kinds of tumour, and each tumour appears to have a single species. Microscopical examination of the cultures must be made from fresh material, as the bodies do not stand fixation or hardening; though with weak chromic and acetic acids appearances similar to those depicted by Soudakewitsch were obtained. The preparation may, however, be stained with methylen-blue, safranin, or in anilin-blue (weak aqueous solution, with at most 1–5 per cent. alcohol).

The appearances found on examination were extremely variable as to shape, but may be roughly divided into three classes, with, however, numerous transition forms—amœboid forms, typical rhizopoda, and involution or resting forms. The organism of cancer is without doubt a rhizopod, according to the author, and four successful inoculations on mice with pure cultures are recorded.

Growth of Tubercle Bacilli on Potato Substrata.*—Herr E. Tomaszewski tested four different samples of tubercle bacilli on neutral and acid gelatin-potato, glycerin-bouillon, glycerin-agar, neutral and acid glycerin-potato-broth, glycerin-potato-agar, and glycerin-potato-bouillon. The most favourable growth took place on glycerin-bouillon and glycerin-agar. The author therefore concluded that there was no advantage in potato media as against the two last-mentioned substrata.

Cultures of Micrococcus melitensis and its Serum Reaction.†—Dr. T. Zammit reports that:—(1) the micrococcus of Bruce can be grown successfully from a culture seven months old; (2) two-year old cultures give a clear serum reaction; (3) the micrococcus does not grow on sea-water-agar even when brown from sewage contamination; (4) but grows on an agared solution of normal human fæces.

Preparation of Culture Media.‡—Mr. R. B. F. Randolph has, for the last three years, been in the habit of boiling all culture media in an agate-ware double boiler, the outside chamber of which contains a 50 per cent. filtered solution of commercial calcium chloride. This solution has a boiling point of 112° C., and consequently, when boiling, is hot enough to keep the contents of the inner chamber in rapid ebullition. The advantages of this plan are that nothing ever burns, the boiling takes place quietly and without bumping, and the rate of ebullition is easily controlled by adjusting the size of the flame.

Apparatus for obtaining Plate Cultures or Surface Growths of Essential Anaerobes.§—The apparatus (fig. 63) described by Dr. W. Bulloch consists of a bell-jar placed on a ground-glass slab. At the top are two openings fitted with tubes and stop-cocks, from one of which a tube leads to the bottom of the bell-jar. The lower edge of the bell-glass is smeared with unguentum resinæ. On the slab is placed a Petri's dish, and in this a beaker containing the inoculated tubes. In the Petri's dish and on the side farthest from the long tube are placed

* Zeitschr. f. Hygiene u. Infekts., xxxii. (1899) p. 247. See Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) p. 166.

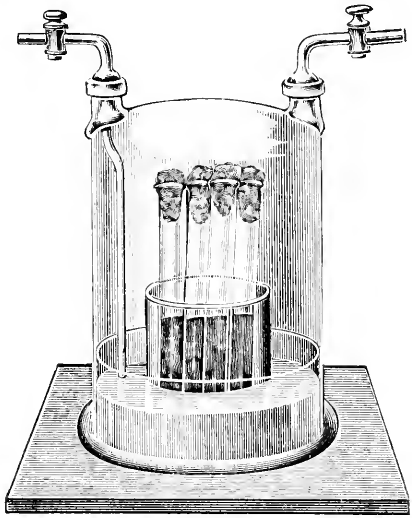
† Brit. Med. Journ., 1900, i. p. 315.

‡ Journ. App. Micr., ii. (1899) pp. 632–3.

§ Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 140–2 (1 fig.).

2–4 grm. dry pyrogallic acid. The bell-jar is then applied so that the end of the long tube dips into the Petri dish. Both stop-cocks are now opened, and hydrogen or coal-gas introduced through the short upper tube. When the apparatus is full both taps are turned and an air pump applied to the short tube. After opening the stop-cock, one or two strokes of the piston produce a sufficient vacuum, and then the tap is closed again. By means of a piece of rubber tubing applied to the long tube, strong potash solution is introduced (109 grm. solid KHO in 145 ccm. water) into the Petri's dish. It is necessary to make the potash solution some time before using. The whole operation of putting the apparatus into complete working order does not occupy five minutes. The apparatus has been used with great success for tetanus, malignant œdema, rauschbrand, and *B. aerogenes capsulatus.*

Fig. 63.



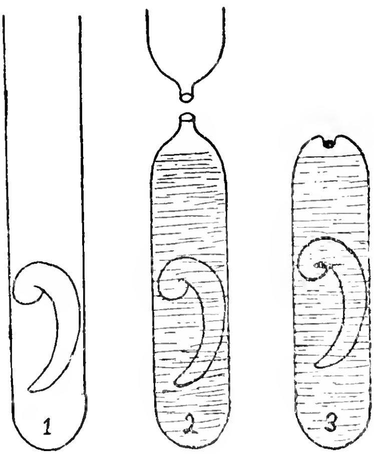
(2) Preparing Objects.

Preparation of Plague Vaccine. * — Prof. A. Lustig and Prof. G. Galeotti have extracted from plague bacilli a poisonous nucleo-proteid, which is capable of conferring immunity even in small doses, by the following method :—" We cultivate the plague bacilli in large glass dishes containing a stratum of common agar-agar. After some days' development we scrape with a bone spatula the colonies which have formed, and dissolve the mass in a 1 per cent. solution of caustic potash. We then add a very dilute solution of either hydrochloric or acetic acid until a slight acid reaction is introduced, and we collect in a filter the precipitate formed. After careful washing, the precipitate itself is dried *in vacuo*, and in the presence of sulphuric acid, or else immediately re-dissolved in a 0·5 per cent. solution of carbonate of soda. The dried substance, which has lost none of its chemical and biological properties, is easily redissolved in a solution of carbonate of soda when required. The solution of this substance may also be passed through a Chamberland filter for greater guarantee of sterility. The precipitate is composed solely of a nucleo-proteid in a state of relative purity. It possesses all the general reactions of nucleo-proteids, is soluble in alkalies, insoluble in dilute acids, gives on digestion an insoluble product and a peptone, and on dissociation by sulphuric acid gives nucleinic bases. It is extremely toxic for several animals, and is able to produce the intravascular coagulation of the blood."

* Brit. Med. Journ., 1900, i. p. 311.

Permanent Preparations in Hermetically Sealed Tubes.*—Mr. H. F. Nachtrier describes a method for keeping animals and botanical specimens in tubes hermetically sealed. Glass tubing of a size just admitting the specimen and considerably longer than the final sealed tube is to be is employed. One end is closed, the tube filled with 80–70 per cent. alcohol, and the specimen carefully introduced. Nearly all the alcohol is then poured off (fig. 64). The tube is then drawn to a point at some distance from the object and broken off at the neck (fig. 65). It is then filled by means of a tube-funnel with a long small end. When filled, the end is sealed in a Bunsen flame (fig. 66). Care is required in sealing, but the secret of success consists in making as small a neck as is practicable. Flemming's mixture of alcohol, glycerin, and water usually answers better than pure alcohol. The introduction of a slip of milky or black glass is an improvement in some cases, as it shows up the objects better.

FIG. 64. FIG. 65. FIG. 66.



Permanent Preparations of Urinary Casts.†—Dr. L. N. Boston has found the following medium suitable for preserving all kinds of casts. Liquor acidi arseniosi (U.S.P.), one fluid ounce; salicylic acid, half a grain; glycerin, two fluid drachms. Warm slightly until the ingredients are dissolved, then add acacia (whole tears) and warm again until the solution is saturated. After subsidence decant the clear supernatant fluid. A drop of formalin may be added to this mixture if desired.

The casts are obtained from urine by sedimentation, the supernatant fluid being decanted off. A drop of the deposit is pipetted on to a slide, and if casts be present, the fluid is evaporated nearly to dryness. A drop of the medium is then placed in the centre of the urine-patch and the two mixed by carefully stirring them together with a needle. A cover-glass is then put on. The slightest pressure or the application of heat is usually destructive of casts. The slide is now put in a cool place for a few hours in order that hardening may be complete, and the preparation ringed round with zinc-white.

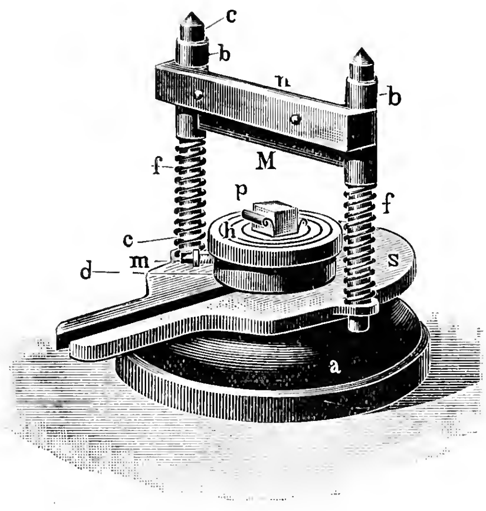
(3) Cutting, including Imbedding and Microtomes.

Schaffer's Paraffin-block Quick Cutter.‡—Prof. Jos. Schaffer's apparatus, which he has now used for three-and-a-half years, is represented in figs. 67 and 68. A circular domed iron base plate *a*, planed flat at the top, bears firmly screwed in its centre, but projecting above it by means

* Science, x. (1899) pp. 771–2 (3 figs.). † Micr. Bull., xvi. (1899) p. 34.
‡ Zeit. f. wiss. Mikr., xvi. (1900) pp. 417–21 (2 figs.).

of a neck (fig. 68, *o*), a metal disc *d*, which is hollowed out (fig. 68, *t*) for the reception of the imbedding plate (fig. 67, *h*). This plate consists of a hard wood disc with shallow brass dowel, which fits pretty accurately in the hollow of *d* (fig. 68, *t*), and can be firmly fastened thereon by the screw *m*. On the imbedding plate the paraffin-block (fig. 67, *p*), which has already received a parallelopipedal form from the adjustable imbedding frame, is erected with plane faces and firmly melted on. In the iron base plate two steel pins (fig. 68, *o′* and *o″*), equidistant from the circumference and in two radii at right angles to one another, are inserted, their height exactly corresponding to the thickness of the neck bearing the disc *d*. A conspicuous part of the apparatus is the guillotine over the imbedding plate, worked by a vertical up-and-down push motion. The hard brass plate *s*, by means of a long slit, grips the neck of the disc *d* clamp-fashion, as well as one of the steel pins (*o′* or *o″*).

FIG. 67.



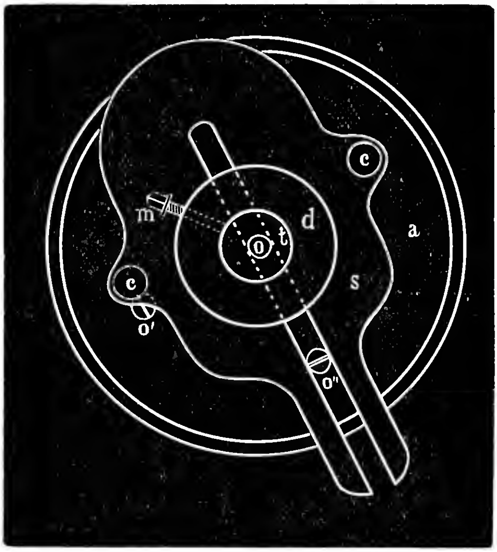
As the perpendicular distance between the flat top of the dome and the underside of the neck *o* exactly corresponds to the thickness of the plate *s*, the latter can be worked to and fro as if in a slide-groove. This movement is confined to the range between one of the steel pivots, *o′* or *o″*, and the central neck *o*. If the plate with the slit is drawn out, it can then be lifted over the pivot and rotated round *o*, and placed over the other pivot. This rotation is exactly 90°.

The plate *s* carries, on two lateral projections, two vertical steel columns *c*, whose bases are screwed into the plate. These columns support a crossbar *n*, the knife-carrier, by means of two collars so accurately fitted that they only allow a clean vertical push of the knife-carrier. The knife (fig. 67, M) is fastened on one face of the crossbar, and moves with it. The down motion is by finger pressure; the up by the resilience of the two spiral springs *f*.

When one face of the block has been cut, the knife-carrier is lifted off the columns, turned through 180°, and replaced; the second face is then cut, and is parallel to the first. Then the plate *s* is rotated through 90°, and the other two faces are similarly cut.

When the paraffin-block has been so "defined," the imbedding plate

Fig. 68.



with the block is removed and placed in the clamp of the microtome. The apparatus is made by A. Fromme, Hainburgerstrasse 21, Vienna iii.

(4) Staining and Injecting.

Staining Malaria Blood.*—Prof. A. Celli stains malaria blood by first fixing the films 15–20 minutes in absolute alcohol. The films are made by allowing the blood to spread itself out between two cover-glasses. The staining is done by the Tiemann-Remanowsky method:—(*a*) A saturated aqueous solution of medicinal methylen-blue at 25°–30° for three days; (*b*) an aqueous 1 per cent. solution of eosin, A, G. or B (Lucius). One to 3 parts of (*a*) are mixed with 3–5 parts (*b*). The time required for staining the films is 20–30 minutes. The red corpuscle is stained pink, the hæmosporidium blue, and its chromatic substance purple.

Method for Staining the Nuclei of Endoglobular Parasites of Birds.†—M. A. Laveran uses a solution of methylen-blue prepared by Dr. Borrel in the following way. A solution of silver nitrate is treated with soda solution, and the precipitated silver oxide carefully washed. To the silver oxide is added a saturated solution of methylen-blue, and

* Brit. Med. Journ., 1900, i. p. 304. † C.R. Soc. Biol., vi. (1899) pp. 249–52.

the mixture having been well shaken is left for several days before it is decanted. This blue is termed Borrel's blue.

Films of bird's blood infected with Laverania are fixed in absolute alcohol for one hour, and then immersed in the following freshly prepared staining solution:—Borrel's blue, 1 ccm. in a 1 per mil. aqueous solution; soluble eosin, 5 ccm.; distilled water, 4 ccm. The blue and eosin solutions are filtered at the time of mixture and not afterwards.

After 12–24 hours, the cover-glasses are washed in distilled water, and then immersed for one or two minutes in a 1 per cent. aqueous solution of tannin. The slip is then washed, dried, and mounted in balsam.

The nuclei of the Hæmatozoa are stained violet, the rest of the protoplasm is uncoloured or faintly blue; the red corpuscles are pink and their nuclei violet.

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

New and more Permanent Method of Mounting Amyloid Sections Stained with Iodine.*—Dr. A. B. Green recommends the following procedure for mounting amyloid sections. Three solutions are required:—(1) Weigert's iodine; (2) liquid paraffin (30 ccm.) and iodine crystals (1 grm.); (3) xylol (30 ccm.), iodine crystals (1 grm). First place on a cover-slip white vaselin to be ready for mounting. Float the section on to a slide, and remove as much water as possible. Drop on some of solution (1) until the section is sufficiently stained. Drain off excess, and pour over some of solution (2). Drain away excess, and pour on solution (3). Drain away excess, blot quickly, and put on vaselined cover-slip at once.

(6) Miscellaneous.

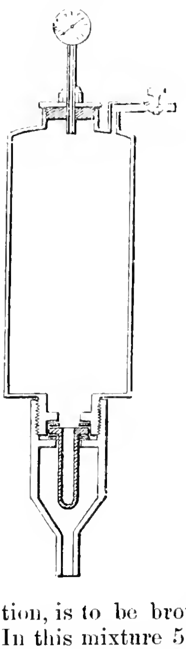
Methods for Distinguishing between Bacillus Tuberculosis and Bacillus Smegmæ.†—Mr. W. C. C. Pakes points out that *Bacillus smegmæ* may be easily mistaken for *Bacillus tuberculosis*, and that it has been found in sputum, wine, and milk. It differs from the tubercle bacillus in not being pathogenic to guinea-pigs, in its cultural reactions, and its inability to resist the decolorising action of absolute alcohol after having been stained with warm phenol-fuchsin. The following modified Ziehl-Neelson method is advised:—The film, which should not be too thin, is dried in the air, and then passed thrice through the flame. The preparation is stained with hot phenol fuchsin (60°) for five minutes, and then washed with water. Every visible trace of stain is removed in absolute alcohol, and, after having been washed in water, the preparation is immersed in 25 per cent. H_2SO_4 for five or six seconds, and then washed in water again. Having been contrast-stained for about three seconds in phenol-methylen-blue, the preparation is washed, dried, and mounted.

If there be any doubt, Hansell's method may now be adopted. The film is prepared and stained as before, but after washing in water, it is dried and then immersed in acid-alcohol (absolute alcohol 97 per cent., HCl 3 per cent.) for ten minutes, after which it is washed in water. The preparation is contrast-stained for several seconds in equal parts of a saturated alcoholic solution of methylen and water, washed, dried, and mounted.

* Lancet, 1899, i. p. 581. † Brit. Med. Journ., 1900, i. p. 186.

New Method for Detection of Bacillus Coli Communis and Bacillus Typhi Abdominalis in Water.*—Mr. W. C. C. Pakes describes a method for detecting *B. coli* and *B. typhosus* in water, which has the advantage of being more delicate than those usually employed. The medium is glucose formate broth, which is composed of ordinary meat infusion, 1 per cent. pepton, 0·5 per cent. NaCl, 2 per cent. glucose, and 0·4 per cent. sodium formate. After solution of the ingredients, the medium is neutralised, and then 2 ccm. of $\frac{N}{1}$ NaHO added. The broth is then boiled in the steam steriliser for 20 minutes, filtered, poured into test-tubes, and sterilised for 20 minutes on the day it is made and the two succeeding days. After inoculation, the tubes are placed in Buchner's tubes with alkaline pyrogallol (anaerobic cultivation) and incubated at 42° for from 18–24 hours. An examination is then made, and those tubes which show signs of growth are removed. Incubation of the remainder is continued, and examinations made at the end of 48 and 72 hours, when, if there be no signs of the growth, the tubes are rejected. Ordinary gelatin and agar-plates are then made.

Fig. 69.



In testing a sample of water for *B. coli*, large and small quantities must be examined, and the water is concentrated by passing it through a special filter, an illustration of which is appended (fig. 69). After all the water has run through, 10 ccm. of sterilised water or bouillon are poured into the bougie, and the bacteria brushed into the fluid. The emulsion represents a concentration of 200 times; and 0·1 ccm. will represent 20 cm., and so on. A series of glucose formate broth tubes is then inoculated with variable quantities both of the original water and of the emulsion.

Testing for Ergot in Flour.†—Fr. Musset demonstrates the presence of ergot in flour by using 70 ccm. of a mixture of chloroform and alcohol (about 10–1), the specific gravity of which, at the time of examination, is to be brought up to 1·435 by the addition of absolute alcohol. In this mixture 5 grm. of the suspected flour are shaken up, and after having been allowed to settle, some of the floating scum is removed to a cover-glass and allowed to dry. A little xylol is then added, and the preparation examined microscopically.

Bibliography.

Carazzi, D.—**Manuale di tecnica microscopica.** xii. and 311 pp. Milano, 1899.

Duclaux, E.—**Traité de Microbiologie.** T. i. Microbiologie générale, 3 and 632 pp. T. ii. Diastases, Toxines et Venins, 3 and 768 pp. Paris, 1899.

Migula, W.—**System der Bacterien: Handbuch der Morphologie, Entwicklungsgeschichte und Systematik der Bacterien.** Bd. i., 1897; Bd. ii., 1900. Jena.

Lehmann, K. B., und R. Neumann.—**Atlas und Grundriss der Bacteriologie und Lehrbuch der speciellen bacteriologischen Diagnostik.** 2. Auflage. München, 1899.

* Brit. Med. Journ., 1900, i. pp. 188–9 (1 fig.).

† Ph. Centr. Halle, 1899, p. 617. See Zeitschr. Angew. Mikr., v. (1899) pp. 230–1.

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 21ST OF FEBRUARY, 1900, AT 20 HANOVER SQUARE, W., THE PRESIDENT, W. CARRUTHERS, ESQ., F.R.S., IN THE CHAIR.

The Minutes of the Annual Meeting of January 17th, 1900, 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 Society were voted to the donors.

	From
H. W. Conn, The Story of Life's Mechanism. (8vo, London, 1899)	*The Publishers.*
The Illustrated Annual of Microscopy, 1900. (8vo, London, 1900)	*The Publishers.*
A "Jones' Most Improved combined Microscope and Apparatus"	*Mr. E. M. Nelson.*

With reference to the Jones' Microscope, Mr. Nelson said it was one of Jones's Most Improved patterns, and would be specially interesting because hitherto the Society had possessed no example of this instrument in its collection. The exact date of this instrument was a little uncertain, but he believed it to be about the last improvement made in the non-achromatic Microscope. The first published description of this Microscope, with a figure, is to be found in Adams' *Essays on the Microscope*, 1798.

Dr. J. W. Measures said he had been announced to give an exhibition of photomicrographic and projection apparatus, but he did not propose to detain the Meeting with any lengthened remarks on the apparatus made use of. Those who had examined it would readily understand that the arrangement would suffice both for photographic purposes and for projection. The camera was fitted with bellows divided into two parts, of which the front portion could be used separately, or both parts could be coupled together, when a considerably greater extension was available. It was fixed on a strong iron stand with levelling screws in the feet, and, being very firm, no inconvenience had been found to arise from vibration in consequence of the Microscope and illuminating apparatus being on one table and the camera on another. The lamp used was one of considerable power, being supplied with a continuous electric current of 65 volts and 30 ampères. All other parts required for illumination, such as condenser, water-chamber, iris diaphragm, &c., were fitted upon saddles sliding upon a prismatic steel rail in front of the lamp, so that when once they had been accurately centred, they could be moved along the rail to any required position without getting out of the centre.

The first portion of the exhibition was intended to illustrate the use of the arrangements for projecting the images of opaque objects upon the screen; such objects as coins, post-cards, &c., being powerfully illuminated by a beam of light reflected upon them by a mirror, and shown upon a small screen placed in the middle of the room at a distance of about 15 feet. This was followed by the exhibition, on a larger screen at a greater distance, of a large number of microscopic slides, comprising insects, plant sections, marine polyps, and preparations of animal tissues, chiefly by means of Messrs. Zeiss's micro-planar objectives.

As showing the capabilities of the apparatus to exhibit ordinary lantern slides, the last portion of the exhibition consisted of a number of views of landscapes, plants, and animals, as well as some extremely fine photomicrographs of diatoms, &c., which had been lent for the occasion by Dr. Spitta.

The whole of the apparatus is constructed so as to render this transition from *micro-* to *macro*-projection, and the reverse, very rapid and easy, all the requisite rearrangement of parts being readily effected in one or two, or at the most in three minutes.

The President, in inviting remarks from those present, said he thought it was obvious that they had before them an instrument which must be of great utility in illustrating public lectures, by showing the minute details of sections on a large scale, much larger than they had the conveniences for doing in that room. He was sure that all present would join him in giving their best thanks to Dr. Measures for this very interesting and instructive exhibition.

Mr. Lewis Wright said he had heard a great deal as to the excellence of Messrs. Zeiss's micro-planars, and he had long desired to see what could be done with them. He would only say now that what he had seen that evening fully came up to anything he had anticipated; their flatness of field and the quality of the definition up to the margin of the field were remarkably good. The highest power, however, which seemed to have been used was the 20 millimetre, whereas he should very much like to have seen something with a 1/2 inch, though he had been very pleased with what had been shown.

A vote of thanks to Dr. Measures was then put to the Meeting and carried unanimously.

The following Instrument was exhibited:—

Mr. E. M. Nelson:—A "Jones' Most Improved combined Microscope and Apparatus."

New Fellows:—The following gentlemen were elected *Ordinary* Fellows of the Society:—Mr. Ronald Hamlyn-Harris, Major Francis Robert Winn Sampson.

MEETING

Held on the 21st of March, 1900, at 20 Hanover Square, W., A. D. Michael, Esq., F.L.S., Vice-President, in the Chair.

The Minutes of the Meeting of 21st February last were read and confirmed, and were signed by the Chairman.

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

	From
Marion J. Newbigin, Colour in Nature. (8vo, London, 1898)	*The Publisher.*
An old Microscope by Benjamin Martin	*Mr. F. R. Dixon-Nuttall.*

With reference to the Microscope presented by Mr. Dixon-Nuttall, Mr. E. M. Nelson said this was a Microscope made by Benjamin Martin, dating about the year 1765. It was particularly interesting to the Society because they had not one of this form in their collection. A solar projecting apparatus was packed in the same box; this was the invention of Dr. Lieberkühn, who brought it to London in 1740; Cuff improved it by adding the mirror in 1743. It was a very well made and perfect example.

Mr. E. M. Nelson called attention to a number of Microscopes which had been sent to the Society for exhibition that evening.

The first of these was by Plössl, kindly sent by Mr. C. L. Curties. Mr. Parsons has found that this Microscope had already been illustrated in our Journal for 1883, p. 703; but as it was now probably forgotten, he would ask the Fellows to inspect the very peculiar coarse adjustment that was fitted to the instrument. The principle was similar to that of the reciprocating movement of a steam-engine. The body-tube was the piston-rod, and the head of the coarse-adjustment pinion, which was large in diameter, was the fly-wheel. A pin placed near the periphery of this wheel was connected to the body-tube by a connecting-rod; therefore on turning the wheel reciprocating movement was imparted to the body-tube, and this formed the coarse adjustment.

The next five Microscopes had kindly been sent by Messrs. Spiers and Pond. The first was an English model similar to the ordinary pattern of Student's Microscope.

The next was a French model, with a plain sliding tube coarse adjustment, and a short lever nose-piece fine adjustment. This latter worked in a slot cut in the outer tube; in order therefore to effect the coarse adjustment, it was necessary to move the tube directly up or down; a gradual adjustment by turning the tube round was impossible.

The next was a smaller instrument fitted with a coarse adjustment of a very peculiar kind; it was evidently a modification of Plössl's, but the connecting arms were suppressed, and a pin working in a radial slot in the milled head of the coarse adjustment was substituted for them.

A smaller Microscope was shown, which had an ingenious method of attaching the outer tube of the sliding coarse adjustment to the limb; two holes were pierced through the front of the tube, so that the heads of the screws fixing the tube to the limb might be on the inside of the tube. This made a far more secure fitting than when the screws were put in from the other side.

The last was a very small compound Microscope, whose total height was only about 3 in.

The next Microscope was sent for exhibition by Mr. Ernest Barker. It was of the portable kind, and was attached to its box, which measured only $4\frac{1}{2} \times 1\frac{3}{4} \times 2$ in., and which also contained a small live-box, a pipette, a pair of tweezers, and a trough. It was a very compact and portable little instrument, eminently suitable for field work.

The Chairman said they were greatly obliged to the various exhibitors of these Microscopes, and also to Mr. Nelson for kindly explaining them. The last one referred to was certainly a most ingenious and compact little instrument, and likely to be extremely useful as a travelling Microscope to persons in India or other places where perhaps transport was difficult, and every additional ounce added to the burden to be carried was of importance. The only inconvenience appeared to be that it could not be used upright, which was rather necessary when the object was in liquid.

The thanks of the Society were cordially voted to Mr. Nelson and to those gentlemen who had sent the various instruments for exhibition.

Mr. E. M. Nelson read the following extract, kindly sent by Mr. W. Jerome Harrison, of Birmingham, from Dr. Hooke's *Microscopium* (1678), describing a method of using some convex lenses by contact with a drop of water.

1678.—Hooke, Robt., Lectures and Collections: Part II. Microscopium: containing . . . the Author's Discourse and Description of Microscopes, improved for discerning the nature and texture of Bodies. 8vo, London.

Pp. 98–99.—Objects may be placed between two glass plates for examination. Globules of melted glass fixed in metal plates make good high-power lenses. "If further, you would have a Microscope with one single refraction, and consequently capable of the greatest clearness and brightness that any one kind of Microscope can possibly be imagined susceptible of, when you have fixed one of these little globules as I have directed, and spread a little of the liquor upon a piece of looking-glass plate, then apply the said plate with the liquor next to the globule, and gently move it close to the globule, till the liquor touch; which done, you will find the liquor presently to adhere to the globule, and still to adhere to it though you move it back a little; by which means, this being of a specifique refraction, not much differing from glass, the second refraction is quite taken off, and little or none left but that of the convex side of the globule next the eye; by which means as much of the inconvenience of refraction as is possible is removed, and that by the easiest and most practicable expedient that can be desired."

He thought it was extremely interesting to know that the immersion objective was not, after all, such a modern invention as was generally supposed.

The Chairman said this was a very interesting record, showing once more what they seemed to spend their lives in learning—that there was nothing new under the sun. In Hooke's *Microscopium* the illustrations were somewhat rough, but there was so much in it that one might almost say of it as used to be said of Leeuwenhoek—that it was never safe to say a thing is new until you had searched Leeuwenhoek.

Mr. Nelson said that Mr. Powell had just pointed out to him that these lenses of Hooke's differed in principle from the immersion objectives of the present day, because all of these had flat fronts, whereas in Hooke's the water was applied to a convex surface, and so formed a sort of concave lens, which acted to some extent as a corrective of the chromatism of the glass.

Mr. Vezey said he had just heard that the small portable Microscope which had been exhibited by Mr. Nelson as the Seaside Microscope, was one made by Messrs. Newton and Co., of Fleet Street, and was on sale now as it had been for the last twenty years. It had been illustrated by a woodcut in their catalogue for a number of years.

Mr. Swift exhibited a new pattern Microscope which differed somewhat from the usual types, the upper portion being a replica of the Continental form (apparently the first example made by an English firm), except that it was fitted with the Campbell differential-screw fine adjustment, whilst the lower portion was of the ordinary English type; the vertical axis had however been thrown out more than usual so as to admit of a larger stage being used.

The Chairman, in expressing the thanks of the Meeting to Mr. Swift for his exhibit, said that the large stage no doubt took up a considerable space, but it was of great use in a working instrument.

Mr. C. F. Rousselet read a note with reference to a large number of slides of new, rare, and foreign Rotifera, which were exhibited under numerous Microscopes in the room. The new species all belonged to the genus *Synchæta*, and many others had been described since the publication of Hudson and Gosse's monograph. Descriptive cards directed attention to the chief points of interest in connection with the specimens shown. In addition to this collection, two specially well mounted slides of *Stephanoceros* and *Floscularia* were shown, as illustrating the possibility of preserving these delicate organisms in a perfectly expanded and lifelike condition.

The Chairman was sure that every one present would join in passing a very hearty vote of thanks for the very magnificent exhibition which Mr. Rousselet had arranged. His mode of manipulation was probably one of the things in Microscopy which was really new and could not be found in Leeuwenhoek or in Hooke's *Microscopium*. Those who had seen Mr. Rousselet's very interesting and beautiful specimens would feel that it required nothing to be said by him to recommend them.

The thanks of the Meeting were unanimously voted to Mr. Rousselet for this very interesting exhibition.

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

The Society:—An old Microscope, "B. Martin Invt. et Fecit, No. 13."

Mr. C. Baker:—A Microscope by S. Plössl & Cie., Wien.

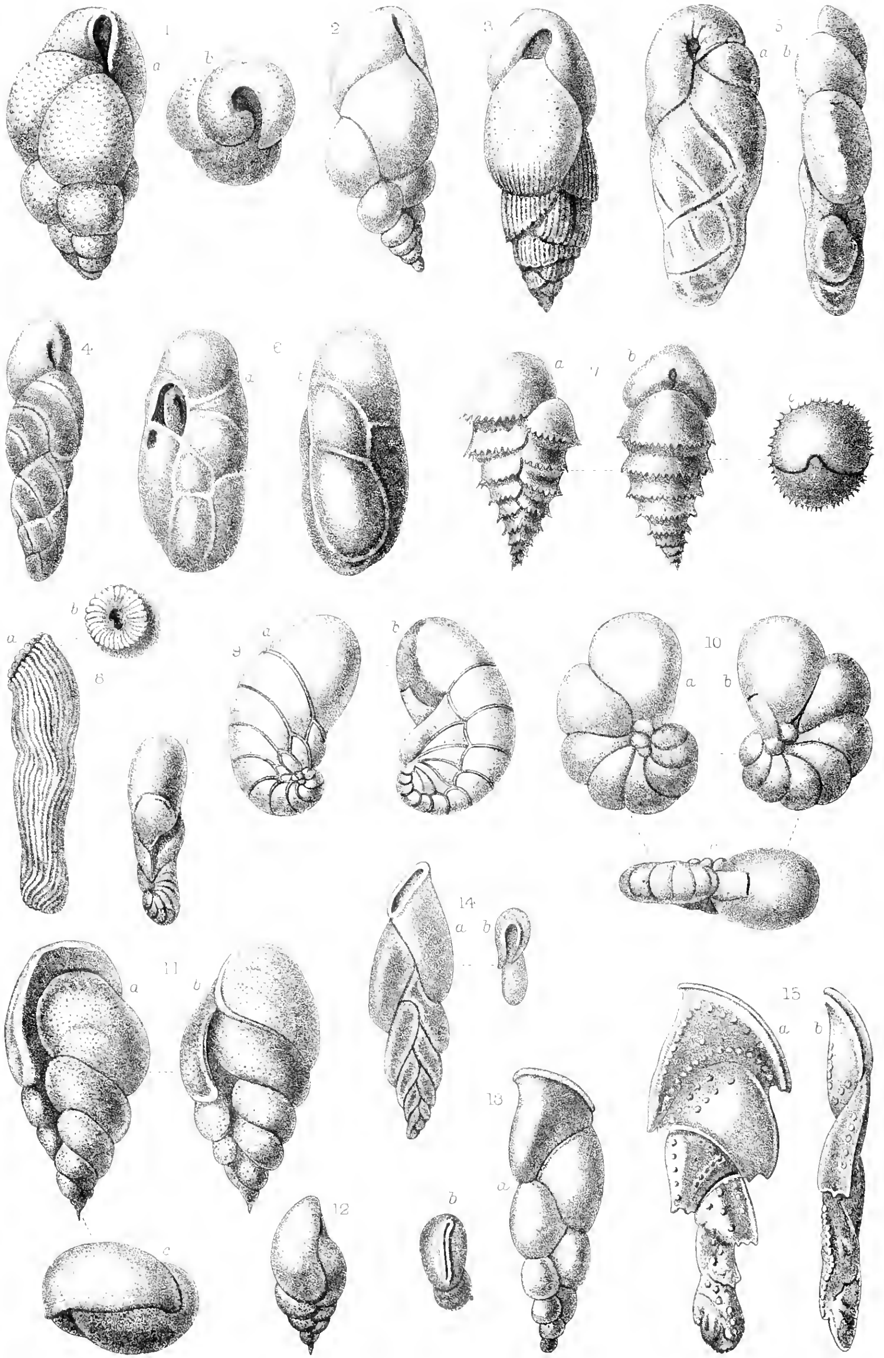
Mr. Ernest E. Barker:—A Field Microscope.

Messrs. Spiers and Pond:—Five Microscopes.

Messrs. J. Swift and Son:—A Microscope.

Mr. F. C. Rousselet:—Exhibition of New, Rare, and Foreign Rotifers, mounted:—Anuræa aculeata var. undescribed, A. cochlearis var. recurvicornis, Apsilus lentiformis, Asplanchna herricki, Brachionus caudatus, B. militaris, B. mulleri (?), B. punctatus, B. variabilis, Floscularia campanulata, F. pelagica, Lacinularia elliptica, L. natans, L. pedunculata, L. reticulata, L. striolata, Mastigocerca capucina, Monostyla lamellata, Ploesoma lenticulare, P. truncata, Scaridium eudactylotum, Schizocerca diversicornis, Stephanoceros eichhorni, Synchæta cecilia, S. Kitina sp. n. undescribed, S. longipes, S. monopus, S. stylata, S. triophthalma, S. vorax, Trochosphæra solstitialis.

New Fellows.—The following were elected *Ordinary* Fellows:—Messrs. A. W. Oxbrow and David J. Scourfield.



F W Millett. del. ad nat

West, Newman lith

FORAMINIFERA OF MALAY ARCHIPELAGO.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

JUNE 1900.

TRANSACTIONS OF THE SOCIETY.

IV.—*Report on the Recent Foraminifera of the Malay Archipelago collected by Mr. A. Durrand, F.R.M.S.—Part VIII.*

By Fortescue William Millett, F.R.M.S.

(*Read* 16*th May*, 1900.)

Plate II.

Sub-family **Bulimininæ.**

Bulimina pupoides d'Orbigny.

Bulimina pupoides d'Orbigny, 1846, For. Foss. Vienne, p. 185, pl. xi. figs. 11, 12. *B. pupoides* (d'Orb.) Woodward and Thomas, 1885, 13th Ann. Rept. Geol. and Nat. Hist. Survey of Minnesota, p. 169, pl. iii. fig. 11. *B. pupoides* (d'Orb.) Terrigi, 1889, Mem. R. Accad. Lincei, ser. 5, vol. vi. p. 110, pl. v. fig. 6. *B. pupoides* (d'Orb.) Terrigi, 1891, Mem. R. Com. Geol. d'Italia, vol. iv. p. 72, pl. i. fig. 22. *B. pupoides* (d'Orb.) Woodward and Thomas, 1893, vol. iii. Final Rept. Geol. and Nat. Hist. Survey of Minnesota, p. 32, pl. C, figs. 21–24. *B. pupoides* (d'Orb.) Egger, 1893, Abhandl.

EXPLANATION OF PLATE II.

Fig. 1.—*Bulimina elegans* d'Orbigny. × 100.
„ 2. „ *fusiformis* Williamson. × 90.
„ 3. „ *subornata* Brady. × 135.
„ 4. „ *elegantissima* d'Orbigny. × 115.
„ 5. „ „ var. *compressa* var. n. × 115.
„ 6. „ *subcylindrica* Brady. × 75.
„ 7. „ *marginata* d'Orbigny var. *biserialis* var. n. × 90.
„ 8. „ *Williamsoniana* Brady. × 60.
„ 9. „ *convoluta* Williamson. × 60.
„ 10. „ „ var. *nitida* var. n. × 60.
„ 11.—*Pleurostomella contorta* sp. n. × 75.
„ 12. „ „ young specimen. × 75.
„ 13.—*Virgulina Schreibersiana* Czjzek var. × 85.
„ 14. „ *squamosa* d'Orbigny. × 60.
„ 15.—*Bifarina Mackinnonii* sp. n. × 80.

k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 285, pl. viii. fig. 63. *B. pupoides* (d'Orb.) Egger, 1895, Jahresbericht xvi. Naturhist. Ver. Passau, p. 14, pl. iv. figs. 6–8. *B. pupoides* (d'Orb.) Flint, 1899, Rept. U.S. Nat. Mus. for 1897, p. 290, pl. xxxvii. fig. 3. *B. pupoides* (d'Orb.) Egger, 1899, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xxi. p. 49, pl. xv. figs. 1, 2. *B. pupoides* (d'Orb.) Wright, 1909, Geol. Mag., dec. 4, vol. vii. p. 100, pl. v. fig. 3.

Bulimina affinis d'Orbigny.

Bulimina affinis d'Orbigny, 1839, Foram. Cuba, p. 109, pl. ii. figs. 25, 26. *B. affinis* (d'Orb.) Sherborn and Chapman, 1886, Journ. R. Micr. Soc., vol. vi. p. 743, pl. xvi. fig. 1. *B. affinis* (d'Orb.) Rzehak, 1886, Verh. Nat. Ver. Brünn, vol. xxiv. p. 80, pl. i. fig. 2. *B. affinis* (d'Orb.) Burrows, Sherborn, and Bailey, 1890, Journ. R. Micr. Soc., p. 554, pl. viii. fig. 23. *B. affinis* (d'Orb.) Chapman, 1892, Journ. R. Micr. Soc., p. 756, pl. xii. fig. 10. *B. affinis* (d'Orb.) Woodward and Thomas, 1893, vol. iii. Final Rept. Geol. and Nat. Hist. Survey of Minnesota, p. 32, pl. C, fig. 19. *B. affinis* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 285, pl. viii. fig. 71. *B. affinis* (d'Orb.) Egger, 1895, Jahresbericht xvi. Naturhist. Ver. Passau, p. 14, pl. iv. figs. 4, 5. *B. affinis* (d'Orb.) Flint, 1899, Rept. U.S. Nat. Mus. for 1897, p. 290, pl. xxxvii. fig. 2. *B. ovulum* (Reuss) Egger, 1899, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xxi. p. 50, pl. xv. fig. 46.

Bulimina elegans d'Orbigny, plate II. fig. 1.

Bulimina elegans d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 270, No. 10; Modèle, No. 9. *B. elegans* (d'Orb.) Parker, Jones, and Brady, 1865, Ann. and Mag. Nat. Hist., ser. 3, vol. xvi. p. 20, pl. ii. fig. 64. *B. elegans* (d'Orb.) Chapman, 1892, Quart. Journ. Geol. Soc., vol. xlviii. p. 516, pl. xv. fig. 9. *B. elegans* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 284, pl. viii. figs. 66, 67. *B. elegans* (d'Orb.) Jones, 1895, Palæont. Soc., p. 162, fig. 17. *B. elegans* (d'Orb.) Egger, 1895, Jahresbericht xvi. Naturhist. Ver. Passau, p. 16, pl. iii. fig. 9. *B. elegans* (d'Orb.) Flint, 1899, Rept. U.S. Nat. Mus. for 1897, p. 294, pl. xxxvi. fig. 3. *B. elegans* (d'Orb.) Egger, 1899, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xxi. p. 50, pl. xv. fig. 44.

Of this group the central form is *B. elegans*, which is by far the most important in numbers as well as in distinctive characters. The aperture is always large and curiously contorted, suggesting a stage in the evolution of a complicated double aperture found in some allied species, a description of which will be given in due course. The *B. coprolithoides* of Andreae * has a somewhat similar aperture, and closely resembles this form in other respects. *B. pupoides* and

* Abhandl. Geol. Special-Karte Elsass-Loth., vol. ii. Heft 3, 1884, p. 305, pl. vi. fig. 4.

B. affinis are here variants of *B. elegans*, and are both represented by individuals feeble and few in number. In these the aperture is normal. They are all widely distributed in the Malay region, although, with the exception of *B. elegans*, they are nowhere abundant.

Bulimina elegans d'Orbigny var. *exilis* Brady.

Bulimina elegans var. *exilis* Brady, 1884, Chall. Rept., p. 399, pl. i. figs. 5, 6.

This variety has hitherto been found only in deep water, and is said by Brady to be not rare in the North Atlantic, and also to have been met with in the North and South Pacific. It does not appear to have been noticed by other observers.

In the Malay Archipelago it is very rare in its normal condition, but there are varieties of *Virgulina* closely resembling it, which are not uncommon.

Bulimina fusiformis Williamson, plate II. fig. 2.

Bulimina pupoides var. *fusiformis* Williamson, 1858, Rec. Foram. Gt. Britain, p. 63, pl. v. figs. 129, 130. *B. fusiformis* (Will.) Wright, 1900, Geol. Mag., dec. 4, vol. vii. p. 100, pl. v. fig. 5.

Is found in more or less abundance on the coasts of Great Britain, and is stated by Joseph Wright to be "common" in the Post-Glacial beds of Cheshire.

The triserial specimen figured under this name by Terquem * can hardly be assigned to this species.

The Malay examples, although neither numerous nor widely distributed, are sufficiently characteristic, and as usual, indicate an affinity with the genus *Virgulina*.

Of its existence elsewhere either in the recent or the fossil condition, there is no evidence to record.

Bulimina ovata d'Orbigny.

Bulimina ovata d'Orbigny, 1846, For. Foss. Vienne, p. 185, pl. xi. figs. 13, 14. *B. ovata* (d'Orb.) Terrigi, 1891, Mem. R. Com. Geol. d'Italia, vol. iv. p. 72, pl. i. fig. 20. *B. ovata* (d'Orb.) Egger, 1895, Jahresbericht xvi. Naturhist. Ver. Passau, p. 15, pl. iii. fig. 11. *B. ovata* (d'Orb.) Burrows and Holland, 1897, Proc. Geol. Assoc., vol. xv. p. 32, pl. ii. fig. 11. *B. ovata* (d'Orb.) Egger, 1899, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xxi. p. 49, pl. xv. fig. 45.

Is not well represented, the specimens being small and feeble as well as few in number. It appears to be restricted to Area 1.

Bulimina pyrula d'Orbigny.

Bulimina caudigera d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 270, No. 16; Modèle, No. 68. *B. pyrula* d'Orbigny, 1846, For.

* Ess. Plage Dunkerque, 1875, p. 37, pl. v. fig. 10.

Foss. Vienne, p. 184, pl. xi. figs. 9, 10. *B. pyrula* (d'Orb.) Terrigi, 1891, Mem. Com. Geol. d'Italia, vol. iv. p. 71, pl. i. figs. 18, 19. *B. pyrula* (d'Orb.) Chapman, 1892, Journ. R. Micr. Soc., p. 756, pl. xii. fig. 9. *B. pyrula* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 285, pl. viii. fig. 107. *B. cuspidata* Franzenau, 1894 (Soc. Hist. Nat. Croatia), p. 253, pl. i. fig. 23. *B. pyrula* (d'Orb.) Egger, 1895, Jahresbericht xvi. Naturhist. Ver. Passau, p. 16, pl. iv. fig. 1. *B. pyrula* (d'Orb.) Chapman, 1895, Ann. and Mag. Nat. Hist., ser. 6, vol. xvi. p. 326, pl. xii. fig. 11, *B. pyrula* (d'Orb.) Flint, 1899, Rept. U.S. Nat. Mus. for 1897, p. 290, pl. xxxvi. figs. 4, 5.

The examples of this species are few, small, and ill-developed, but they are found scattered over the whole region. They vary in the direction of *B. subcylindrica.*

Bulimina subornata Brady, plate II. fig. 3.

Bulimina subornata Brady, 1884, Chall. Rept., p. 402, pl. li. fig. 6. *B. subornata* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 286, pl. viii. fig. 79.

The examples agree with those of the 'Challenger' dredgings in having the shell-wall conspicuously foraminated, but are devoid of the aboral stout spine, and the chambers have a tendency to overlap, in this respect resembling those of *B. marginata.* Brady writes that it "is a rare species, occurring at only two of the 'Challenger' stations, both in the Pacific, namely, the *Hyalonema*-ground south of Japan, 345 fathoms, where it is tolerably plentiful, and off Aru Islands, 800 fathoms."

There are two 'Gazelle' stations at which it occurs, both off the West Coast of Australia.

It is common in the Malay Archipelago, and is found at many of the stations in both areas.

Bulimina elegantissima d'Orbigny, plate II. fig. 4.

Bulimina elegantissima d'Orbigny, 1839, Foram. Amér. Merid., p. 51, pl. vii. figs. 13, 14. *B. elegantissima* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss. Cl. II. vol. xviii. p. 289, pl. viii. figs. 101, 102. *B. elegantissima* (d'Orb.) Wright, 1900, Geol. Mag., dec. 4, vol. vii. p. 100, pl. v. fig. 6.

This variable, but at the same time easily recognised species, is very abundant in the Malay Archipelago, and is widely diffused in both areas. It occurs in all its varieties, ranging from the compact build identical with that of the sandy *B. Presli* to the elongated form figured.

As an illustration of the persistency of this species in time, it may be mentioned that there would be little difficulty in selecting from the

Malay Archipelago material specimens to match most of the forms figured by Terquem * in his work on the Foraminifera of the Paris Eocene, under the names of *B. pulchra*, *B. turbinata*, *B. intorta*, *B. ovula*, and several others.

Bulimina elegantissima var. *compressa* var. n., plate II. fig. 5.

Differs from the type chiefly in being much compressed. It is a rare variety, and seems to be restricted to Area 1.

Bulimina subteres Brady.

Bulimina Presli var. *elegantissima* (d'Orb.) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 374, pl. xv. figs. 12–17. *B. subteres* Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 55. *B. subteres* (Brady) Wright, 1882, Proc. Belfast Nat. Field Club, App. 1880–1881, p. 180, pl. viii. fig. 2. *B. subteres* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 289, pl. viii. figs. 73, 74. *B. subteres* (Brady) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 46, pl. ix. figs. 445–453.

Is not very abundant, although found at several Stations in both areas. The specimens are small, but have all the characters of the species.

Bulimina subcylindrica Brady, plate II. fig. 6.

Bulimina subcylindrica Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 56. *B. subcylindrica*, Brady, 1884, Chall. Rept., p. 404, pl. l. fig. 16. *B. subcylindrica* (Brady) Halkyard, 1889, Trans. and Ann. Rept. Manchester Micr. Soc., p. 64, pl. i. fig. 12. *B. subcylindrica* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 289, pl. viii. fig. 100.

This rare form is represented by a solitary specimen from Station 30 in Area 1. Some fine specimens in my cabinet from 'Challenger' Station 185, Raine Island, have the clear shell-substance mottled with opaque white patches, identical with those so commonly found in *Pulvinulina elegans*.

Brady names six 'Challenger' Stations, three of which are in the Atlantic, and three in the South Pacific. Halkyard records a few doubtful examples from Jersey and Guernsey. The only 'Gazelle' Station is off the West Coast of Africa, north of the Equator.

Bulimina marginata d'Orbigny.

Bulimina marginata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 269, No. 4, pl. xii. figs. 10–12. *B marginata* (d'Orb.) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 220, pl. xliii.

* Mém. Soc. Géol. France, sér. 3, vol. ii. 1882, pl. xx.

figs. 7, 10. *B. marginata* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 287, pl. viii. figs. 69, 70. *B. marginata* (d'Orb.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 46, pl. ix. figs. 439–444. *B. marginata* (d'Orb.) Jones, 1895, Palæont. Soc., p. 165, pl. iii. figs. 5, 6. *B. marginata* (d'Orb.) Wright, 1900, Geol. Mag., dec. 4, vol. vii. p. 100, pl. v. fig. 4.

Of this well-known species there is little to be noted. It is abundant all over the Region, and the specimens exhibit the usual variations of form.

Bulimina marginata var. *biserialis* var. n., plate II. fig. 7.

Differs from the type in being biserial. It is also more symmetrical, tapering regularly from the oral to the aboral end. The crenulations of the free edge of the chambers often develope into spines. Its nearest representative amongst the triserial forms appears to be the *B. pulchella* of d'Orbigny.*

According to the definitions of the genera, this form should be placed amongst the Bolivinæ, but it is so manifestly a variety of *Bulimina marginata* that there need be no hesitation in associating it with that species.

It is less numerous and less widely distributed than the type, but occurs in both areas.

Bulimina aculeata d'Orbigny.

"Polymorpha *Pineiformia*" Soldani, 1791, Testaceographia, vol. i. part ii. p. 118, pl. cccxxvii. fig. ii., and pl. cxxx. figs. *v v*. *B. aculeata* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 269, No. 7. *B. aculeata* (d'Orb.) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 220, pl. xliii. fig. 8. *B. aculeata* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 287, pl. viii. figs. 72, 78. *B. aculeata* (d'Orb.) Jones, 1895, Palæont. Soc., p. 163, pl. iii. figs. 1, 2. *B. aculeata* (Czjczek) Egger, 1895, Jahresbericht xvi. Naturhist. Ver. Passau, p. 17, pl. iii. figs. 8, 10, 13, 14. *B. aculeata* (d'Orb.) Flint, 1899, Rept. U.S. Nat. Mus. for 1897, p. 291, pl. xxxvii. fig. 4. *B. aculeata* (Czjczek) Egger, 1899, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xxi. p. 53, pl. xv. figs. 5, 6, 21.

The examples all have the keeled or margined chambers characteristic of *B. marginata*, and may therefore be considered varieties of that species. The form with globular chambers and spines at the base only, which is probably derived from *B. pupoides*, is not represented.

The species is less common in the Malay Archipelago anchor-mud than *B. marginata*, which may perhaps be owing to the fact that it is more of a deep-water species.

* Foram. Amér. Mérid., 1839, p. 50, pl. i. figs. 6, 7.

Bulimina inflata Seguenza.

Bulimina inflata Seguenza, 1862, Atti Accad. Gioenia Sci. Nat., ser. 2, vol. xviii. p. 109, pl. i. fig. 10. *B. inflata* (Seg.) Andreae, 1884, Abhandl. geol. Specialkarte Elsass-Loth., vol. ii. pp. 211, 224, pl. ix. figs. 6, 7. *B. inflata* (Seg.) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 220, pl. xliii. fig. 9. *B. inflata* (Seg.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 288, pl. viii. fig. 85. *B. inflata* (Seg.) Silvestri, 1893, Atti e Rendic. Accad. Sci. Lett. e Arti dei Zelanti e PP. dello Studio di Acireale, vol. v. p. 12, pl. v. figs. 68, 69. *B. inflata* (Seg.) Flint, 1899, Rept. U.S. Nat. Mus. for 1897, p. 291, pl. xxxvii. fig. 5.

Is very rare in the Malay Archipelago, and has been observed only at Station 2 in Area 1.

Bulimina Williamsoniana Brady, plate II. fig. 8.

Bulimina Williamsoniana Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n. s. p. 56; and 1884, Chall. Rept., p. 408, pl. li. figs. 16, 17.

This interesting species, although of well-marked characters, has been strangely overlooked by Rhizopodists, and all that is known about it seems to be comprised in the 'Challenger Report.' According to Brady it appears to be limited in its distribution to the South Pacific.

It is by no means uncommon in Torres Strait and at various places on the Australian coasts.

In the Malay Archipelago it is abundant at Station 2, and occurs also, but very sparingly, at Station 6. It has not been noted at other Stations more remote from the Australian region.

Bulimina convoluta Williamson, plate II. fig. 9.

Bulimina pupoides var. *convoluta* Williamson, 1858, Rec. Foram. Gt. Britain, p. 63, pl. v. figs. 132, 133. *B. convoluta* (Will.) Brady, 1884, Chall. Rept., p. 409, pl. cxiii. fig. 6. *B. convoluta* (Will.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 288, pl. viii. figs. 83, 84.

This admittedly abnormal form, although classed with the *Textularidæ*, does not possess the true Textularian plan of growth, inasmuch as the chambers do not alternate in the sense that each successive addition shifts the aperture from one side of the test to the other. The plan of growth is rather Rotaliform; a primary row of chambers having applied to it a secondary row analogous to the "asterigerine" flaps found in the genus *Discorbina*.

The aperture, which is not always apparent, consists sometimes of a horizontal slit, at other times of a small funnel-shaped depression, and is situated on the septal face of the primary chamber, at the apex of the suture formed by the junction of the last added secondary chamber.

The typical form is very abundant at Station 13, and is found, though sparingly, at a few other Stations.

The only 'Challenger' Station is at Raine Island, Torres Strait. Dr. Egger records it from seven 'Gazelle' Stations extending from West Africa to West Australia; rare at all of them.

Bulimina convoluta var. *nitida* var. n., plate II. fig. 10.

This variety is almost purely Rotaliform, the secondary series of chambers being very small and often scarcely discernible. The aperture, like that of the type, is situated at the superior junction of the last added primary and secondary chambers, and is usually a straight horizontal slit as figured. The shell substance is opaque and lustrous, almost iridescent.

The two forms occur together, but one or the other always predominates; at Station 13 the type is abundant and the variety rare; at all the other Stations where they both occur, this is reversed.

Pleurostomella Reuss.

Pleurostomella contorta sp. n., plate II. figs. 11, 12.

Test conical, slightly compressed, rounded at the oral, pointed at the aboral extremity. Chambers short and inflated, arranged in two parallel series, each of which overlaps the other on one side; sutures oblique and depressed. Aperture a transverse fissure in the septal face of the terminal chamber, close to its junction with the last-formed chamber of the opposite series. Length 0·45 mm.

This is an anomalous species, and has little more than its flattened septal face to indicate its affinity with the genus. In the young condition, fig. 12, the characters are more marked than in the adult.

It is by no means uncommon in the Malay Archipelago, and is found at Stations in both Areas.

Virgulina d'Orbigny.

Virgulina Schreibersiana Czjzek.

Virgulina Schreibersiana Czjzek, 1848, Haidinger's Naturwiss. Abhandl., vol. ii. p. 147, pl. xiii. figs. 18–20. *V. Schreibersii* (Cz.) Malagoli, 1887, Atti Soc. Nat. Modena, ser. 3, vol. iii. p. 108, pl. i. fig. 5. *V. Schreibersiana* (Cz.) Egger, 1893, Abhandl. k. bayer. Ak. Wiss., Cl. II. vol. xviii. p. 290, pl. viii. figs. 93, 95. *V. Schreibersiana* (Cz.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 48, pl. ix. figs. 459, 461–472. *V. Schreibersiana* (Cz.) Fornasini, 1897, Rendic. Accad. Sci. Bologna, n.s. vol. ii. pl. ii. fig. 9. *V. Schreibersiana* (Cz.) Fornasini, 1898, Mem. R. Accad. Sci. Istit. di Bologna, ser. 5, vol. vii. p. 206, pl., fig. 6. *V. Schreibersiana* (Cz.)

Morton, 1897, Proc. Portland Nat. Hist. Soc., vol. ii. p. 115, pl. i. fig. 9. *V. Schreibersiana* (Cz.) Flint, 1899, Rept. U.S. Nat. Mus. for 1897, p. 291, pl. xxxvii. fig. 6.

This species occurs in vast profusion and in great variety of form. The variety figured (plate II. fig. 13) is so numerous, so persistent in form, and so widely distributed in the Malay Archipelago, that it is deemed worthy of notice.

Virgulina squamosa d'Orbigny, plate II. fig. 14.

Virgulina squamosa d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 267, No. 1;—Modèle, No. 64. *V. squamosa* (d'Orb.) Goës, 1894. K. Svenska Vet.-Akad. Handl., vol. xxv. p. 47, pl. ix. figs. 454, 456, 460. *V. squamosa* (d'Orb.) Egger, 1895, Jahresbericht xvi. Naturhist. Ver. Passau, p. 19, pl. i. fig. 20.

This rather unsatisfactory form is represented by a few specimens from Station 13. In general appearance they bear some resemblance to *Bolivina nitida* Brady,* but the 'Challenger' form is more compact and less Virguline in character.

Bifarina Parker and Jones.

Bifarina Mackinnonii sp. n., plate II. fig. 15.

Test elongate, tapering towards the aboral extremity. Virguline chambers numerous and compressed into a cylindrical mass. Uniserial chambers triangular and much compressed, margins acute and carinate. Sutures limbate, forming a zigzag line. Aperture an elongated slit, terminal, and extending the full width of the chamber. Length 0·63 mm.

This interesting form is very rare. I have found a few poor specimens from the 'Challenger' dredgings from Station 185, Raine Island, and to Mr. A. Earland I am indebted for some good examples from Macassar Straits.

In the Malay Archipelago it has been noticed only at Station 22.

To the late Sir William Mackinnon, Chairman of the Board of Directors of the Netherlands India Steam Navigation Co., Mr. Durrand is indebted for the facilities afforded him for obtaining the material which forms the subject of this Report; and in recognition of this kindness, this species is respectfully dedicated to his memory.

* Chall. Rept., 1884, p. 420, pl. lii. fig. 30.

NOTES.

The Microscopes of Powell, Ross, and Smith.

By Edward M. Nelson.

I.—HUGH POWELL'S MICROSCOPES.

Hugh Powell, born in 1799, was, like Andrew Ross, a philosophical instrument maker. He resided at 24 Clarendon Street, Somers Town, and probably worked for the trade, but the first notice we have of him is in connection with the first of three Microscopes made by him for Cornelius Varley.* These Microscopes are figured and described in the *Transactions* of the Society of Arts, the account of the first being in vol. xlviii. p. 332, pl. 4 (1831).

Figs. 70, 71 show that this is a non-achromatic simple Microscope; five lenses are mounted in a calotte rotating wheel, the coarse adjustment is by moving the stage up and down the pillar, and by clamping it with a pinching screw. The rod carrying the lenses, which slides into the top of the pillar, is moved by a fine adjustment screw, the milled head of which is seen at the bottom of the pillar.

The plan of this fine adjustment is very important, because it is the first instance we have of a sprung fine adjustment movement; a nut is placed on the screw at a short distance from its entry into the lower end of the rod which carries the lenses (fig. 72), and by it a spring is compressed (fig. 72); another spring is also placed at the lower end of the screw to keep the milled head in close contact with its seat (fig. 73). By these means all slack between the movable rod and the screw is taken up, thus ensuring that a movement of the rod will immediately follow that of the screw, and this quite independently of the direction in which it is turned; in other words, loss of time when the motion of the screw is reversed is wholly prevented. We shall see that this device was copied in Valentine's Microscope, made by Andrew Ross. The stage has a lever mechanical movement; this, after having been twice modified by Varley, was further altered by White in 1843, and in that form was used by several makers for about thirty years. Below the stage there was a cylinder diaphragm (fig. 74). This is the first time we meet with a true cylinder diaphragm; the appliance which most nearly approaches it being the "cannon" of Joblot in 1719. The base of this Microscope is peculiar, as it has no proper foot, but instead it is fitted with a screw-clamp for

* Cornelius Varley was an artist; he was born in 1781 and died in 1873, his last picture having been painted in his ninetieth year. He was much interested in scientific matters; he ground and polished Microscope lenses, and in 1826 he ground and polished a plano-convex diamond lens for Dr. Goring. He was one of the seventeen founders of this Society who met at Edwin Quekett's house in 1839.

attachment to the edge of a table; curiously, at an exhibition some little time ago, there was a Microscope in use that had precisely this same kind of clamp.

Fig. 70.

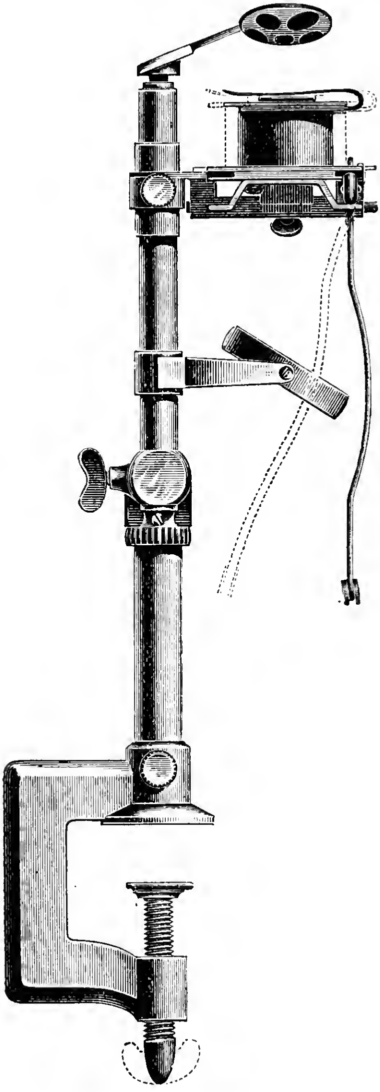
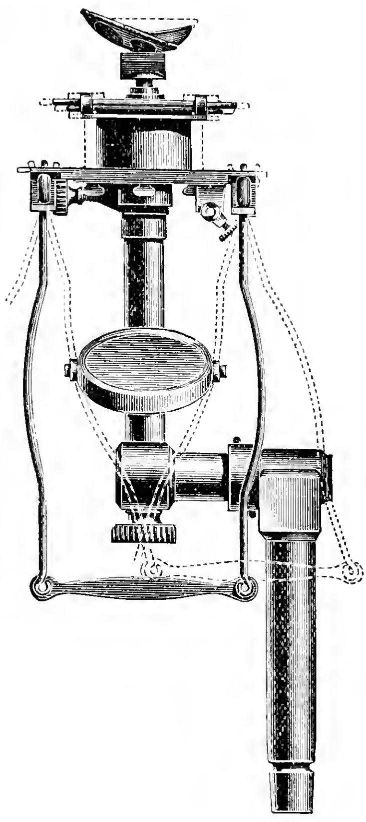


Fig. 71.



Amongst the apparatus figured with this Microscope, there is one little piece that deserves special notice, viz. the stage forceps; this is sprung in a manner still used by Powell, not only for apparatus of this kind, but also for his jointed mirror arm. This method, shown in fig. 75, is very simple and most efficacious; the pivot, which is carried through the plate holding it, is grooved, and a flat spring with a U-shaped nick in it slips into this groove. I have an old Microscope by Powell, dated about 1840, in which the mirror, stage forceps, stage bull's-eye, &c., are all sprung in this manner; and although it is some sixty years old, its moving parts act in the smoothest way possible.

Fig. 72.

On examining the plates in the *Transactions* of the Society of Arts, published both before and after this time, we find that a number of them were drawn by C. Varley and engraved by E. Turrell. Varley lived at 1 Charles Street, Clarendon Square, Somers Town, and Edmund Turrell was, we learn, an engineer and engraver at 46 Clarendon Street. On February 14th, 1832, Turrell published in the *Transactions* of the Society of Arts,* an account of his well-known Microscope-stage, which was at first, and for a long time subsequently, made only by Powell. This is still the best ever designed, and is largely used at the present time; so we see that these two men not only lived in the same neighbourhood as Powell, but also gave their attention to Microscope construction. The question naturally arises, who was the author of all this springing in the Microscope? It is impossible to say what influence Turrell had in the matter, because he probably died shortly after his invention of the mechanical stage, as his name disappears from the plates in the Society of Arts' *Transactions*, and in 1838 we learn that he was dead. Varley certainly was the first microscopist to appreciate and record the great value of springing every movement in a Microscope; he was himself a good mechanic, and had just previously designed a special lathe

Fig. 73.

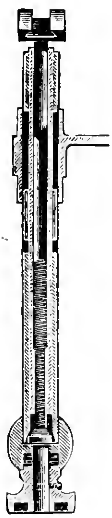


Fig. 74.

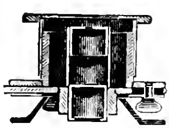
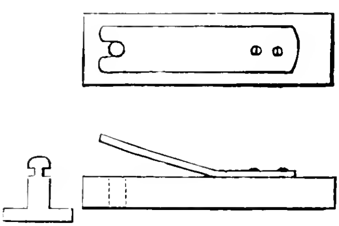


Fig. 75.

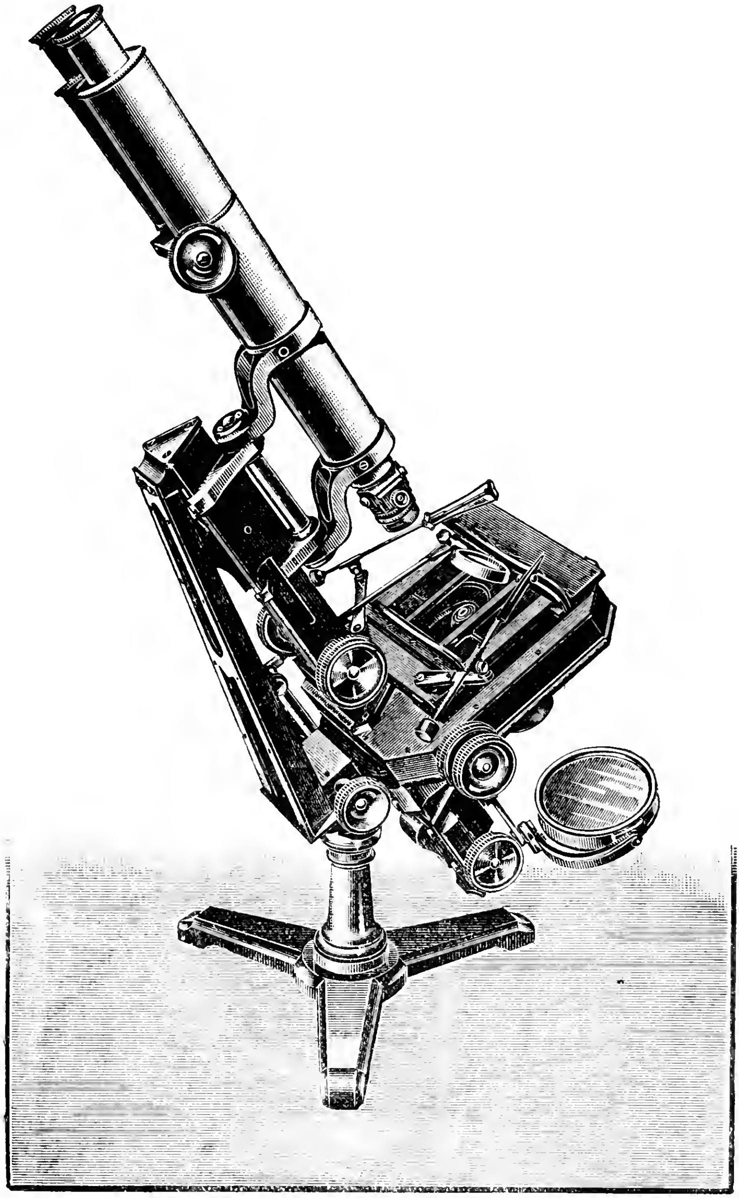


for lens work; moreover he must have acquired a large experience of mechanical appliances from the great number of plates he had drawn

* Vol. xlix. p. 113, pl. 4 (1833).

of all sorts of machines, so that it is probable that, in designing the general plan of his Microscopes, he had indicated details with regard to the springing of the various movements ; but a careful perusal of

Fig. 76.



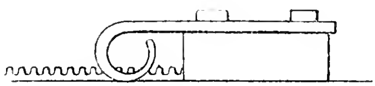
the descriptions of these Microscopes will show that Powell's share in this matter was far from inconsiderable.

Next we have, in the *Transactions* of the Society of Arts, the first description of Powell's work issued under his own name, viz. his stage fine adjustment.* Here there is a Turrell stage raised by wedges, which are advanced beneath it by means of a micrometer screw.

The head of the screw is divided into twenty divisions, and the value of each division is one six-thousandth of an inch. The Microscope made by Powell for this Society in 1841 has a stage of this kind (fig. 76).

The next in order is Varley's second Microscope, which he calls a "Vial Microscope."† This Microscope, simple and non-achromatic, was a modification of his previous model; both the calotte lens-holder and the fine adjustment were suppressed, and a rackwork coarse adjustment with a square bar having 40 teeth to the inch and a sprung pinion was supplied; this is the first instance we have of a sprung pinion, and a better plan of mounting a pinion has not yet been devised; but although it was subsequently adopted by the principal makers, all, with the exception of Powell, have at the present time discarded it (fig. 77). (A sprung pinion can also be very well seen in fig. 80.)

FIG. 77.



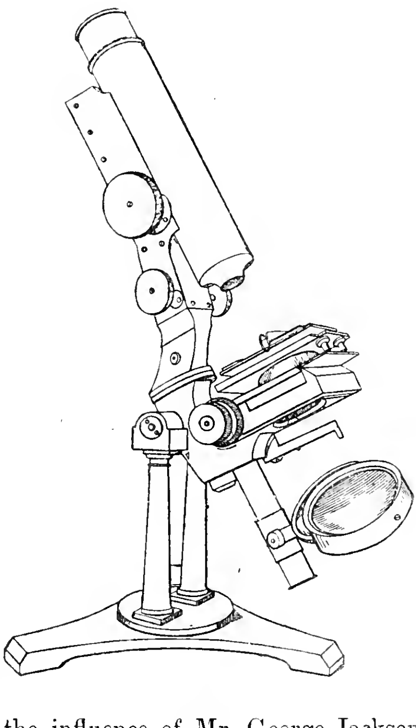
There was a special kind of stage for holding a cylindrical bottle or phial, through the side of which algæ or other objects were examined; for viewing slides or similar objects, the phial was removed, and a stage with lever mechanical motion fitted into its place. The screw-clamp foot was replaced by a circular ring and post, not unlike a modern Microscope lamp support. In this Microscope we first have the mirror-arm joints sprung in the manner indicated above (fig. 75). These Microscopes became popular, and in a modified form were made by Powell for Andrew Pritchard, who published an account of them in the second edition of his *Microscopic Illustrations* (1838).

Now we come to the year 1841, which is an important date in Microscope construction, because about this time the recently constituted Microscopical Society of London "requested Messrs. Hugh Powell, Andrew Ross, and James Smith ‡ each to furnish a standard instrument, made according to their own peculiar views." Powell's Microscope was delivered on December 22nd of that year, and although an account with a figure of it was promised, it has, so far as I am aware, never been published. The Microscope (fig. 76) is still in our cabinet, and, with the exception of the addition of a binocular body in

* Vol. l. part 2, p. 108, plate 3 being in vol. xlix. (1833).
† Trans. Soc. Arts, l. p. 158, pls. 5 and 6 (1834).
‡ The order was given to Smith on August 19th, 1840, and to Powell and Ross on May 26th, 1841.

1862, is in its original condition. The mounting of the body upon a carriage which traverses an upright triangular post is evidently derived from the Ross model of 1839. The flat tripod foot, single pillar, and compass joint, were a survival from preceding non-achromatic Microscopes. It is important to note that this instrument has an achromatic condenser, and is therefore a very early example of one so fitted; because the achromatic condenser was, as we learn from the *Penny Cyclopædia*, introduced into this country from France in 1839. The stage, which has Turrell's mechanical movements, is raised by means of a 50-thread screw pushing under it three inclined planes, placed at the periphery of a rotating plate (slope 1 in 6); the speed is therefore 1/300 in. for each revolution. All the motions throughout the entire Microscope are thoroughly sprung.

Fig. 78.



At this time Powell took into partnership his brother-in-law, Mr. P. H. Lealand; and under their joint names a Microscope (fig. 78), upon an entirely different plan, was brought out; it is figured in the frontispiece of Cooper's *Microscopic Journal* for 1841, and described at page 177, but the working parts are better shown in the plate in the *Transactions* of the Society of Arts.* In the general design of this Microscope, both as regards the mounting of the body on the grooved limb and the double pillar support, the influence of Mr. George Jackson will be at once recognised, and this is the first instrument, so far as is known, in which these two ideas of his were carried out. It should be remembered in this connection that Jackson introduced three things in Microscope construction: first, the grooving of the Lister limb; secondly, the double pillar †; and thirdly, the ploughing of the body and substage slides in one cut. It is interesting to note

* Vol. liii. p. 78 (April 1841).

† According to Quekett, the double pillar was introduced by George Jackson in 1838, but I have been unable to find any example or notice of it prior to this Microscope of Powell's in 1841.

that this Microscope had the weight of the body and the coarse adjustment placed upon its fine adjustment, which was actuated by a cone on a micrometer screw. (The advancing cone, for stage focussing, was first described by Andrew Pritchard in his *Micrographia.**

The limb of this Microscope could be rotated at the flanges, seen just above the level of the stage; this limb, with its coarse and fine adjustment, proved unsatisfactory, and quickly passed away; but the most important part of the model, viz. the trunnion on the limb, which quite displaced the compass joint, constitutes a real advance in Microscope construction, and is now almost the only method in use, both here and on the Continent. This plan, as we have seen above, was due to George Jackson; the double pillar was of course only a matter of detail. The Microscope had a Turrell's stage with non-concentric rotation.

The next Microscope made by Messrs. Powell and Lealand (fig. 79) is a very important one; it is figured and described in the November number of the *London Physiological Journal* for 1843 (only five numbers of this very rare work were published). We notice that both the Lister limb with the Jackson groove and the flat tripod with the two pillars have been discarded, and in their place we have a bar movement and a true tripod to carry the Microscope. Inside the bar or transverse arm is a lever of the first order, which moves only the nose-piece carrying the objective, the other end of the lever being actuated by an advancing cone on the end of a micrometer screw; the stage is similar to that of the preceding Microscope, viz. a Turrell's with non-concentric rotation. The instrument is still supported on trunnions, so the advantage of Jackson's plan is retained, although his form of foot is altered. There can be no doubt that Microscopes built on the bar movement model had far superior fine adjustments to those made with a Lister limb, which at that time, and for forty years afterwards, were fitted only with short lever fine adjustments attached to the end of their body-tubes.

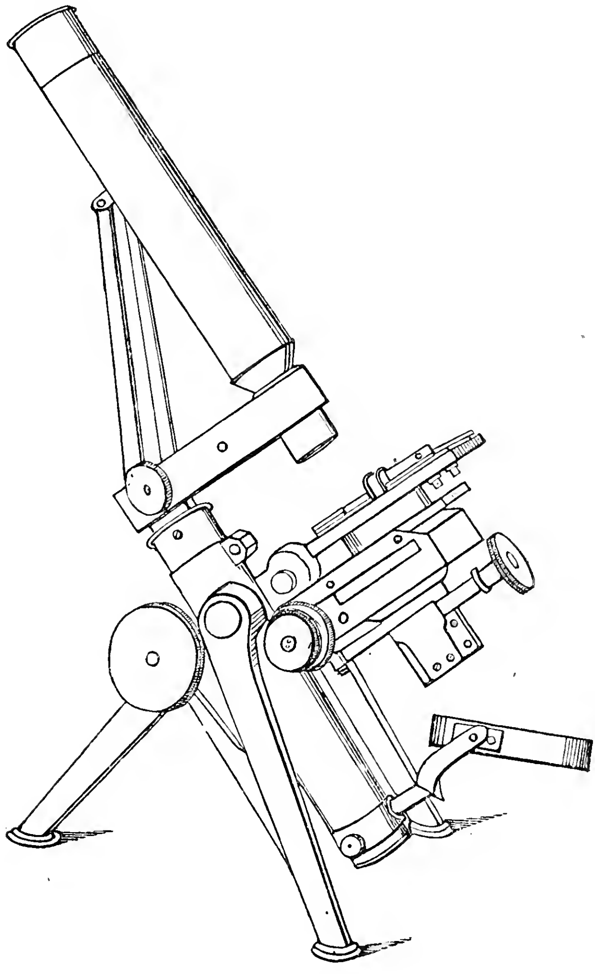
As the publication of this Microscope pre-dated that of Andrew Ross by one month, it follows that the credit of the invention must be given to Powell. In the article "Microscope" in the *Penny Cyclopædia*, 1839, Andrew Ross utterly condemns the bar movement; nevertheless in 1843 he adopted it, and it was exclusively used by that firm for about thirty years.

In 1847 Messrs. Powell and Lealand greatly improved this fine adjustment by suppressing the advancing cone, and by placing a direct acting micrometer screw in a vertical position on the top of the bar, immediately behind its pivot (fig. 80); and from that day to the present time the fine adjustments made by this firm have remained unchanged. This plan of fine adjustment is first figured and described in connection with a portable Microscope in the first edition of Quekett, p. 80, fig. 45 (1848). Quekett, in his second edition (1852), p. 77,

* Page 217, fig. 23, 1837.

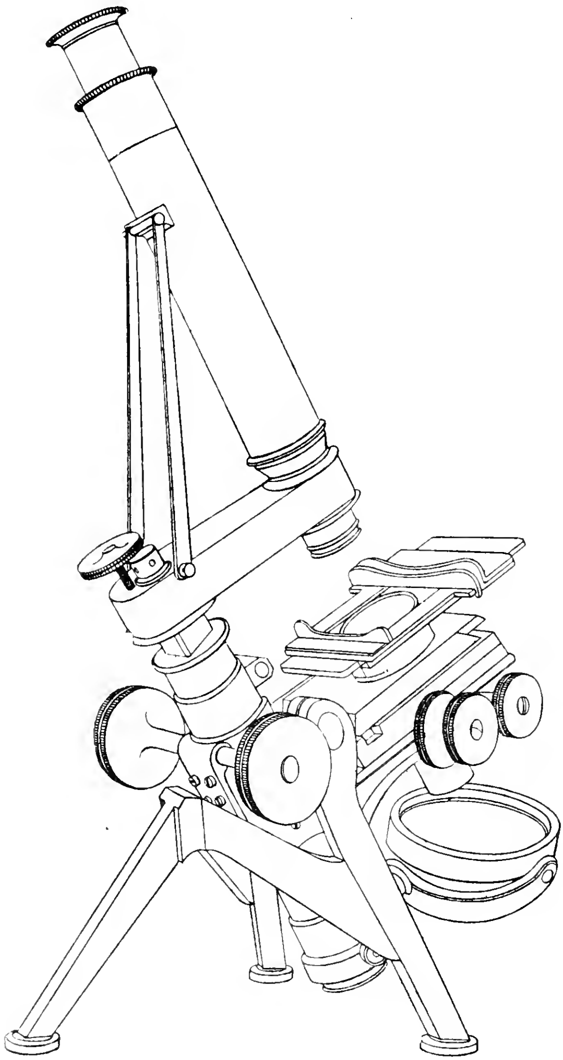
falls into an error in stating that the Microscope he represents in plate 2, which is similar to fig. 80 above, is described in the *London Physiological Journal* (1843). He has failed to note the alteration in the fine adjustment.

FIG. 79.



We are, however, slightly anticipating the next Microscope Powell made for C. Varley, which is figured and described in the December number of the *London Physiological Journal* for 1843. It will be unnecessary to fully describe this instrument; I may merely state that it had a lever motion to its stage, a rackwork coarse adjustment with a sprung pinion, and a short lever nose-piece fine adjustment. It is here mentioned particularly on account of the peculiar manner in

Fig. 80.



which it is attached to its pillar, and also for the shape of its flat tripod foot. The limb of this Microscope, instead of being supported by a compass joint at the top of a single pillar, was attached to the side of the pillar by means of a stout conical * pin, which passed through both the pillar and the limb, and which was capable of being tightened up by a screw. The flat tripod foot was known as the bird's-claw. This excellent form of mount, which from its construction leaves plenty of room on the right-hand side of the Microscope for the manipulation of the substage and the mirror, was afterwards adopted by Powell for his iron Microscope, which I described in the *Journal* for 1899, p. 209, and from which figs. 81 and 82 are reproduced.

Fig. 81.

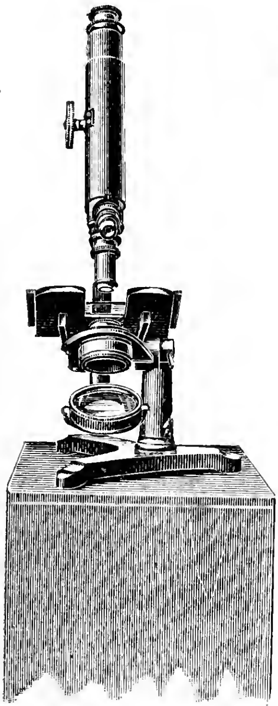
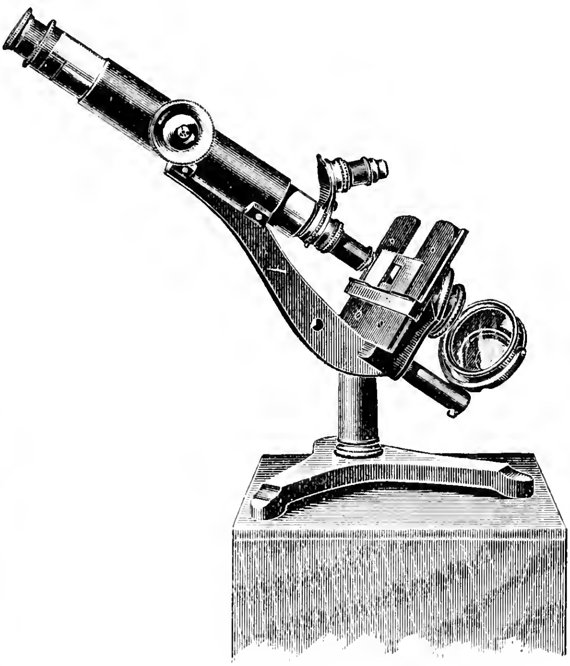


Fig. 82.



The next Microscope made by Messrs. Powell and Lealand is not, I believe, figured or described anywhere; neither can we now assign a precise date for its introduction. I have asked Mr. Thomas Powell about it, and he tells me that his own instrument is dated 1855, and that, as it was only worked at in odd times, it took a long time to make. It is not improbable therefore that this model was brought out after the Exhibition of 1851. It will be unnecessary to illustrate this

* This and similar important details of Microscope construction mentioned in these papers are not mere copies from books, but have been learnt by the examination of existing Microscopes.

instrument, as it is very similar to the No. 1 stand as at present made (see fig. 84). The differences between them are as follows:—the tripod foot is smaller, but similar in every other respect; the stage has non-concentric rotation; in the substage the pinion for rotary motion is placed in a vertical instead of a horizontal position as at present, and the substage apparatus screws into the substage. The back-stay fitted to the bodies of the previous models is omitted. This was the first Microscope made by this firm that had a complete substage; in this point it was probably a copy of the Microscope Andrew Ross prepared for the Exhibition of 1851, at which Messrs. Powell and Lealand were not exhibitors.

The next Microscope was brought out in 1861, and was figured and described by Mr. Lobb in the *Quarterly Journal of Microscopical Science.** The instrument (fig. 83) is about the same size and is very similar to the present model, the principal difference being in the arrangement of the concentric rotation of the stage. A large and massive ring is firmly attached to the limb of the Microscope; inside this ring there is a second ring capable of being rotated by rack-and-pinion; to this second ring is attached a short and stout limb carrying both the stage and substage. When therefore the stage is rotated, the substage rotates with it. This stage, like that of all Powell's Microscopes, had Turrell's rectangular mechanical movements, and the substage had rectangular and an independent rotary movement as well. The pinions for rotating both the stages, as well as for the independent rotation of the substage, are placed in a vertical position; but in an example I have seen, dated 1866, they are placed horizontally. The Turrell stage of this Microscope was made much thinner than those of the previous models; this permitted a very oblique beam of illumination to be thrown upon the object from below the stage—a point which in those days was thought to be of much importance. This Microscope is fitted with a Wenham binocular, in such a manner that the binocular tubes can be removed and a monocular tube substituted for them; this method of mounting the binocular body is still retained in the No. 1 Microscope as at present made. Wenham described this excellent form of binocular in the *Transactions* of the Microscopical Society †; and as this Microscope was finished about May 1861, it follows that it must have been one of the first Microscopes to be fitted with a Wenham binocular. Powell was the first to adapt rackwork to the tubes to adjust the instrument for different widths between the eyes. In my opinion, the Wenham binocular is the best and most generally useful binocular that has as yet been invented.

The next and last Microscope is the present No. 1, which was brought out in 1869, and which, strange to say, has never been figured or described in our *Journal*. It will be seen from fig. 84 that it does

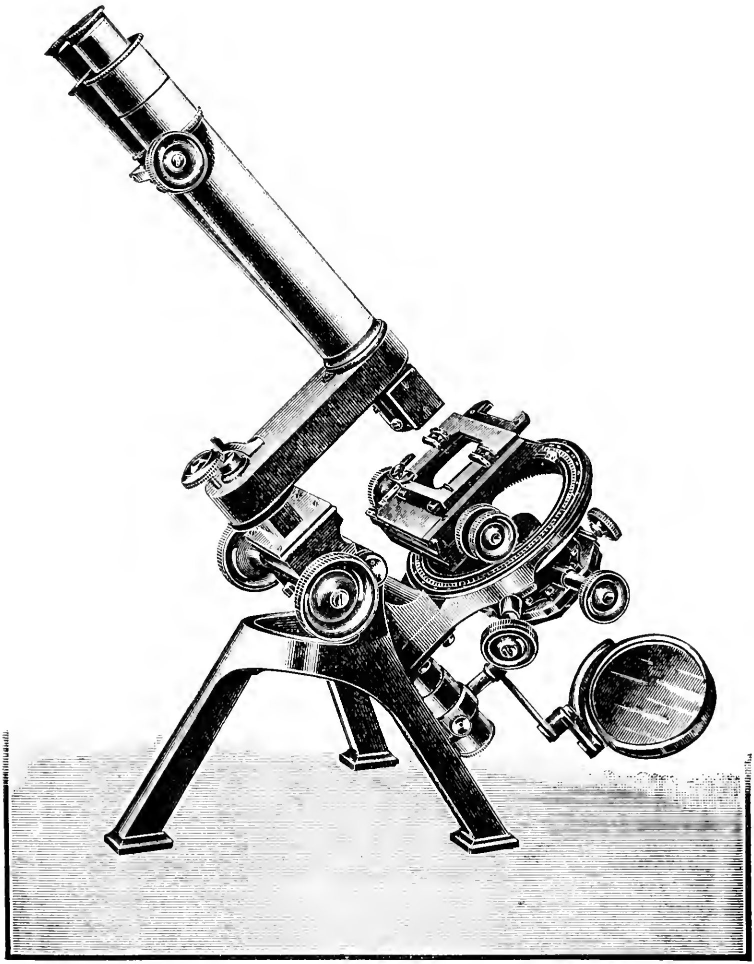
* Vol. i. n.s. (1861) p. 175.

† Vol. ix. p. 15 (1861), paper read December 12th, 1860.

not differ greatly from the preceding model; the ring was made thinner, and the rotating stage mounted in the same plane as the ring; as the substage is entirely detached from the stage, it does not rotate with it. The difference between Powell's concentric rotating stages and those of Ross, is that Powell's are capable of complete rotation through the entire circle, while those of Ross can only be rotated through about 3/4 of the circle, as the limb fouls the heads of the pinions of the rectangular movements of the stage.

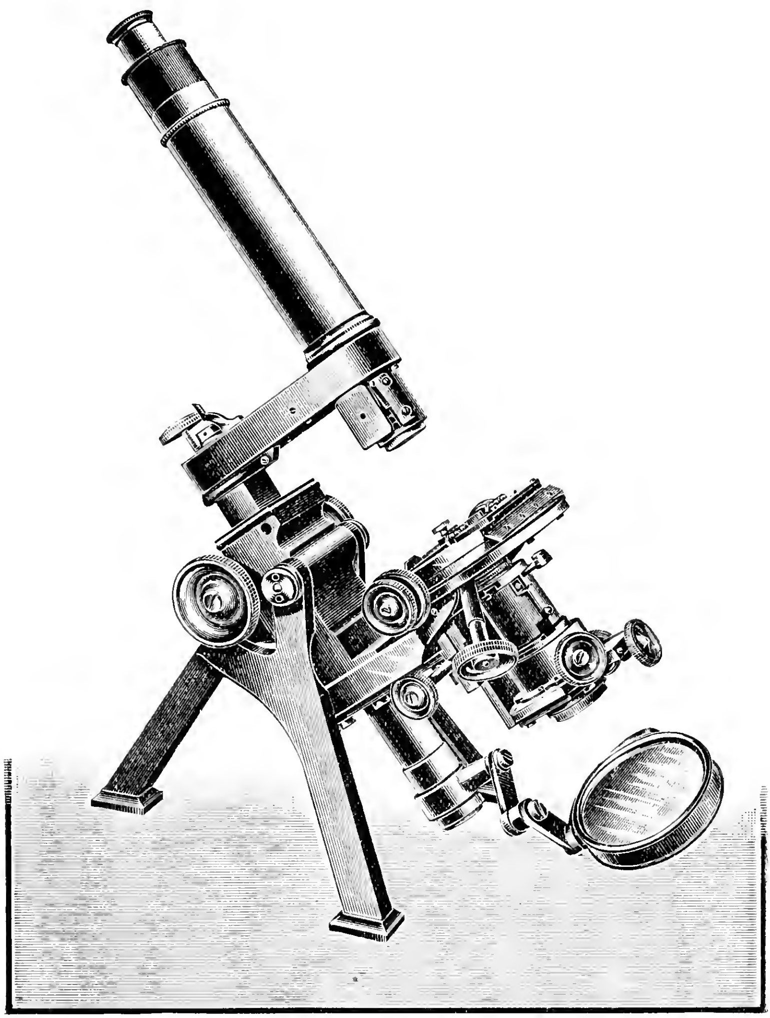
This rotary stage is beautifully finished; it is a conical movement

Fig. 83.



which bears upon six steel points let into the fixed brass ring. The pinion for the rotation of the stage cannot, as in some other Microscopes, be thrown in and out of gear, but the movement is so perfectly adjusted that the stage can be rotated easily and smoothly without handling the pinion. The only alterations that have been made in this stand were at the author's suggestion, viz. 1st, a fine adjustment was added to the substage in 1882, this being the first Microscope to be

Fig. 84.



so fitted; 2nd, rackwork to the draw-tube in 1887; and 3rd, diagonal rackwork was fitted to the coarse adjustments in 1897. The figure is taken from the instrument recently presented to this Society by the late Dr. Whittle.

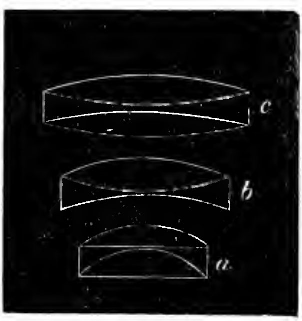
OBJECT-GLASSES.

With regard to Powell's early object-glasses nothing has been published; and as most of them have been put together so that they cannot be unscrewed, I have only been able to examine a few. The following is a list of some glasses in my cabinet, with their apertures and optical indices, and with a record of such observations as I have been able to make.

Date.	Focus.	N.A.	O.I.	Remarks.
1838	2	·10	20	A fine lens.
"	1	·25	25	Very good lens.
"	1/2	·225	11·2	Well corrected.
"	1/4	·34	9	Well corrected.
"	1/8	·5	6	Double fronts. Three graduated diaphragms at the back.
1840	1/16	·6	3·5	(Double fronts. Three graduated diaphragms at the back.)
	1/2	·34	15·6	
1848	1/4	·5	10·5	Triple front and back, double middle, marked covered and uncovered (fig. 85).
Ante 1857	1/4	·7	14	Single front, double middle, triple back, collar graduated.
"	1/12	·93	6·6	Triple front and back, double middle, collar graduated (fig. 85).

In 1846 we find a 1/4 with a triple front and double middle and back.

Fig. 85.



With regard to the single front for medium powers, such as the 1/4 of 0·7 N.A., Powell did not seem to find it satisfactory, because he afterwards went back to the triple front and back and double middle (fig. 85).

Powell was the pioneer of very high powers; as early as 1840 he made a 1/16, in 1860 a 1/25, and in 1864 a 1/50. In 1857 he claims an aperture as great as 175° for his 1/16, in which year our President, Mr. Shadbolt, says "its performance is deserving of the highest praise." In the Paris Exhibition of 1855 a water-immersion lens by Prof. Amici was exhibited, and in the London Exhibition of 1862 water-immersion lenses were exhibited by Messrs. Hartnack and others, those of Messrs. Hartnack being better than those of other foreign exhibitors, but his 1 mm. focus immersion was stated to be inferior to Messrs. Powell and Lealand's dry 1/25. Now, the true principles underlying water-immersion were not understood at that time; it was thought that the only advantage to be gained in adopting it would be a reduction in the quantity of light reflected at the plane surface of the front lens, and therefore the new construction was held to be not worth further consideration. In America, however, the water-immersion was taken up by Wales and Tolles; but Mr. Stodder, writing upon the resolution of Nobert's bands in April 1868, thinks it necessary to explain the term water-immersion, which shows that there it was quite a new thing at that time.

Later in the same year Col. Woodward claims to have been the first to obtain a true resolution of the 15 band (90,078 lines to the inch), and says that the Powell and Lealand 1/25 gave the best results, though among the lenses he was using there were a No. 11 Hartnack immersion (1866) and a Wales immersion 1/10. It would seem that these immersion lenses were of 0·98 N.A., and Powell and Lealand's 1/25 was close on N.A. 1·0. The immersion objectives by Messrs. Hartnack in the Paris Exhibition of 1867 were much improved. Mr. J. Mayall, jun., writing in October 1868, prefers immersion objectives to dry.

Early in 1869 Messrs. Powell and Lealand brought out their first immersion, a 1/16, and with this Col. Woodward,* in April 1869, succeeded in resolving the 19th band (112,597 lines to the inch), a performance which all the other lenses in his possession failed to accomplish.

In July 1872 we first hear of a water-immersion 1/10 having a duplex front made by Tolles. (Mr. Wenham's proposed duplex front for a dry lens in March 1869 may have suggested the idea to Mr. Tolles.) In October 1872, Col. Woodward stated that, with Tolles' new water-immersion 1/16 (which presumably had a duplex front), he had been able to surpass all his former work, including that done with Powell's 1/16 immersion of 1869.

In December 1874, Messrs. Powell and Lealand brought out their new formula water-immersion lenses: these had duplex fronts, and were remarkably fine lenses. The next step was the introduction of homogeneous immersion by Mr. Stephenson and Prof. Abbe in April 1878; but it is necessary to point out that homogeneous-immersion lenses had been previously made by Tolles, who used soft balsam instead of oil of cedar as the immersion fluid. In April 1879 Messrs. Powell and Lealand exhibited their first oil-immersion, an 1/8; and having now brought the history both of the Microscope objective and of Mr. Powell's connection with it to comparatively recent times, we must stop.

Powell was famous for his achromatic condensers; and for many

* Col. Woodward's claims were disputed at the time, but anyone carefully reading his masterly articles and the letters of his disputants can only come to the conclusion that the colonel's claims were just.

years he alone made condensers suitable for the highest kinds of critical work. The following short account contains the history of the achromatic condenser. In 1838 an achromatic objective was used as a condenser by Dujardin; in 1839 this plan was adopted by Andrew Ross. The achromatic condensers we find in 1840 are merely the achromatic quarters of that period having an aperture not greater than 0·35 N.A.; these had no stops or diaphragms of any kind. In 1849 Gillett's condenser was introduced; its aperture was about 0·65 N.A., and it had a rotating wheel of stops. In 1854 Powell brought out a new achromatic condenser of 0·76 N.A., which, like Gillett's, was provided with a wheel of stops. In 1859 he improved it by increasing its aperture to 0·98 N.A.; but it is stated that in order to utilise its full effect, it is necessary to have the object mounted between two cover-glasses. This defect must have been subsequently remedied, as I possessed one of these condensers and found that it would work through any ordinary slip. The formula of this 1859 condenser was altered somewhere about the end of the seventies, its aplanatic aperture being increased, otherwise it remained the same. This new formula condenser may be distinguished from the older one by the plano front of its second lens, the second lens of the other having a concave front surface. This 1859 condenser remained unapproached for critical microscopical work, until the substage condenser was apochromatised by Powell in 1895. In April 1869, Messrs. Powell and Lealand brought out a side bull's-eye, which, used in conjunction with a super-stage, gave a powerful beam of very oblique illumination. It is probable that it was with this instrument that the so-called "striæ" on *Amphipleura pellucida* were really first resolved.

About the year 1870 Powell brought out a new arrangement of prisms for obtaining non-stereoscopic binocular vision, with high powers. The utility of such appliances is doubtful, because they all more or less impair the sharpness of the image; the only thing that has ever been said in their favour is that they are less fatiguing than the monocular, but it is doubtful if they possess even this one advantage.

Hugh Powell died November 1883. An excellent portrait of him was presented to our readers as a Frontispiece to the volume of this Journal for 1899.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, Etc.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Development of Chondrocranium in Man.‡ — Dr. Giuseppe Levi finds that the first rudiment of the chondrocranium in man consists of separate groups of closely adpressed connective-tissue cells, the groups indicating roughly the position of the future bones. There is apparently no homology between these groups and the parachordals and trabeculæ of other mammals. The groups retain their separateness during the period when they are converted into cartilage, and do not lose it until just before the time when the chondrocranium reaches its highest degree of development. The groups do not become simultaneously differentiated in the chondrocranium; the occipital appears first, then the sphenoid and the auditory capsule, finally the ethmoid. Similarly, the process of cartilage formation in the different areas does not proceed with equal rapidity, nor, except in the occipital region, is its formation simultaneous throughout the individual areas. The occipital region shows in its development a striking analogy to a vertebra, and in the author's opinion consists of a distinct occipital vertebra, and a region probably composed of fused vertebral primordia. The changes which occur in the shape of the skull during development are chiefly due to the changes of position of the occipital and sphenoidal regions. Indeed, the floor of the *sella turcica* may be said to be the only part of the skull which retains its primitive position throughout the whole of development.

Development of Villi in Human Intestine.§ — Mr. J. M. Berry summarises his results in the following sentences:—(1) The number of villi in the intestine increases with the age of the embryo; (2) fully

* 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. ‡ Arch. Mikr. Anat., lv. (1900) pp. 341–414 (1 pl. and 3 text figs.).

§ Anat. Anzeig., xvii. (1900) pp. 242–9 (6 figs.).

developed villi and young villi exist in the growing intestine side by side; (3) the villi appear first as longitudinal folds which grow larger and then break up into villi; (4) the villi develope first in the upper portions of the intestine.

Placenta of Galago agisymbanus.*—Prof. H. Strahl finds that in this as in other lemurs the placenta is diffuse. In the middle of pregnancy the villi are scattered over the whole of the chorion, but they do not reach an equal degree of development in its different regions, nor do they arise simultaneously in these regions. The absorptive mechanism of the placenta is somewhat complex; for three or four different conditions obtain. These arise in part in later stages of development, and depend upon variations in the form and arrangement of the chorionic epithelium and the blood-vessels of the villi. The utilisation of the extravasated maternal blood which is to be found in the mucous membrane is carried out by the epithelial cells of the uterine glands.

Presence of a Thymus of the Fourth Visceral Cleft in Man.†—Dr. K. Groschuff, in a previous paper ‡ on the development of the thymus in mammals, came to the conclusion that a thymus segment developes in relation to the fourth gill-cleft wherever this possesses an epithelial body (*glandula parathyroidea*). In man the fourth gill-cleft regularly gives origin to such an epithelial body, but yet a thymus segment belonging to this cleft has not hitherto been directly observed. A careful investigation of embryos and new-born subjects has proved the existence of this thymus segment in some cases, but has led the author to modify his views to some extent. He does not now regard the thymus segment of the fourth gill-cleft as a constant structure in man, and finds that even in cattle and cats it is not, as he previously thought, invariably present. Generally, he now states his position as follows:—this thymus segment is not invariably present in any mammal, but wherever an epithelial body occurs it may be expected to occur with more or less frequency.

Double and Bifid Ureters in Man.§—E. Sacquépée describes a case of double ureter, and discusses other described cases in their bearing on theories of the development of kidney and ureter. He finds that unilateral doubling has been frequently observed; bilateral doubling, or the presence of two ureters at one side, and a bifid ureter at the other, as in his own case, is rare. Most of the existing theories in explanation of these facts fail to explain all the anomalies which occur; these are, the fact that the ureter is sometimes double and sometimes bifid; that the abnormal ureter often drains the upper part of the kidney, which is sometimes normal, sometimes much modified; and that the abnormal ureter may open at one of several points. It is certain that the Wolffian duct may give rise to two ureterine outgrowths, and this explains some of, but not all, the anomalies which occur. Other cases may be explained by the persistence of the Müllerian duct in the male and the Wolffian in the female, thus producing only an apparent ureter. Again, the

* Abh. Senckenberg. Naturf. Ges., xxvi. (1899) pp. 153–99 (8 pls.).
† Anat. Anzeig., xvii. (1900) pp. 161–70 (5 figs.).
‡ Tom. cit., xii. (1896) pp. 497–512.
§ Journ. Anat. Physiol., xxxvi. (1900) pp. 103–20 (4 figs.).

general anomalies in the development of kidney and ureter are more easily explicable on the old theory of Kölliker that the kidney arises from the ureter, than on the current view that it arises independently of the ureter from the middle layer. In the latter case it is difficult to understand why the absence of one kidney should be so frequently associated with the absence of the corresponding ureter, or why triple kidney should be associated with triple ureter.

Abnormalities in Development of Chick.* — Dr. Ch. Féré notices that not a few authors have described cases where the *area opaca* in the chick has developed normally in the absence of the embryo, showing that a certain independence of growth of *area opaca* and *area pellucida* must exist. Again, in the *area opaca* the vascular and the non-vascular zones are not intimately related, for the one may develope independently of the other. The author describes an interesting case observed by himself in which the non-vascular zone of the *area opaca* was very slightly developed, so that the blastoderm consisted of a somewhat abnormal embryo surrounded by a vascular area resting almost directly on the yolk. This condition may be described as the complement of the much commoner case where the non-vascular zone developes at the expense of the embryo.

Chick's Amnion-Allantois.†—Dr. C. Creighton describes a peculiar system of lymphatic sheaths around certain tributary branches and capillary loops of the umbilical vein on the inner lamina of the chick's allantois, where it is adherent to or fused with the amnion. He brings forward evidence to show that the "lymph" required in the later period of incubation for the absorption of yolk is obtained from the *liquor amnii*, partly by direct transudation from the amnion-sac, where it presses upon the proximal pole of the yolk-sac, partly by that system of lymphatic sheaths of the allantoic vessels, filled with lymph from the adherent amnion, to which yolk is brought from the yolk-sac by a roundabout way, along with much of the albumen from the albumen-sac.

Development of Crocodile.‡—Dr. A. Voeltzkow has studied *Crocodilus madagascariensis* Grand. in its native haunts, and has succeeded in obtaining an abundant supply of eggs. The eggs are laid in nests in dry sandy banks, the nest being often a hole 1/3–1/2 metre deep, which is afterwards carefully filled up by the mother. The egg-laying occurs at night, and during the period of development ($2\frac{1}{2}$–3 months) the nest is regularly visited by the mother. The author succeeded in demonstrating the truth of the statement that the young, just before hatching, produce a loud call-note, to which the mother responds by opening the nest. He further found that in the case of eggs kept in boxes of sand in his house, a heavy step or a vibration in the vicinity of the box resulted in the production of the call-note. There can be little doubt that the movements of the mother in the vicinity of the nest produce vibrations in the loose sand, which induce the imprisoned young to produce the call-note. After liberation the young accompany the mother to the water.

* Journ. Anat. Physiol., xxxvi. (1900) pp. 99–102 (1 pl.).
† Journ. Anat. Physiol. Norm. Path., xxxiii. (1899) pp. 527–44 (2 pls.).
‡ Abh. Senckenberg. Naturf. Ges., xxvi. (1899) pp. 1–150 (17 pls. and 18 figs.).

The early stages of development occur in the oviduct; and in eggs freshly laid the visceral clefts are present, and the first rudiment of the limbs is discernible. As there are great practical difficulties in obtaining gravid females, the early stages of development were not observed in very great detail. The observations were throughout confined to the development of the external characters. In regard to the development of the hard palate, some interesting points were made out. The first trace of this structure is a triangular plicated swelling at either side of the maxilla—a condition which may be compared to that which is permanent in the Gecko among lizards. In the course of development in the crocodile the structure gradually passes through the stages represented in the other lizards; but while in the lizards the internal nares may lie at the posterior border of the palatines, they never come into relation with the pterygoids as in living crocodiles. In these therefore the posterior nares gradually move backwards, successively occupying the positions seen in fossil forms, until they ultimately reach the typical position. At the time of hatching the jaw of the embryo is furnished with a strong bifid callosity, which is made of dentine and is not merely a horny structure. It appears at the end of the first month of incubation, and persists for some days after hatching. The paper also discusses the development of various other external morphological structures.

Ovarian Follicles of Reptiles.*—Miss Marie Loyez has investigated the structure of the ovary in certain lizards and Ophidians, and finds that the follicles consist of two kinds of cell:—(1) ordinary follicular cells, and (2) large cells which are apparently aborted ova, and which appear to assist in the formation of yolk. The egg grows at the expense of these cells, the process recalling the conditions seen in many invertebrates. It is of interest to note that normal eggs exercise a phagocytic action upon these follicular cells; but degenerating eggs, on the other hand, yield to the phagocytic activity of the follicular cells, thus exactly reversing the normal conditions.

External Features in the Development of Lepidosiren paradoxa Fitz.†—Mr. J. Graham Kerr finds that the papillæ on the hind legs of the male *Lepidosiren* rapidly develope at the breeding season into slender vascular filaments, and that the main axis of the limb also enlarges. He considers that the main function of this modified structure can scarcely be other than respiratory. The cœlomic egg, which is of a pale salmon colour with a whitish germinal cap, measures from about 6 to 7 mm. in diameter, and is enclosed in a transparent capsule about 1 mm. thick. As found in the nest—an underground burrow at the bottom of the swamps of the Gran Chaco—the egg is enclosed in a horny capsule, and in some cases is invested by a jelly-like secretion comparable to that found in Amphibia. Segmentation is complete and unequal, closely resembling that of *Amia*. Invagination begins over about one-third of the entire extent of the boundary between small and large cells; but, owing to the flattening out of the lateral parts, the blastopore is only about one-fourth of the original slit. The archen-

* Comptes Rendus, cxxx. (1900) pp. 48-50.
† Phil. Trans., Series B, cxcii. pp. 299-330 (5 pls.).

teron appears to be formed by an invagination similar to that found in Urodela and *Petromyzon*.

Compared with *Ceratodus*, the medullary folds are extremely low, and in the trunk region merge into one another, the arching over being effected by superficial cells only. The cavity so enclosed soon vanishes, and the central canal of the nervous axis arises secondarily. There is no neurenteric canal, and the blastopore early becomes the cloacal opening.

Four pairs of external gills are developed upon the four branchial arches, and are apparent as four prominent knobs about four days before hatching. By this time a crescentic cement organ, corresponding to that of the larva of Anura, has appeared. Like the central canal of the nervous axis, ear, mouth, and nose cavities are formed by secondary excavations in an originally solid rudiment.

The newly hatched larva, of a pale yellowish salmon colour but unpigmented, is superficially tadpole-like. The "blastopore" closes about the time of hatching for about two weeks; but for some time previous to this the pronephric duct has completed its growth and has established its opening into the hind-gut. In the second week pigment appears, first in the pigment-layer of the retina, and soon afterwards on the dorsal surface of the head and anterior body region. The external gills are now pinnate, and growing rapidly, and when fully formed are raised upon a common stalk. While the external gills are still at their full development, pulmonary breathing has commenced, and the branchial clefts become perforate long after they are completely overgrown by the opercular fold. The external gills are lost about six weeks after hatching. By differential growth they come to lie directly above or behind the root of the fore limb. The fore and hind limb undergo, as in *Ceratodus*, a rotation in opposite directions.

The young Lepidosiren is remarkably newt-like. It shows a colour change with varying light and darkness.

Merogonic Fertilisation.*—Prof. Yves Delage takes account of some of the comments which have been made on his researches on merogonic fertilisation. He points out how his work differs from that of the Hertwigs and Boveri. He rejects Giard's interpretation that the phenomena were those of male parthenogenesis. He reasserts his conviction that the essential phenomenon of fertilisation is the substitution of a male nucleus for a female nucleus in the cytoplasm of the ovum, the male nucleus having an excitability which the inert female nucleus has lost, and which leads to division.

Convergence.†—Herr Philippi expresses a strong belief in the law of recapitulation, but he admits that its recognition is not always easy. Cœnogenesis is one source of obscurity, or rather one of the ways in which we interpret cases where the recapitulation-theory fails to fit. Convergence is another stumbling-block; there may be superficial resemblance between entirely distinct types, e.g. blindworms and burrowing snakes, or within the same order or family, e.g. the occurrence of the *Mytilus*-form in *Myalina*, *Myoconcha*, and *Mysidioptera*. Again,

* Arch. Zool. Expér., vii. (1899) pp. 511-27.
† SB. Ges. Naturfreunde Berlin, 1899, pp. 87-90.

there may be "repetitive species-making," when from the same stock similar forms arise at different times and without being related to one another, e.g. the *Vola*-types which arose from the Pectinid stock in the Lias, again in the Cretaceous, and again in the Tertiary.

Law of Reversion.* — Prof. Karl Pearson states the following general results at the conclusion of a paper on the law of reversion:— (*a*) The laws hitherto propounded for blended inheritance do not appear to cover the cases of exclusive inheritance, e.g. such cases as eye-colour in man, coat-colour in horses or hounds, &c. (*b*) The law of ancestral heredity must be distinguished from a law of reversion. Neither seems to fit the facts, if we adopt the amounts of heritage 1/4, 1/16, 1/32, &c., from parent, grandparent, great-grandparent, &c., originally taken as a first approximation by Mr. Galton. (*c*) That the mean correlation of an n^{th} parent with the offspring is one-half that of an $(n-1)^{th}$ parent also appears doubtful. (This would follow if reversion were started from the parent.) (*d*) Testing theory by the case of basset hounds, we find much difficulty, owing partly to the great prepotency of the dam, and partly to the large amount of artificial selection which is evidenced at every turn, and obscures what may be termed the *natural* laws of inheritance. (*c*) There is an urgent need to widely extend our knowledge of heredity by new experiments and observations on other organs in different races. Facts are of the first necessity at the present time, and facts collected on a large scale for a wide range.

Polydactylism in Poultry.†—R. Anthony notes that polydactylism of the hind limb, rare among birds, is frequent in the gallinaceous tribe, and especially in the common fowl. In all cases which he studied, except one, it consisted in a duplication, or sometimes even in a triplication of the hallux. When the malformation is complete, there is a superior hallux of 2–4 phalanges (as if sometimes reverting to a more primitive state) and an inferior hallux of two phalanges. There is also a division of the tendons of the muscles of the hallux; the short flexor remains always normal; the short extensor stops in extreme cases at the top of the first hallux, the long extensor replacing it functionally. The polydactylism arises from a division of the primordium of the hallux.

Development of Musculature of Reptiles.‡—H. R. Corning has investigated the development of the muscles of the head and the anterior extremity in *Lacerta*, his special object being the study of the history of the mesodermic segments of the anterior part of the head, as contrasted with the somites (primitive segments) of the posterior cephalic region. His investigation confirms the view that these anterior mesodermic segments are primitive, and of more importance in the interpretation of the cephalon than the secondary somites, which play a part in most vertebrates in the formation of the occipital region of the skull. In other words, he believes that the segmentation of the skull has nothing to do with the segmentation of the mesoderm of the anterior part of the head.

* Proc. R. Soc. London, lxvi. (1900) pp. 140–64.

† Journ. Anat. Physiol., xxxv. (1899) pp. 711–50 (25 figs.).

‡ Morph. Jahrbuch, xxviii. (1899) pp. 28–104 (4 pls.).

As to the origin of the musculature of the anterior extremity, he finds that myotomes 9–13 give off ventral prolongations which do not directly give rise to the muscles, as Mollier supposes, but which constitute the primordium of the ventral musculature, from which secondarily muscle-cells pass out to the extremity. The hypoglossus muscles arise from the ventral prolongations of myotomes 2–5, the first myotome being rudimentary. The oculomotor muscles arise from the wall of the head-cavity, which developes in an embryo with one to two primitive segments from the entoderm at the anterior end of the chorda. The primordia originate from the epithelial wall of the cavity, and then separate from it, growing towards the bulbus, and towards their later origin and insertion. The *M. rectus externus* arises from a cell-mass, the epithelial origin of the elements of which points to a derivation from a head-cavity. The *M. obliquus superior* originates from the dorsal part of the *trigeminus* muscle primordium. Of the muscles of the gill-arches, the *trigeminus* and *facialis* only were investigated. They arise from the proliferation of the medial plate of the cœlom spaces, after these have been separated by the appearances of the gill-slits, and are of distinctly splanchnic origin.

Giant Spermatids in Bombinator igneus.*— Dr. Ivar Bromar describes giant spermatids constantly present at the reproductive period. They are usually multinucleate, and in the midst of the nuclei there lies a sphere or an *idiosome*, with numerous centrosomes. One nucleus is usually much larger than the rest, and all are connected by processes with the central idiosome. The giant spermatids seem to arise by pluripolar mitoses from giant spermatocytes of the second order, and the transformation is discussed in detail. Many of the giant spermatids degenerate; others form giant or monstrous spermatozoa.

Spermatozoa of Bombinator igneus.† — Dr. Ivar Bromar has investigated the structure and development of the remarkable sperms of this toad. As to structure, each has a greatly elongated head with a central supporting rod, and two central corpuscles at its anterior end. To the posterior of these the tail is attached. It consists of two filaments, a slender motile one and a thicker supporting one which is not actively motile. The former is furnished with a delicate membranous fringe (fin-membrane), and is longer than the latter, with which it unites in the vicinity of the posterior end of the head. As to development, after the second maturation division the two central corpuscles are to be seen, surrounded by the idiosome, arranged in a line perpendicular to the cell-margin. While the two spermatids are still connected by the remains of the spindle, the central corpuscle nearest the periphery begins to grow out into a filament which is the first beginning of the motile thread of the tail. As it grows, the idiosome with its contained corpuscles moves inwards towards the nucleus, dragging the thread with it, and a vesicle appears at the side of the idiosome, which increases as the idiosome itself diminishes. As idiosome-vesicle, idiosome, and central corpuscles reach the nucleus, this rotates about its middle point through a half-circle, the ultimate result being that when the head is

* Anat. Anzeig., xvii. (1900) pp. 20–30 (10 figs.).
† Tom. cit. pp. 129–45 (24 figs.).

differentiated, the central corpuscles lie at its anterior, and not as usual at its posterior end. The supporting-rod of the future head arises from the idiosome-vesicle and grows downwards into the nucleus, and the nucleus becomes converted into the head. The tail-filament acquires its fin-membrane, and becomes divided into the two threads. Later the sperm seems to separate itself from the remaining vacuolated cytoplasm. The points of importance are, the absence of any change of shape in the central corpuscles, the position of these in the ripe sperm, and the fact that in the spermatid the idiosome does not separate itself from the central corpuscles.

b. Histology.

Physics of Cell Life.* — Dr. L. Rhumbler, in investigating the physical aspect of cell life, has studied the distribution of pigment in eggs and young larvæ. He accepts the view that protoplasm has a foam structure, and endeavours to explain the distribution of pigment as due to physical stress and strain. Thus, Fischel succeeded in staining living Echinoderm eggs with neutral red, and found that during division the minute coloured granules collected round the nucleus, and in the spindle stage became dumbbell-shaped. Rhumbler explains this phenomenon in the following way. During division the nucleus absorbs water from the surrounding foam, the alveoli thus diminish in size, and large bodies, such as yolk-spherules, are squeezed away from the region of pressure. But very small bodies like the stained granules may cling to the alveolar lamellæ, and by the condensation of these they appear to collect round the nucleus. Again, the pigmented sperm-track in the frog's egg may arise from the physical stress produced by the passage of the sperm through the foam in quite a similar manner. The sperm tends to pull the foam framework along with it; there is thus tension behind it, and as a result there is an outflow of the more liquid contents of the alveoli, and a shrinkage of the lamellæ to which the pigment granules cling. In general the author believes that in developing eggs pigment plays no active part, but collects passively in regions of increased pressure and condensation.

Study of Mitosis in Living Cells.†—Herr J. Sobotta recommends the larvæ of *Salamandra maculata* as suitable objects in which to study karyokinesis in actual process. Especially suitable are portions of the cartilaginous branchial arches examined in salt solution. A karyokinetic process can be followed for three or four hours, and the chromatin figures—familiar in stained and fixed preparations—can be demonstrated in the living cell.

Intranuclear Crystalloids.‡—MM. L. Léger and O. Duboscq note that, while intranuclear crystalloids are well known to botanists, they have not been often recorded in animal cells. In all the adult epithelial cells of the mid-gut (which the authors carefully define) of *Gryllus* and *Gryllomorpha*, there are intranuclear crystalloids. These are charac-

* Arch. Entwickelungsmechanik, ix. (1899) pp. 32–100 (1 pl.). See also Amer. Nat., xxxiv. (1900) pp. 54–6.

† SB. Phys.-Med. Ges. Würzburg, 1899, pp. 91–4.

‡ Arch. Zool. Expér., vii. (1899) Notes et Revue, pp. xxxv.–xxxviii. (2 figs.).

terised by their resistance to acids, their solubility in pepsin, and their affinity for stains. It is not known how they are formed.

Epidermic Proliferations on a Whale.*—Herr W. Weltner describes the remarkable way in which the epidermis of *Megaptera boops* sends upgrowths into the (18) chambers formed in the shell of *Coronula diadema*,—a cirripede which fastens on the whale's skin. He also notes the wart-like epidermic elevations (characteristic of this whale), from the middle of which one or two hairs may project.

Structure of Pavement Epithelium.†—Carlo Foà has studied the epithelium of fœtal calves and of adult cattle, in order to investigate the remarkable network and intercellular bridges in regard to which various opinions have been held. He finds that in very young embryos closed polygonal chambers lie between the epithelial cells. As development proceeds, the lamellæ which form the lateral walls of the chambers become more and more attenuated, and the lines which indicate the crossing-points of these lamellæ more distinct. The result is to produce the appearance of fine bridge-like threads connecting the cells together. Between these threads spaces occur in which the nutritive fluids of the tissue circulate.

Structure of Nervous System.‡—Prof. L. Edinger briefly discusses the gradual development of our present knowledge of the nervous system. In the first place, comparative researches both on the vertebrate and the invertebrate nervous system have clearly shown that the ganglion-cells are invariably the essential elements, and that they always give rise to the nerve-fibres. Modern research may be said to have become concentrated around three questions :—(1) The relation between nerves and ganglion-cells; (2) the minute structure of the ganglion-cells; and (3) the relation between the nerves arising from different cells. As to the first point, Apáthy's work has shown that fine fibrils, having a specific colour reaction, penetrate from the nerves into the ganglion-cells. In some cases Apáthy has succeeded in demonstrating the existence, both in the peripheral and in the central nervous system, of a fibrillar network which probably constitutes the true conducting substance of the nervous system. Thus, his work may be said to demonstrate anatomically the fact, hitherto proved only by physiological reasoning, that the ganglion-cells constitute the central organs of the nervous system. Again, Nissl has shown that the fine granules which have long been known in ganglion-cells have a very intimate connection with the life of the cells, and contain the substances which are used up during active functioning. The granules lie between the fibrillæ, and change according to the state of activity of the cell.

Centrosome in Nerve-cells.§ — M. Charles Nelis has studied the nerve-cells of the dog and rabbit, employing various methods of fixation and coloration in the search for the centrosome. He obtained entirely negative results in normal specimens, and believes that the centrosome is normally absent in the nerve-cells of mammals. Animals infected

* SB. Ges. Naturfreunde Berlin, 1899, pp. 102–3 (2 pls.).
† Arch. Mikr. Anat., lv. (1900) pp. 431–41 (1 pl.).
‡ Ber. Senckenberg. Naturf. Ges., 1899, pp. 108–11.
§ Bull. Acad. R. Belg , xii. (1899) pp. 715–34 (1 pl.).

with the virus of rabies, however, showed a distinct centrosome, which apparently divides into two as the disease progresses. The two centrosomes then migrate towards opposite poles. The author explains this phenomenon in the following way:—The effect of rabies on the nuclei of the nerve-cells is to produce regressive phenomena,—a process of atrophy, which is preceded by a temporary tendency to proliferation. This tendency is indicated only by the appearance of the centrosome, its division, and the incipient migration of the new centrosomes.

Central Corpuscles in Nerve-cells.*—Dr. Rud. Kolster notes briefly the finding of very distinct central corpuscles in the cells of the dorsal nervous system in *Cottus scorpius*. In some cases one central corpuscle only was present, and in others two; the two conditions occurring with about equal frequency. In each case there was a central darkly-staining granule surrounded by a clear area. Details are to be published later.

Structure of Serous Gland-cells.†—Charles Garnier has investigated the minute structure of the serous glands of Vertebrates, with the object of studying the process of secretion, and the part played by the ergastoplasm in the process. His paper includes an account not only of his own observations, but of the observations and conclusions of others, a historical sketch of the subject, and a very full bibliography. The author gives an ideal sketch of the history of a gland-cell in the following terms. The cytoplasm, at first nearly homogeneous, becomes differentiated, and displays filaments having at first an acidophil reaction; at the same time the nucleus enlarges, undergoes various changes, and eventually yields caryoplasmic substances to the ergastoplasmic filaments which become basophil. When this is accomplished, the nucleus is reconstructed, and the basophil filaments give rise to the secretion. As the secretory granules are differentiated, the ergastoplasmic filaments disappear, the secretion is excreted, and the cytoplasm is ready to begin the cycle anew. This series of changes cannot be followed entirely in any particular case, for each gland has its special peculiarities, but the author believes that it represents the most general condition. The ergastoplasm is to be regarded as an intermediary between the substances of plasmatic origin and the cytoplasmic protoplasm, and serves to transform for the cytoplasm the substances furnished to it by the nucleus. According to other observers, it would appear that in some cases the nucleus takes a more active part in secretion than is indicated in this scheme.

Plastic Activity of Lymph-cells.‡—Prof. L. Ranvier describes under this name a phenomenon which he has witnessed in the cells of rat-serum. When the serum is warmed gradually up to 35° C. in a moist chamber containing air-bubbles, the serum-cells approach the bubbles and flatten themselves against them just as they do against a resistant body. If the preparation is then cooled down to 21° C., the cells recover their globular form, showing that the phenomenon is a vital one.

* Anat. Anzeig., xvii. (1900) pp. 172–3 (2 figs.).
† Journ. Anat. Physiol., xxxvi. (1900) pp. 22–98 (3 pls.).
‡ Comptes Rendus, cxxx. (1900) pp. 19–20.

Nucleated Erythrocytes in Normal Blood.*—Dr. Maurizio Ascoli has made a series of observations on the blood of the dog, with the object of determining the question whether nucleated erythrocytes ever occur in the normal blood of an adult mammal. The blood was taken from the *vena efferens tibiæ* immediately after its exit from the bone, and the result was to show the constant presence of a small number of nucleated red corpuscles. The author considers that the observation tends to discredit the common hypothesis that erythrocytes must necessarily arise from colourless elements in the adult.

Erythrocytes and Blood-plates.†—Dr. C. Sacerdotti brings forward evidence in favour of the view that the blood-plates are morphologically independent components of the circulating blood, or, in other words, that they are not secondary derivatives of either red or white blood-corpuscles.

Islands of Langerhans in Pancreas.‡—Dr. V. Diamare has made an elaborate study of the structure and development of these bodies. What gives his study particular value is that he takes account of the state of affairs in all the main types of Vertebrates. The main conclusion appears to be that the so-called islands of Langerhans in the pancreas represent a definite and normal kind of tissue, distinct from the zymogenous tissue even from early stages, and similar in nature to the intra- and para-thyroid bodies.

Intravascular Cells in Capillaries of the Liver.§—Prof. Browicz has returned to the study of the remarkable cells of the capillaries of the liver which have been already described by him and by Kupffer. Though in broad outline their respective observations are similar, they differ in that Kupffer believes that the cells form a syncytium, and that they constitute an integral part of the capillary wall. The author hardened his preparations in 2 per cent. formalin, and cut frozen sections. By this method he was enabled to demonstrate the existence of cell-boundaries, and to show that the cells form no integral part of the capillary wall, for they are often distinctly separated from it. The function of the cells the author believes to be the production of pigment from engulfed erythrocytes.

Connective-Tissue of Amphioxus.‖—Dr. H. Joseph distinguishes the following different kinds:—the content of the notochord; the cellular content of the oral cirri and their basal membrane; the fibrillar mucilage-yielding connective-tissue in the notochord sheath, &c.; the gelatinous substance in the fin-rays; and a tissue (with a strong affinity for picric acid) which occurs in the branchial bars, the velar threads, and the oral cirri. As to the last, he suggests that it may represent the primitive non-cellular state of the cartilaginous skeletal tissue in higher forms.

Parietal Organ of Lamprey.¶—Prof. F. K. Studnička finds that this is an eye, with an external pellucida and a convex retina. The

* Arch. Mikr. Anat., lv. (1900) pp. 426–30.
† Anat. Anzeig., xvii. (1900) pp. 249–53.
‡ Internat. Monatschr. Anat. Phys., xvi. (1899) pp. 1–54 (3 pls.).
§ Arch. Mikr. Anat., lv. (1900) pp. 420–6.
‖ Arbeit. Zool. Inst. Univ. Wien, xii. (1900) pp. 1–34 (1 pl. and 2 figs.).
¶ S.B. k. böhmisch. Ges. Wiss., 1899, No. xxxvii., 17 pp. (1 pl. and 2 figs.).

retina includes three kinds of elements,—supporting cells, sensory cells, and ganglion-cells, besides a layer of nerve-fibres in its lower portion. There is no lens, and the pellucida cannot act as such, but the spherical hyaline outer terminations of the sensory cells have probably this function. In other words, each sensory cell has its own lens. The entire structure cannot be called rudimentary, though it obviously represents a different phyletic stage from that seen in *Sphenodon*, where the parietal organ is a "cameral" eye, with a concave retina and a lens.

Single and Twin Cones in Retina of Fishes.* — Messrs. C. H. Eigenmann and G. D. Shafer discuss the mosaic of single and twin cones. The arrangement of these is remarkably constant for any given species, but differs considerably in different groups. Yet the patterns in all of the species examined can be arranged in a series.

Cilia in Convoluted Tubules of Mammalian Kidney.† — Prof. E. Wace Carlier notes that the fact that the cells lining these tubules are ciliated seems to have been lost sight of in Britain, though many Continental investigators have studied the subject. He brings forward evidence from many mammals showing that the presence of cilia as a normal constituent of the secreting cells of the convoluted tubules is an undoubted fact. In another communication ‡ he shows that the human kidney is no exception.

Structure of Lungs in Birds.§—Dr. F. Supino points out that the lung of birds does not exhibit large polyhedral alveoli, as Panceri described, nor an inextricable network of intercommunicating bronchioles, as Sappey described, but exhibits very numerous bronchioles each one of which dilates to form its own little alveolus.

Sensory Pits of Crotalinæ.‖ — Mr. G. S. West has studied these structures in various crotaline snakes. They are to be regarded as tegumental sense-organs of the lateral line series, and consist of two chambers, an outer and an inner, separated by a partition or pit-membrane. Each chamber communicates with the exterior, but the inner one by a minute aperture only. The pit-membrane is a sensory structure, and is liberally supplied with nerves (branches of v.) and blood-vessels. In development both chambers arise by invaginations of the epidermis. Nothing is known of their function.

Retina of Amphibians.¶ — Mr. H. M. Bernard has investigated the minute structure of the retina in the frog and other Amphibians, employing such fixatives as *boiling* corrosive acetic acid, the animal having been kept and killed in darkness. He finds that the cones of the retina "are not elements with any special sensory function, as was maintained by the earlier investigators, but that they are simply stages in the development of fresh rods; and that, in addition to their potential value as future rods, they serve, even in their earliest stages, to keep

* Amer. Nat., xxxiv. (1900) pp. 109–18 (19 figs.).
† Proc. Scot. Micr. Soc., ii. (1898–9) pp. 243–51 (1 pl.).
‡ Tom. cit., pp. 275–7 (2 figs.).
§ Atti Soc. Venet.-Trent. Sci. Nat., 1898 (published 1899) pp. 306–15 (1 pl.).
‖ Quart. Journ. Micr. Sci., xliii. (1900) pp. 49–59 (1 pl.).
¶ Tom. cit., pp. 23-47 (1 pl.).

the layer of the rods compact." He does not as yet apply this conclusion outside the Amphibia, not being convinced that the "cones" of the Vertebrate retina are necessarily identical structures throughout the phylum; but he believes that the minute differences recorded by the various histologists who have studied the retina will prove to be due to the fact that different physiological conditions induce distinct structural differences.

Bursa Entiana of Selachians.* — Dr. H. C. Redeke discusses the exact meaning of this term, in regard to which he believes considerable confusion exists. The true *bursa entiana* is a small area of the stomach at the anterior end of the *pars pylorica*, and is present only in *Galeus canis*. In some sharks and many rays the spiral valve of the intestine is confined to the posterior region of the mid-gut, so that between the pylorus and the region where the valve begins there is an intermediate valveless area which has been erroneously supposed to be the *bursa entiana*. This area may be called tween-gut (*Zwischendarm*), and is absent in most Selachians where the spiral valve begins immediately behind the pylorus.

Tooth-plate of Cyprinoids.†—Valerian Gratzianow has investigated the histology of the remarkable horny plate found in these fish. He finds that it is an epidermal structure, consisting of large polygonal cells which readily take up stains. At its base are a number of connective-tissue papillæ, recalling the similar structures found in the horny plates of *Ornithorhynchus*. In one case (in the telescope fish) at the summit of certain of the papillæ sensitive bulbs similar to taste-buds were found. The author can only explain this remarkable circumstance as due to atavism, and suggesting that the masticatory plate is a recent acquisition. In certain of the Cyprinoids the tooth-plate arises by a simple differentiation of the gullet epithelium; but in *Carassius* and *Cyprinus* its origin is somewhat more complex, recalling the development of a true tooth. Further details of structure and development are promised.

Micro-crystals of Vertebrate Blood.‡—Herr H. U. Kobert discusses the micro-crystallographic behaviour of vertebrate blood at some length and in considerable detail. His observations are rather critical than novel, though they give evidence of much personal work and assiduity. The author discusses the crystalline and crystalloid appearances found in the various conditions of blood and its constituents, much space being devoted to the important hæmin crystals. The article includes remarks on Charcot's crystals, blood-serum crystals, fibrin-crystals, and formalin-pigment crystals. The illustrations are somewhat crude and diagrammatic, but may be accepted as faithful delineations of the appearances described.

c. General.

Artificial Production of Rhythmic Muscle Contractions.§—Prof. J. Loeb has found that certain solutions containing ions of sodium, chlorine,

* Anat. Anzeig., xvii. (1900) pp. 146-59 (3 figs.).
† Zool. Anzeig., xxiii. (1900) pp. 66-73 (5 figs.).
‡ Zeitschr. f. angew. Mikr., v. (1899) pp. 157-72, 185-200, 213-28, 241-6 (39 figs.).
§ Festschr. A. Fick, 1899, pp. 101-19. See Amer. Nat., xxxiv. (1900) p. 150.

lithium, bromine, iodine, &c., may cause rhythmical contractions in muscle, while other solutions with other ions of calcium, potassium, magnesium, barium, strontium, &c., check such contractions. It is supposed that the rhythmic contractions are the result of the combination of the favourable ions with the muscle. This should be collated with Loeb's research, already recorded, on the artificial production of parthenogenesis in the ova of sea-urchins.

Specific Gravity of Animals.*—Mr. S. R. Williams has determined the specific gravity of certain fresh-water animals, and finds that it varies from 1·0095 (*Hydra viridis*) to a maximum of 1·046 in *Cypridopsis*. The movements of an animal are closely related to its density, and there is also a correlation between density and food habits. Of the animals tested, *Stentor* represents a typical case of but slightly modified protoplasm; the heavier animals have some specialised tissues which are denser; in *Hydra* (the lightest) the extreme vacuolation of the inner layer is well known. In the case of the developing animal, the chief tissue to absorb water, and therefore the tissue of most rapid increase in bulk, is the mesenchyme. All the walls of the internal organs, however, grow thinner and less dense as the animal increases in size.

Diastatic Ferment in Hen's Egg.†—Herr J. Müller has discovered that the yolk of a newly-laid hen's egg exerts a distinct diastatic influence. The optimum temperature for the action of the ferment is 37° C.; free acids and alkalies, even in slight concentration, inhibit the action.

Mimicry in Snakes.‡—Prof. O. Boettger, in the course of a general lecture on snakes, discusses in some detail instances of mimicry by harmless snakes of poisonous species. Thus a collection of snakes from Brazil showed that the prevailing colours are red, black, and white or yellow, arranged in certain definite patterns. The coral snake (*Elaps*) is the only genus which is markedly poisonous, and all its species display these vivid contrasting colours. Eight other snakes, belonging to as many different genera, display the same tints; and as, with the doubtful exception of two, they are all innocuous, the colours must be regarded as mimetic. In Mexico species of *Elaps* also occur, and are mimicked there by species of *Geophis*, *Tropidodipsas*, *Coronella*, &c. In tropical India the poisonous snakes *Doliophis*, *Callophis*, and *Hemibungarus* are mimicked by *Calamaria*, *Polydontophis*, and *Ablabes*. As in these cases the poisonous forms prey upon the mimics, the colouring must only protect the latter from other foes, such as birds and lizards. The suggestion of mimicry between *Callophis* and *Doliophis* made by A. B. Meyer is rendered improbable by the fact that both are poisonous. The sea-snakes *Hydrophis* and *Distira* are mimicked by *Hipistes hydrinus* and *Chersydrus granulatus* which live in brackish water. In Africa the egg-eating snake *Dasypeltis* mimics the poisonous *Echis*.

Reappearance of the Tilefish.§—Prof. H. C. Bumpus notes that during the summer of 1898 the investigations of the U.S. Fish Commission brought to light the fact that the tilefish (*Lopholatilus chamæleonticeps*), once supposed to be extinct, now occurs in great numbers off

* Amer. Nat., xxxiv. (1900) pp. 95–108 (3 figs.).
† SB. Phys.-Med. Ges. Würzburg, 1899, pp. 95–6.
‡ Ber. Senckenberg. Naturf. Ges., 1899, pp. 75–88 (7 figs.).
§ Bull. U.S. Fish Commission, 1898 (published 1899), pp. 321–33.

the southern coast of New England. This is important practically, since the fish is valuable, and the history—which is reported in detail—is of scientific interest, since it furnishes evidence that life on the sea-bottom is subject to periodic modification, and that a species almost annihilated (in 1882) may become quickly re-established.

Labyrinthine Apparatus of Labyrinthic Fishes.*—Herr C. Grigorian confirms Zograff's conclusion that this strange apparatus usually serves for air-breathing, and that the wall of the associated pouch is auxiliary to the same function. Where the labyrinthine apparatus is less developed, as in *Macropodus*, the pouch and the mouth-cavity are specially adapted for respiration, their internal surface being covered with small outgrowths. Where the apparatus is quite weakly developed, as in *Ophiocephalus*, it has only a mechanical function, and the wall of the pouch serves for air-breathing.

Colouring Matter of Electric Lobes in the Torpedinidæ.†—Dr. Anacleto Romano points out that, while it has long been known that the *lobi electrici* of the brain in the Torpedo are of a lemon-yellow colour, the reason of the coloration has not been investigated. Somewhat similar coloration is characteristic of the electric nerve-tissue of other electric fish. The author finds that it is in all cases due to the presence of fat, which not only impregnates the protoplasm of the cells, but surrounds the cells themselves, and interpenetrates the somewhat sparse neuroglia. This fat contains yellow lipochrome pigment and also hæmatin, and owes its colour to the combination of the two pigments. By experiment, the author has convinced himself that the function of the fat is to protect the nerve-tissue by its high resistance against a centripetal electric current from the organ.

Habits of Polypterus and Protopterus.‡—Mr. J. S. Budgett has been enabled to make some observations on these two genera of fish in the river Gambia. Of *Polypterus* two very distinct species occur, *P. lepradii* Steind. and *P. senegalus* Steind.; but the habits of the two are similar. Both spawn during the rainy season in the flooded low-lying plains, a regular migration taking place from river to swamp in June, and from swamp to river in October and November. The females appear to be greatly in excess of the males, and there are marked differences between the sexes. There is no doubt that the air-bladder is used as an accessory breathing organ, and the spiracle is used for the emission of the air of respiration. The pectoral fins are used as organs of propulsion.

In *Protopterus* there is no marked external difference between the sexes. The nests were not found, but fertilised eggs were obtained. Segmentation is complete but very unequal, and results in the formation of an upper hemisphere of small cells, and a lower hemisphere of larger cells. The eggs were not reared beyond the beginning of gastrulation.

Plankton Variation.§—M. Bruyant has studied the variations in the plankton of Lake Chauvet during October and November. He finds

* Zool. Anzeig., xxiii. (1900) pp. 161–70 (6 figs.).
† Anat. Anzeig., xvii. (1900) pp. 177–83 (1 fig.).
‡ Proc. Cambridge Phil. Soc., x. (1900) pp. 236–40.
§ Comptes Rendus, cxxx. (1900) pp. 45–8 (2 figs.).

that during the day the Entomostraca, which constitute the great bulk of the fauna, sink down to escape the strong light, and rise again to the surface during the night. This observation confirms those of Yung.

Tropical and more Northerly Plankton.*—Mr. I. C. Thompson reports on two collections made by Captain F. H. Wyse and Mr. G. W. Herdman by means of tow-nets fixed to running water-taps on board two steamships,—a method successfully pursued by Prof. Herdman. The one collection included 70 species, the other 39 species of Copepods. The notes show, in almost all cases, an extension of the hitherto known range of geographical distribution. "Our further knowledge of these minute Crustacea which play so important a part both as ocean scavengers and as themselves a very important constituent of the food of fishes and other animals, would be largely increased if other navigators would kindly, in the interest of science, follow the example of Captain Wyse and Mr. Herdman, and so enable us to have collections from all parts of the world."

Plankton of Fresh-water Lakes.†—Mr. C. Dwight Marsh gives a useful account of the problems and methods of lacustrine plankton research, and a summary of results attained with especial reference to his own experience of North American lakes. The usefulness of the address is increased by the hints that are given as to the most profitable lines of work.

Lake Plankton.‡—Dr. O. Fuhrmann studied the plankton of the Lake of Neuchâtel from October 1896 to September 1897, and compares his results with those of other observers (Apstein and Zacharias) on the lakes of North Germany. Neuchâtel proves to be less rich in plankton than the northern lakes, and shows other striking differences. There are two marked maxima, in December and May respectively, and two marked minima, in March and August. The latter are due to the poverty of Algæ, Daphnids, and Copepods; the December maximum to the abundance of *Asterionella*, *Fragilaria*, *Bythotrephes*, and *Bosmina*; the May maximum to the last two and also to *Dinobryon*, *Cyclops strenuus*, and *Daphnia hyalina*. In the Swiss lakes the surface, so rich in life in the German lakes, is almost devoid of life during the day, the Copepods, Daphnids, and Rotifers performing daily migrations not indicated in the northern lakes. This the author ascribes to the extreme transparency of the Swiss lakes, which renders the illumination of the surface waters too intense during the day for animals sensitive to light.

Swiss Plankton.§—Dr. G. Burckhardt publishes an elaborate and thorough paper on the animal plankton of the larger Swiss lakes. Its scope may be indicated by the following brief list of headings. Under the title of hydrography we have a general discussion of the physical geography of the lakes, their classification, and general characters. This is followed by a faunistic part, which gives lists of the organisms obtained in the lakes, with authorities and references in each case, and then by a systematic section in which the systematic position and rela-

* Trans. Liverpool Biol. Soc., xiv. (1900) pp. 262–94 (1 pl. and 3 figs.).
† Science, xi. (1900) pp. 374–89.
‡ Arch. Sci. Phys. et Nat., viii. (1899) pp. 485–7.
§ Rev. Suisse Zool., vii. (1900) pp. 353–713 (5 pls.).

tions of the organisms (except Protozoa) are considered in most careful detail. Finally, a zoogeographical section is devoted to a brief consideration of the distribution of the species, the occurrence of local variation, and the zoological grouping of the lakes. The paper is described as introductory to a more biological treatment of the subject, and though from its nature it does not lend itself to the purposes of an abstract, is of great importance to the student of fresh-water plankton. The careful systematic treatment of such a difficult group as the Cladocera, for example, should be specially mentioned as likely to prove of enormous value to future investigators, while the extraordinarily careful treatment of variation should make the paper a mine of wealth to students of evolution.

River Plankton.*—Herr S. Prowazek studied the potamo-plankton of the Moldau and Wotawa (S. Bohemia), during August, September, and part of October 1898, and gives lists of the organisms found. Both streams showed great poverty of organic life, especially as regards the Metazoa. There were no Crustacea and very few Rotifers, and among the Protists truly pelagic forms were found to be rare. Many characteristic forms disappeared in October when the water rose.

Organic Evolution and Altruism.†—Mr. W. H. Wynn has an interesting essay on this subject. Following, for instance, the authors of 'The Evolution of Sex' (a work which seems to have been utilised not a little though never referred to), he points out the neglect of the altruistic factor in considering the problem of organic evolution.

What is Life?‡—Prof. F. J. Allen argues for the following views. Every vital phenomenon is due to a change in a nitrogenous compound, and, indeed, in the nitrogen atoms of that compound. There is no vital action without transfer of oxygen, and the transfer is performed by nitrogen (often assisted by iron). In the anabolic action of light on plants, the nitrogen compounds are affected primarily, and the CO_2 and water secondarily. In the living and active molecule the nitrogen is situated centrally, and is often in the pentad state. In the dead molecule it is usually peripheral and in the triad state. The oxygen store of the *living* molecule is more or less united with the nitrogen, but passes to some other element at death. The nitrogen of the living molecule is combined in a complex and perhaps changeable manner, the compound resembling in some respects the cyanogen compounds, in other respects the explosives such as nitro-glycerin. Life in its physical aspect is the culmination of that chemical instability in certain elements which has always kept them circulating at the earth's surface.

Tunicata.

Pacific Tunicata.§—Dr. C. Ph. Sluiter describes the Tunicates of Schauinsland's Pacific Expedition. As is usually the case with Tunicates from little-known regions, the collection includes a large number (25 out of a total of 36 species) of new species; but it is to be noticed that in many cases, notably in the genera *Leptoclinum*, *Amaroucium*, and *Poly-*

* Verh. Zool.-bot. Ges. Wien, xlix. (1899) pp. 446-50 (1 fig.).
† Proc. Birmingham Nat. Hist. and Phil. Soc., xi. (1898-99) pp. 1-43.
‡ Tom. cit., pp. 44-67.
§ Zool. Jahrb. (Abt. Syst.), xiii. (1900) pp. 1-35 (6 pls.).

clinum, the distinction of species is beset with great difficulties. A remarkable fact is the total absence of members of the family Ascididæ, which appear to be rare in the Pacific Ocean. Among the social forms a new species occurs, named by the author *Ecteinascidia diligens*, which differs from the other members of the genus, and indeed from the other members of the Clavellinidæ, in possessing an entire dorsal lamina in place of dorsal languets. The author does not however believe that the condition of the dorsal lamina is of sufficient importance to justify the erection of a new genus, for the genus *Cynthia* exhibits both conditions. The new species is further remarkable for a large brood-chamber which appears when numerous embryos are present.

Balanoglossus as a Generic Name.*—Dr. S. F. Harmer considers that Spengel was not justified by the laws of zoological nomenclature in retaining the name *Balanoglossus* in his Monograph in a restricted sense, for it is merely a synonym for *Ptychodera*. Dr. Harmer proposes the name *Balanocephalus* as a generic name for the species included by Spengel in the old genus. The type species would then be *B. kupfferi* v. Willemoes Suhm.

INVERTEBRATA.

Mollusca.

γ. Gastropoda.

Cell-lineage in Aplysia.†—Dr. D. Carazzi has followed the earlier stages of development in *Aplysia limacina* L., with special reference to the spiral cleavage and the cell-lineage. He finds that oviposition occupies a period of 4–5 hours, the calculated number of eggs laid at one time being about three millions. Fertilisation is internal, but maturation does not occur till after deposition, the spermatozoon meanwhile lying inert within the ovum. The first segmentation furrow appears from four to five hours after deposition. The blastomeres are markedly unequal, and the author was enabled to study in detail the remarkable phenomena associated with their formation, and to correct certain errors of previous observers. The exact manner of formation cannot be made clear without figures. In regard to the further history of segmentation and of the resultant blastomeres, perhaps the most important point is the origin of the mesoblast from the division of the cell called 4 *d* in Conklin's nomenclature. This method of origin of the mesoblast has now been described among the Mollusca in fifteen Gastropods, two Lamellibranchs, and *Ischnochiton* among Amphineura. The author believes that it will also be found to occur in other Mollusca, when embryologists become more conscious of the necessity of making observations on entire eggs instead of relying wholly on sections, and cease to allow their work to be dominated by the gastrula theory. The paper also includes a brief general discussion of the origin and significance of the mesoblast.

Morphological Notes on Tectibranchs.‡—Dr. G. Mazzarelli discusses the structure of the liver, the reno-auricular communication,

* Proc. Cambridge Phil. Soc., x. (1900) pp. 190–1.
† Anat. Anzeig., xvii. (1900) pp. 77–102 (6 figs.).
‡ Biol. Centralbl., xx. (1900) pp. 110–20 (figs. 14–24).

the optic ganglion in *Aplysia*, &c., the organs of Hancock, and the systematic position of the group.

Sensory Cells in Mouth-cavity of Helix.*—Dr. H. Smidt adds a brief note to his previous paper on this subject. From a comparison of the "polype-cells" of the buccal cavity with the corresponding sensory structures found on the large tentacles, he has found reason to believe that the hair-like processes of the cells are capable of spontaneous movements, by means of which they escape the impact of stimuli of too great force.

Histology of Nervous System in Helix.†—Dr. H. Smidt has employed Golgi's method for the solution of the problem of the morphological value of certain cells in the nervous system of the snail, to which he has given the name of companion-cells. He finds that in the case of peripheral nerves these companion-cells are definitely connective-tissue cells, and vary according to the nature of the structure they surround. It is otherwise with the cells found in the radially arranged septa which divide the great nerve-trunks and the commissures into three-sided prisms. These have a system of fibrillæ which recalls that of the glia-cells of vertebrates, and may justly be called glia-cells. In the ganglia of the snail, multipolar cells occur which are connected by transitional forms with the glia-cells of the nerves, and which again recall the glia-cells of vertebrate ganglia. These cells do not appear to send prolongations into the ganglion-cells, but they cling very closely to them.

Anatomy of Triboniophorus.‡—Dr. Wilhelm Pfeiffer has studied the structure of three specimens of this little-known genus. The specimens were obtained from Brisbane, and proved to belong to a hitherto undescribed species, named *T. brisbanensis* by the author. Among the more remarkable characteristics are the following. There are only two retractile tentacles, which bear the eyes and are moved by four posterior retractors and two anterior retractors. The pulmonary chamber forms a system of tubes which are surrounded on all sides by the blood of the dorsal sinus, pulmonary vessels being absent. The ureter is complexly coiled, and is ciliated in certain areas. In the middle of the dorsal surface there is a shell-sac, which contains a calcareous rod and possesses a glandular diverticulum. The organs of the pallial complex are separated from the body-cavity by a muscular diaphragm, and between diaphragm and dorsal body-wall there is a remarkable sense-organ, apparently homologous with the osphradium of the Basommatophora. It is supplied by two stout nerves. The organs of the body-cavity consist of the digestive system, the genital apparatus, and the nervous system. The stomach is tubular, and is furnished with a cæcum, into which one of the three hepatic ducts opens. The paper contains a table showing the relation of the new species to those previously described; but the anatomy of the latter is imperfectly known.

New Abyssal Gastropod.§—MM. Ph. Dautzenberg and H. Fischer describe a remarkable mollusc dredged by the 'Princess Alice' off the

* Anat. Anzeig., xvii. (1900) pp. 170–2 (2 figs.). Cf. *ante*, p. 37.
† Arch. Mikr. Anat., lv. (1900) pp. 300–13 (1 pl.).
‡ Zool. Jahrb. (Abt. Anat.), xiii. (1900) pp. 293–358 (4 pls.).
§ Bull. Soc. Zool. France, xxiv. (1899) pp. 207–11 (4 figs.).

Azores at a depth of 1557 metres. Numerous specimens were found attached to a fragment of a Cephalopod beak. The new form is described as *Bathysciadium conicum* g. et sp. n., and some account of its structure is given by Prof. Paul Pelseneer. It has a simple conical shell, is without gills or ctenidia, has one auricle, a nervous system like that of the Patellidæ, two remarkable otocysts, each containing a single spherical otolith, and a long radula with ten teeth in a row. There are two nephridia, the left being larger than is usual in the Patellidæ. The animals are hermaphrodite, and there is a long copulatory organ. As to the systematic position, the animal has the general characters of the limpets, but differs sufficiently from the members of the existing families to merit the erection of a new family for its reception.

Two New Neomenians.*—Dr. G. Pruvot describes *Stylomenia salvatori* g. et sp. n., which exhibits in its main features transitional characters of much interest. Like the genus *Ismenia*, it must be referred to a primitive group, connected on the one hand with the tribe of Proneomenidæ, and on the other hand with the Neomenidæ. A second form is *Strophomenia lacazei* g. et sp. n., which is probably derived from *Rhopalomenia aglaopheniæ* or some adjacent form. It most closely resembles *Pruvotia sopita*, and perhaps an Australian *Notomenia* described by Thiele. It represents, in any case, one of the most modified Neomenians, degenerate under the influence of parasitism.

δ. Lamellibranchiata.

Locomotion in Solenomya and its Relatives.†—Dr. G. A. Drew notes that the movements of burrowing and the muscular systems are quite similar in all the three genera *Nucula*, *Yoldia*, and *Solenomya*. He takes *Yoldia* as an example. The movements of burrowing consist of thrusting the closed foot far out of the shell anteriorly, spreading the flaps, and withdrawing it with the flaps spread. The spread flaps are closed together when they come to the margin of the shell, and the foot is ready for another thrust. If these movements take place in mud, they will cause the animal to change its position. The closed foot is wedge-shaped, and easily penetrates the mud, while the spread flaps form a very perfect anchor. Anchored in this way, when the retractor muscles of the foot contract, the shell is pulled to the position of the flaps. As repeated thrusts and retractions follow each other with great rapidity, the animal can bury itself very promptly—seven or eight inches in a very few seconds. What special enemies they have has not been determined, but it seems that flounders and cormorants feed upon them. With regard to these enemies this method of escape must be very effective.

Another combination of movements common with *Yoldia*, and frequently performed by *Solenomya*, are the movements of leaping, probably of importance when the animal finds itself stranded on some hard smooth surface where the movements of burrowing are not effective. The foot is bent back under the valve on which the specimen is lying, the flaps spread, the shell turned nearly on its dorsal border, and the expanded disk planted on the bottom. The posterior foot-muscles then contract with a sudden jerk. If the foot remains firm on the disc, this results in

* Arch. Zool. Expér., vii. (1899) pp. 461–509 (3 pls.).
† Anat. Anzeig., xvii. (1900) pp. 257–66 (12 figs.).

turning the shell end for end and frequently throwing it some inches. If the shell overbalances the foot, as more frequently happens, the foot shoots anteriorly with the flaps spread, with a speed peculiar to this movement. Starting with a direct push on the bottom (of the aquarium) and followed by that upon the water, such a movement usually results in a very considerable leap; the shell being thrown posteriorly. These leaps follow each other so rapidly that it frequently happens that the shell hardly touches bottom before another leap is made. In this case the protruded foot is bent dorsally and then makes an antero-ventral sweep, the flaps being spread at the instant the sweep begins, and shut together when the foot is at its greatest protrusion. The musculature involved is then discussed.

There is still another method of locomotion to be described,—that of swimming. In *Solenomya*, the anterior end of the shell is pointed forward, and the movement consists of a series of short darts that remind one of the swimming of a squid. Each dart is accompanied by certain movements of the foot that are very misleading when considered by themselves. It does not burrow through the water, but moves by a somewhat complex process of expelling jets of water. Very possibly the jets are of use in cleaning the mantle chamber and burrow, and the animal has made use of them secondarily for locomotion.

Chinese Mollusca.*—M. Bavay notes the discovery in South China of *Unio affinis* Hende, a species which, like many of its allies from the Yang-Tsé-Kiang, shows a strong resemblance to the *Unios* of North America. The suggestion of affinity between the Molluscan fauna of the two countries is confirmed by two other facts of similar nature. In the north of Tonkin there occurs a species of *Anculotus* Say, a member of the family Strepomatidæ, hitherto supposed to be confined to North America. In the Yang-Tsé-Kiang and its tributaries the same or a closely allied species of *Anculotus* occurs, in company with what appears to be a species of *Pleurocera*, another Strepomatid hitherto only known from North America.

Arthropoda.

a. Insecta.

Census of an Ant-hill.†—Prof. E. Yung has tried to take a census of the ant-hills of *Formica rufa*. His method was to place a board of wood on the hill, to brush off the ants which immediately cover it into a vessel with spirits of wine, and to repeat the operation for an hour or two, day after day, and even week after week, until the nest was thoroughly depopulated. The results were :—

Nest.	Diameter of Base. m.	Height. m.	Population.
A	1·60	0·70	53,018
B	1·28	0·55	67,470
C	1·60	0·60	19,933
D	1·40	0·65	93,694
E	0·95	0·45	47,828

* Bull. Soc. Zool. France, xxiv. (1899) pp. 212–3.
† Arch. Zool. Expér., vii. (1899) Notes et Revue, pp. xxxiii–v.

To each total 10,000 may be added for those not captured. Even then it will be seen that most are under 100,000, that there is considerable variety, and that there is a proportion between size of nest and number of inhabitants. Yung thinks that both Forel and Lubbock have exaggerated the numbers.

Ants in Artificial Nests.*—Prof. H. Reichenbach has been very successful in keeping ants in nests made of plaster of Paris and containing chambers covered with small mirrors. In such nests he has kept many species, and has made a variety of observations on their habits. In regard to the psychical activities of the ants, the author is inclined to agree with Forel that these depend primarily upon inherited automatically acting instincts, but he does not deny the ants the power of profiting by experience to some extent.

Choice of Colours by Insects.†—After a review of the recent literature on this subject, Prof. F. Plateau gives an account of further experiments which confirm his previous conclusion that colour is not the primary factor in attracting insects to flowers. Although flowers are undoubtedly seen by insects from a distance, either from their colour or from some other contrast with their surroundings; when they once reach the flowers, it is perfectly indifferent to them what their colour may be—blue, red, yellow, green, or white—if they differ from one another in no other respect.

Vision of Anthidium manicatum L.‡—Prof. F. Plateau has made observations on the visual power of this bee, one of the Megachilidæ. Superficial observations suggest that it has excellent sight and can distinguish the form of stationary objects with precision; but more careful observation of the way in which the females behave to flowers leads to a modification of this conclusion. Similarly, as to the male, he passes close by the female when she is resting and fails to detect her presence; even when she flies he sometimes fails to distinguish between her and other species.

Hexagonal Structure of Beeswax.§—Mr. F. Chapman points out that crystalline structure in the wax has no effect in producing the hexagonal markings seen on the surface of cooling wax, as suggested by Messrs. Dawson and Woodhead. Indeed, the more nearly homogeneous a substance is, the more readily are the hexagons produced. Mr. Chapman doubts whether the phenomenon—which produces the characteristic jointing of igneous rocks—can be compared with the natural cells of honeycomb, for the melting-point of beeswax is too high for it to be supposed that the bees can melt the wax.

Development of Drones.‖—Herr W. Paulcke found, in 8 out of 12 eggs taken from workers' cells about a quarter of an hour after they had been laid, that the sperm-nucleus and its radiate system could be observed. But in 800 eggs from drone-cells no spermatozoon could be detected. Thrice he saw little dark corpuscles which might possibly be sperm-

* Ber. Senckenberg. Naturf. Ges., 1899, pp. 95–6.
† Mém. Soc. Zool. France, xii. (1899) pp. 336–70. Cf. this Journal, 1899, p. 298.
‡ Ann. Soc. Ent. Belg., xliii. (1899) pp. 452–6.
§ Ann. Nat. Hist., v. (1900) p. 320. Cf. this Journal, *ante*, p. 198.
‖ Anat. Anzeig., xvi. (1899) pp. 474–6 (2 figs.).

nuclei. In eggs laid by "fertile workers" no trace of a spermatozoon was to be seen. Thus the author confirms Dzierzon's theory.

New Psychid.*—A. Vayssière and L. Bordas obtained from Timbuctoo a branch of *Mimosa*, bearing some thirty conical cases which proved to be the chrysalides of a hitherto undescribed Psychid. The Psychids are remarkable in that the caterpillar weaves together foreign particles to form a case resembling that of a caddis-worm. In this instance the cases were formed of fine grains of sand, spun together with silk, and, as the insects had reached the chrysalis stage, were hermetically closed, and suspended from the twigs. Within, instead of the developing imago, there occurred in many cases a large number of eggs. These were at first supposed to be the eggs of a parasite; but it was found later that they were the eggs of the Psychid itself. The female never leaves its envelope, but is fertilised within it by the male, and speedily dies, leaving the eggs to develope within the original case. The eggs, chrysalis, and caterpillar are described; but in the absence of the imago the species is not defined. In one of the cases a larva of a species of Braconidæ was found, and is described.

Ocelli in Tipulidæ.†—Dr. O. E. Imhof briefly notes the discovery in the streets of Baden of a new species of *Trichocera* Meigen., which possesses three ocelli. These have not been previously described in the family, which at present contains 365 species. The new species has also five-jointed palps, but the basal joint is very short, and has possibly been merely overlooked hitherto.

Genital Organs of Zaitha.‡—Mr. T. H. Montgomery, junr., points out that, while the female genital organs of *Zaitha* and *Belostoma* are quite similar, the male organs are very different. In *Belostoma* each testis consists of a single convoluted follicle, in *Zaitha* of five distinct and well-separated nearly straight follicles. As the value of the genitalia in taxonomy has been well vindicated, the fact pointed out indicates that the two genera are by no means so closely related as they have been assumed to be. In fact it might be proper to separate them into different families, and *Zaitha* is perhaps nearer to *Nepa* than to *Belostoma*, with which it has been usually associated.

American "Kissing-Bug."§—P. Serre, in the course of some general observations on the zoology of California, gives an account of this insect, whose attacks created a panic in parts of America during last year. The true "kissing-bug" is *Melanolestes picipes*, but another less venomous species, *M. abdominalis*, is also abundant in California. During the day the insect is to be found under stones, fallen trees, &c., but it is active at night, and attacks the lips of sleepers, probably because the epidermis there is thin enough to be readily pierced. The bite produces serious effects, and may result in death in the case of children or persons of impoverished blood. The effects are probably due to the poison injected from poison-glands, but it has also been suggested that they are due to bacteria introduced into the blood-system by the insect.

* Ann. Fac. Sci. Marseille, x. (no date) pp. 7–22 (1 pl.).
† Zool. Anzeig., xxiii. (1900) p. 116.
‡ Amer. Nat., xxxiv. (1900) pp. 119–21 (2 figs.).
§ Bull. Soc. Zool. France, xxiv. (1899) pp. 197–203.

Apterygogenea from South Russia.*—Einar Wahlgren describes a small collection of these insects made by Dr. E. Lönnberg in the vicinity of the Caspian Sea, which includes a new species of Collembola. Collembola have not hitherto been described from the Caspian area, and the new species, named *Entomobrya lönnbergi*, shows some interesting colour variations. Most of the specimens were white with black eye-spots and a small black spot between the antennæ. Others were elaborately marked with black, the markings showing great constancy and regularity. Between the two extremes a number of connecting links exist, showing that the markings disappear in regular order. The other species found have a very wide distribution.

Structure of Collembola.†—M. Victor Willem has made a detailed investigation of twenty-eight members of this little-known order. He finds that, except in *Smynthurus*, the tracheal system is totally absent, and that the head contains two pairs of metameric cephalic glands, an archaic condition which recalls that seen in Myriopods. In the Thysanura a single pair of glands only is present. In the Collembola, as in Myriopoda, a post-antennary sense-organ is present, while in Thysanura it is absent. The Collembola further differ from the Thysanura in possessing no Malpighian tubules, the function of excretion being carried on entirely by the fatty body which contains concretions of sodium urate. In regard to the ovogenesis, the author has obtained some novel results; he finds that the ova are smaller than the nutritive cells, and actually penetrate into these, so that previous observers have mistaken follicular cells for ova, and ova for vitelline cells. According to the author a similar error has been committed in the case of *Campodea*. As to the relations of the Collembola, the author believes that they constitute a phylum entirely distinct from the Thysanura, and of more ancient origin. They are most nearly related to the Thysanura Entotropha. The author adheres to the view that the Apterygota as a whole are the most primitive of existing insects. The paper as yet is published in brief abstract only.

South American Insects.‡—Filippo Silvestri briefly notes the occurrence of *Projapyx stylifer* O. F. Cook, previously only known from Western Africa, in the Argentine Republic. As yet one specimen only has been seen. In the same note the author describes a new member of the Polyxenidæ, as *Synxenus orientalis* g. et sp. n. The generic definition is as follows:—Segmenta 2–11, præter penicilla lateralia, seriebus duabus squamarum ornata. Segmentum ultimum conicum apice setis longis partim arcuatis serratis radiatim dispositis instructum.

Succession of Mouth-parts in Hydrophilus.§—Herr P. Deegener has studied a complete series of stages in the life-history of this beetle, in order to test Fr. Meinert's conclusion that in insects with metamorphosis the succession of the mouth-parts is the very reverse of that usually accepted. He finds that the order of succession stated by Savigny—(1) mandibles, (2) first maxillæ, (3) labium—is quite correct.

* Öfversigt k. Vetensk. Akad. Förhandl., lvi. (1899) pp. 847–50 (3 figs.).
† Bull. Acad. R. Belg., xii. (1899) pp. 760–7.
‡ Zool. Anzeig., xxiii. (1900) pp. 113–4.
§ SB. Ges. Nat. Freunde Berlin, 1899, pp. 44–9 (3 figs.).

Protective Coloration.*—V. Brandicourt gives a summary of "an interesting and very detailed" study on the protective coloration of insects by Dr. G. P. Marott.† He deals with the caterpillars of *Papilio podalirius* on *Prunus spinosa*, *Parnassius apollo* on *Carduus nutans*, *P. mnemosyne* on *Sedum telephium*, and so on. Perhaps the reference, though belated, may be useful.

β. Myriopoda.

Peculiar Sense-organ in Glomeris.‡—Herr Hennings describes the *foveæ laterales capitis*, which Leydig observed in 1864 on *Glomeris*, which have also been known as Tömösvary's organs since their re-description by Tömösvary in 1882. They are horse-shoe-shaped sensory grooves between the antennæ and the eyes in species of *Glomeris*, and occupy a similar position in the blind *Typhloglomeris cœca* Verh. A sensory cushion of elongated epithelial cells is supported by a chitinous ridge and protected by lateral flanges; there is a special nerve from the brain; the whole is probably an organ of chemical sense.

Palæarctic Myriopoda.§—Dr. Carl Verhoeff, in the course of his investigations on this subject, has come to the Lysiopetalidæ, whose morphology, phylogeny, and classification are discussed in the present instalment of his work. As in the Chordeumidæ, the copulatory organs are very important in classification. In the Lysiopetalidæ one pair of gonopods only is present, and those at each side consist of a gonocoxide and a telopodide. The supporting piece, or tracheal pocket, at either side, and the ventral plate, are also of importance in classification. It is characteristic of the family that the sperm-canal is confined to the femoral part of the telopodide; the canal begins as a distended pit at the base of the telopodide, and ends on a lateral outgrowth of the femoral region to which the name of *ramus canaliculi* is given. The family Lysiopetalidæ is divided by the author into two sub-families, the Callipodinæ and the Lysiopetalinæ, according to the condition of the supporting pieces, and is associated with the family Polydesmidæ to form the sub-order Proterospermophora, characterised by the presence of a single pair of gonopods, consisting of gonocoxide and teleopodide, the latter being furnished with a sperm-canal and having muscles attached. The paper includes a revision of the Lysiopetalidæ, with descriptions of new species.

δ. Arachnida.

Habits of Ischyropsalis helwigii Pz.‖—Dr. Carl W. Verhoeff has kept specimens of this somewhat rare member of the Opilioninæ, and finds that it appears to feed chiefly upon living Molluscs. Insects, small Arachnids, Crustacea, &c., were rejected, but both shelled and naked snails were eagerly consumed. The powerful jaws are used to crush the shell, and the other peculiarities of structure are adaptations to this predatory life.

* Bull. Mens. Soc. Linn. Nord France, xiii. (1897) received 1900, pp. 282–5.
† Boll. Naturalista, 15th June and 15th August, 1897.
‡ SB. Ges. Nat. Freunde Berlin, 1899, pp. 39–44 (2 figs.).
§ Zool. Jahrb. (Abt. Syst.), xiii. (1900) pp. 36–70 (3 pls. and 3 text-figs.).
‖ Zool. Anzeig., xxiii. (1900) pp. 106–7.

Habits of Galeodes and Buthus.* — Dr. Einar Lönnberg has kept specimens of *Galeodes* in confinement, with a view of determining the disputed question as to the presence or absence of poison-glands. The animals ate flies readily, but these were crushed by the powerful jaws, and there seemed no evidence that the victims were poisoned. Some interesting observations were made on specimens of *Galeodes araneoides* and the scorpion *Buthus rufens* kept together in a confined space. On one occasion the *Galeodes* succeeded in cutting the poison-gland of the scorpion, and was then able to overcome it by the strength of its jaws, but the scorpion showed no symptoms of poisoning. On another occasion the scorpion was successful in stinging the *Galeodes* on the ventral surface of the thorax. The sting produced instantaneous paralysis, but this passed off, and the *Galeodes* subsequently recovered. The jaws of *Galeodes* are not strong enough to pierce the human skin, and the bite produces no poisonous effect, in spite of the prevalent opinion to the contrary. As winter approaches, the animals bury themselves in the sand, using in the process both the two anterior pairs of legs and the jaws, which again speaks against the view that the latter contain poison-glands. Observations on the scorpions further showed that these do not use their stings in their combats with one another, and that there is no evidence that they commit suicide if threatened by fire. When digging in the sand *Buthus* uses the three anterior pairs of legs instead of only two pairs like *Galeodes*.

Geographical Distribution of Opilionidæ.†—Dr. J. C. C. Loman has investigated the distribution of this small and compact order, with a view to finding what light the distribution throws upon the relations of the members of the order. He finds that the order is constituted of three sub-orders, Insidiatores, Laniatores, and Palpatores. Of these, the first two are much older than the third, but their relative age cannot yet be determined. The Insidiatores occur in the most southerly parts of the globe, in Chili, South Africa, and South Australia, where they must probably be regarded as the remnants of a formerly much richer fauna. The Laniatores also occur in these southern regions, but in addition are to be found in the tropics, and extend to the sub-tropical zone of the northern hemisphere. Finally, the Palpatores are to be found (1) in the extreme south; (2) in the tropics, where they are confined to the higher mountains; and (3) they constitute the entire Opilionid fauna of the sub-tropical and temperate zones of the northern hemisphere. As the North Pole is approached their numbers rapidly diminish. The occurrence of the Palpatores in the mountains of the tropics is to be correlated with the remnants of a glacial flora and fauna to be found there.

Hydrachnids from the Azores.‡—F. Kœnike notes that the Azores are singularly poor in this group. In 1887 Prof. Barrois described two forms from the islands as *Arrenurus chavesi* Barr., and *Sperchon glandulosus* Kœn. Subsequently he found that the former, which had been based on a female specimen only, was *A. emarginator* O.F.M. Kœnike found that the second form was *S. brevirostris* Kœn., and collections made

* Öfversigt K. Vetens.-Akad. Förhandl., lvi. (1899) pp. 977–83.
† Zool. Jahrb., xiii. (1900) pp. 71–104 (1 pl. and 4 maps).
‡ Bull. Soc. Zool. France, xxiv. (1899) pp. 204–7 (3 figs.).

during the Prince of Monaco's expeditions show that this form is abundant in the Azores. The last-named collections contain this species only; and as both sexes occur, the author has been enabled to draw up a detailed comparison between the male of *Sperchon glandulosus* and that of *S. brevirostris.*

ε. Crustacea.

Notable Crustacea.* — Dr. A. Alcock describes a new hermit-crab (*Chlænopagurus* g. n.), noteworthy (1) in having for its refuge, not the usual mollusc shell, but a sheet or blanket formed by the cœnosarc of a colony of sea-anemones; (2) in being—as far as the male is concerned—symmetrical; and (3) in having the appendages of the third and fifth somites of the male and of the second and fifth segments of the female present on the right or left side indifferently. The sea-anemone, belonging to the Zoanthidæ, merely forms a sheet, which the crab simply tucks under its telson by one end and pulls over its back by the other end—the polyps seeming to have no power of adhesion and to depend on the crab for a fast hold. The peculiar interest of the case is that the two animals seem to have become directly adapted to one another, and to be incapable of a separate and independent existence.

Alcock also describes *Domecia glabra* sp. n., distinguishing it from its sole congener *D. hispida*, and makes notes on *Latreillia pennifera* sp. n., and *Latreillopsis bispinosa.*

North American Cancroid Crabs.†—M. J. Rathbun gives a synopsis of the tribe of Cyclometopous or cancroid crabs (including Cancridæ, Pilumnidæ (= Xanthidæ), and Portunidæ, with a key to the genera and species.

Alleged Rudimentary Eyes of Niphargus.‡ — Prof. F. Vejdovsky finds that in none of the species of *Niphargus* which he has investigated is there any organ corresponding to a normal Arthropod eye. Only in *Niphargus puteanus* can there be any suggestion of an eye-rudiment, and even here the degeneration has gone so far that the optic part of the primordium is quite subordinate, and the whole becomes a sinew-like structure bracing the large cerebral ganglion to the wall of the body.

Larva of Epischura lacustris.§ — Prof. C. Dwight Marsh has some notes on the structure of the larva of this Copepod, which is found only in America (its nearest European relative being *Heterocope*), and is remarkable for the very pronounced asymmetry of the abdomen. In the male of *Epischura lacustris* Forbes, not only is the abdomen twisted to the right, but certain of the segments have marked lateral projections which together form a complicated grasping organ. The author deals especially with the male abdomen and the male fifth feet. The fact that the asymmetry of the abdomen and the lateral processes of the segments appear only in the very last stages, points strongly to the probability that this most marked peculiarity is a recent development, and that *Epischura* may be quite closely connected with forms having symmetrical abdomens.

* Journ. Asiatic Soc. Bengal, lxviii. (1899) pp. 111–9 (1 pl.).
† Amer. Nat., xxxiv. (1900) pp. 131–43 (5 figs.).
‡ SB. k. böhmisch. Ges. Wiss., 1900, 12 pp. (1 pl.).
§ Trans. Wisconsin Acad., xii. (1900) pp. 544–9 (2 pls.).

Rhizorhina and Herpyllobius.*—Sören Jensen has many criticisms to make on H. J. Hansen's treatment of the two remarkable Copepod parasites, *Rhizorhina ampeliscæ* H. J. H. and *Herpyllobius arcticus* Stp.-Ltk. He particularly describes the males and the male genital organs. His systematic conclusion is that the family Sphæronellidæ of Giard and Bonnier contains two groups, Choniostomatinæ and Rhizorhininæ; and that *Herpyllobius*, along with some other slightly known forms, is referable to a quite distinct series, to the family Herpyllobiidæ.

British Amphipods.†—Canon Norman gives lists of the species belonging to the families Pontoporeudæ, Phoxocephalidæ, and Ampeliscidæ; and he also notes the species which have been added to our fauna since the publication of Bate and Westwood's book, by D. Robertson, T. R. R. Stebbing, A. O. Walker, J. Hornell, and T. Scott.

Palæarctic Isopoda.‡—Dr. Carl W. Verhoeff, in the course of his studies on the fauna of European caves, discusses some new or little-known members of this group. In regard to the genus *Titanethes*, he finds that the only well-known species, *T. albus* Schiödte, is abundant in the caves of Carniola, while in the caves of Herzegowina it is replaced by *T. herzegowinensis* sp. n. The two species are described in much detail. A new sub-family, the Cyphoniscinæ, is erected for two new genera *Cyphoniscus* and *Leucocyphoniscus*, each known by a single female specimen only, and occurring, the one in a cave in southern Herzegowina, the other under a stone on Monte Generoso in the Alps. The author also records the finding of new somewhat aberrant species of *Armadillidium*, which necessitates the breaking up of the genus into four subgenera.

Annelida.

Maturation and Fertilisation in Annelida.§—Edmond Gathy publishes a beautifully illustrated memoir on the development of the egg and the process of fertilisation in *Tubifex rivulorum* and *Clepsine complanata*. The following are among the more important of the results obtained. In *Tubifex* the nucleolus of the young ovocyte is rich in nuclein; but as the egg developes the nucleolus becomes gradually modified, and ultimately yields a nucleolus which gives no colour reaction for nuclein. A second nucleolus may appear during development, but if so, it does not arise from the first. The nucleolus gradually dissolves within the nucleus before or during the formation of the first figure, and it takes no part in the formation of the figure. Polar corpuscles occur both in the maturation divisions and in the segmentation divisions, and are derived from the nucleus. They are the active agents in the formation of the figures, and determine the appearance of polar spheres and asters. These latter are generally derived from the cytoplasm, while the spindle arises in whole or in part from the caryoplasm. Asters and polar spheres are not permanent cell-organs, but are mere transitory modifications of the cytoplasm, arising under the influence of the polar corpuscles. The nucleus is reconstructed from vesicles de-

* Oversigt K. Danske Vidensk. Selskabs Forhandl., 1900, pp. 61–112 (2 pls.).
† Ann. Nat. Hist. v. (1900) pp. 326–46.
‡ Zool. Anzeig., xxiii. (1900) pp. 117–30 (11 figs.).
§ La Cellule, xvii. (1900) pp. 7–62 (4 pls.).

rived from rods, and these rods or chromosomes do not undergo reduction either before or during the formation of the polar bodies, but only at the beginning of the first figure of segmentation.

In *Clepsine* similar results were obtained in regard to the polar corpuscles, polar spheres, &c., but there are certain complexities in regard to the history of the nucleolus. An interesting point is that when the eggs are detached, and are lying freely in the ovarian cavity, they are still surrounded by their follicular membrane.

American Oligochæta.*—Dr. Gustav Eisen publishes a monograph on this subject, based on collections made in North America, especially on the Pacific coast and the adjacent islands. In Mexico and Central America a form provisionally regarded as merely a sub-species of *Pontoscolex corethrurus* is very abundant, and its minute characters are described in some detail. Among the points regarded by the author as of special protective value, and therefore as helping to explain the wide distribution of the members of the genus, are the following:—(1) In the anterior segments the muscle-layers are separated by spaces, which the author believes enable the body to expand suddenly, and so cling to the burrow; (2) the caudal zone ("zone of growth" of Schmarda) is especially sensitive, and can also suddenly expand, thus enabling the worm to perceive and resist a sudden attack; (3) the posterior end of the body has a corkscrew twist which must also enable the worm to cling closely to the soil; (4) the epidermis contains complex "auditory" cells.

The genus *Ocnerodrilus* is split up into a number of sub-genera, of which one, *Nematogenia*, is characterised by the presence of peculiar spirally coiled lymphocytes (nematocytes), not hitherto described in Oligochætes.

An interesting new species of *Benhamia* is described, which is bright green in colour, and in the position of its spermiducal pores connects the genus with *Dichogaster*. It is indeed now possible to draw up a perfect series from the *Benhamia* condition on the one hand to the *Dichogaster* condition on the other.

In an appendix is a brief but interesting note on the disappearance of native forms before the hardier European species. In California and the Southern States it is now impossible to find in rich garden soil or manure heaps anything but imported species. Among the causes of this replacement the author notices the following:—the native forms are pale-coloured and are more sensitive to heat and light than the hardy deeply-pigmented European species. Again, the imported forms thrive best in cultivated soil, while cultivation drives the native species away. The latter have a short breeding season, and must therefore reproduce less rapidly than the European forms with their longer period of maturity. The replacement takes place, however, in the case of Terricolæ only, few of the European Limicoline forms having as yet obtained a foothold.

Oligochæta of Illinois.†—Mr. F. Smith gives a list of species from this region, and descriptions of two Tubificidæ—*Rhizodrilus lacteus* g.

* Proc. California Acad. Sci., ii. (1900) pp. 85–276 (10 pls.).
† Bull. Illinois Lab. Nat. Hist., v. (1900) pp. 441–58 (2 pls.).

et sp. n. somewhat closely related to *Lumbriculus spiralis* of Leidy, and *Embolocephalus multisetosus* sp. n.

Nervous System of Annelids.*—Dr. J. Havet has employed Golgi's method in the study of the minute structure of the nervous system in certain Oligochætes and Hirudinea. He finds that in the latter the skin contains numerous bipolar nerve-cells, usually arranged in groups, and having protoplasmic prolongations which converge to form a kind of nerve-plate. In Oligochætes these external prolongations are absent. In both, sensory nerves are formed by internal prolongations of these nerve-cells, and these sensory nerves ultimately pass into the ganglia of the ventral nerve-chain. The ganglia have a peripheral coat consisting of several layers of unipolar (Hirudinea and Oligochætes), or bipolar (Oligochætes), or multipolar (Oligochætes) nerve-cells, which are usually pear-shaped, and vary greatly in size. The chief prolongations assist to form a lateral nerve of the same side as that in which the cells lie to which they belong, and they also assist to form a lateral nerve of the opposite side. Most of the important prolongations give off secondary branches, which ramify and intertwine to constitute the dotted substance of Leydig. These secondary branches bear pear-shaped appendices, and end in thickened points. All the nerves are formed by the prolongations of the sensory or motor nerve-cells, and the two kinds of prolongation can be distinguished by their minute characters.

Copulation in Leeches.†—Emile Brumpt reviews the literature of this subject, and gives an account of his own observations in the different groups of Hirudinea, with special reference to the phenomenon of "hypodermic impregnation." In *Hirudo troctina* he was able to observe clearly that one individual acted as a male and the other as a female; the observation was made on two separate occasions, and in both cases the larger individual acted as the male. Similar observations have been made by Etrard for other Gnathobdellidæ. In the genus *Herpobdella* the author confirms Isao Ijima's observation that the spermatophores are deposited on the integument of the body, and believes, contrary to the opinion of that author, that this is the normal method of fertilisation. In *Callobdella* among Rhynchobdellidæ fertilisation is reciprocal, a spermatophore being found in or near the female orifice of each individual at the end of copulation. In *Pontobdella* the author observed the reciprocal deposition of a spermatophore on the surface of each of the copulating individuals; the contents subsequently pass through the skin, which exhibits a permanent mark at the spot. In *Piscicola* the spermatophore is placed in the female orifice, and fertilisation appears to be unilateral. In the case of the Glossosiphonidæ the author has been able to confirm and amplify the statements of previous authors as to the occurrence of the "hypodermic impregnation" of Whitman; but on the other hand, like Kowalevsky, he has been unable to obtain experimental verification of the view that this impregnation results in effective fertilisation. His observations on the subject are as yet incomplete, and the present paper has for its special object the emphasising of the important blanks in our know-

* La Cellule, xvii. (1900) pp. 65–136 (7 pls.).
† Bull. Soc. Zool. France, xxiv. (1899) pp. 221–38.

ledge of the process of fertilisation in different genera, in the hope that observers who have the opportunity will endeavour to fill these blanks. The paper contains some useful hints on habitats, &c., of the less well known species, with notes as to localities where observations may be profitably attempted.

Nematohelminthes.

Moulting and Encystation in Nematodes.* — E. Maupas finds in *Cephalobus ciliatus*, *C. concavus*, *C. truncatus*, *Rhabditis pellio*, *R. caussaneli*, *Leptodera appendiculata*, *Angiostoma limacis*, and *Tylenchus devastatrix*, that the life is divided into five stages separated by four moults. The first four stages are larval, the fifth and last belongs to adult life. Each moult is a complete rejection and renewal of the cuticle. During the exuviation the animals are lethargic for periods varying with the rate of development in the species. Thus in *Rhabditis*, whose larval life occupies 2–4 days according to the temperature, the quiescent phase does not last for more than two or three hours; while in *Cephalobus ciliatus*, which has a larval life of 35–40 days or more, the quiescent stage lasts 2–3 days. The moults correspond to similar stages in development, as shown by the state of the organs generally and of the gonads in particular. Maupas draws an interesting parallel between the moults of Nematodes and those of Arthropods, though he distinguishes the two types of cuticle, and separates moults of metamorphosis from moults of growth. Encystation may occur between the first and third moult, and replaces the second. It is not a phenomenon *sui generis*, but should be regarded as an adaptive modification of the moult. The cyst is incontestably the homologue of the second exuvial casting. Of course, the cysts of *Trichina*, &c., are of a different nature, and should rather be called capsules.

Only the larvæ of the second stage seem to have the power of true encystation, and the chief condition of it is scant nutrition. It is an adaptation to avoid death. Experiments on *Rhabditis teres* show that the encysted larvæ have often a great capacity of resisting desiccation, but sometimes the power is very slight. The power of revivification is a special adaptation to particular conditions of life, and, like all adaptations, it is subject to variation.

Filaria of Human Eye.†—Dr. F. Supino has investigated the species of *Filaria* from the human eye which Grassi called *F. inermis*, and has come to the conclusion that it is identical with *F. apapillocephala* Cond., *F. palpebralis* Pace, *F. peritonæi hominis* Bab., *F. conjunctivæ* Add., *F. dubini* Cond., *F. oculi asini* Cond., and *F. lentis* Dies.

Filaria loa.‡—Prof. R. Blanchard gives a detailed account of this parasite, which occurs beneath the conjunctiva in negroes from the West Coast of Africa. The author studied a mature male and an immature female.

* Arch. Zool. Expér., vii. (1899) pp. 563–628 (3 pls.).

† Atti R. Accad. Lincei (Rend.), ix. (1900) pp. 85–91 (3 figs.).

‡ Arch. Parasitol., ii. (1899) pp. 504–34 (2 figs.). See Zool. Centralbl., vii. (1900) pp. 243–4.

Arctic Nematodes.*—Dr. O. von Linstow describes *Ascaris decipiens* Krabbe from *Trichechus rosmarus*, *Phoca vitulina*, &c. The larvæ live in crowds on the inner wall of the stomach with their heads in the mucous membrane; the adults are free in the intestine. Three larval forms are distinguished. A number of Nematodes from Gadidæ are recorded, while *Thoracostoma denticaudatum* Schn., *Spilophora punctata* sp. n., *Enoplus edentatus* sp. n., *E. communis* Bast., and *Anoplostoma gracile* sp. n., are free-living forms. The author also compares the arctic and subarctic with the subantarctic forms.

Uncinariæ in the Felidæ.†—Dr. L. Cohn finds that three good species of *Uncinaria* infest the Felidæ, and he has been able to make some observations on *Uncinaria perniciosa* from a panther. This form occurred in small dark-coloured nodules in the wall of the small intestine, each nodule containing a number of individuals, the females always being in excess. The nodules lay in the submucosa, and opened into the lumen of the intestine of a small pore. In the intestinal mucus a number of larvæ were found, and the author believes that the life-history is direct, there being no secondary host. The larvæ pass directly into the intestine of the host, and when sufficiently mature invade its wall and cause the nodules.

Platyhelminthes.

Classification of Platyhelminthes.‡—Sig. V. Ariola proposes a new, confessedly somewhat artificial, grouping of Platyhelminthes:—

I. Sub-class. Trematoda.
II. ,, Cestodaria,—Caryophyllidæ and Archigetidæ.
III. ,, Cestoda.
- 1. Order Dibothria.
  - A. Sub-order Atomiosoma:—Ligulidæ, Tricuspidaridæ, Bothrimonidæ, and Cyatobothridæ.
  - B. Sub-order Tomiosoma:—Leuckartidæ, Dibothriorhynchidæ, Dibothriotetrarhynchidæ, and Dibothridæ.
- 2. Order Tribothria = Scyphocephalidæ.
- 3. Order Tetrabothria.
  - A. Sub-order Tetrabothriina (including Mesoporina and Pleuroporina).
  - B. Sub-order Tetracotylina (incl. Mesoporina and Pleuroporina).
- 4. Order Octobothria = Octobothridæ.

Classification of Cestodes.§—Herr M. Lühe criticises Ariola's classification of Cestodes. Thus the order Octobothria cannot be upheld, for the only representative is *Octobothrium rostellatum* Dies. = *Tænia erythrini* Fabr. 1780, which has not been found since the time of Fabricius. Again, as to the order Tribothria, represented by *Scyphocephalus bisulcatus* Riggb., only two of the suckers are comparable to those of *Bothriocephalus*, the third is a quite differently constructed suctorial organ.

* Fauna Arctica (Römer and Schaudinn), Bd. i. Lief. i., Jena, 1900, pp. 119–32 (1 pl.). See Zool. Centralbl., vii. (1900) pp. 244–5.
† Arch. Parasitol., ii. (1899) pp. 5–22. See also Amer. Nat., xxxiv. (1900) p. 72.
‡ Atti Soc. ligust. Sci. Nat., x. (1899) pp. 5–12. See Centralbl. Bakt. u. Par., xxvii. (1900) pp. 345–6.
§ Zool. Anzeig., xxii. (1899) pp. 539–43.

Avian Cestodes.*—Dr. Ludwig Cohn publishes some further (preliminary) notes on this subject. He erects a new genus—*Anomotænia*—for those Cystoidotæniæ which have a double circle of hooks, irregularly alternating genital pores, and numerous testes at the posterior end of the proglottis. The species of this genus offer a remarkable parallelism to the species of *Choanotænia* among Cestodes with one row of hooks. Another new genus, *Anonchotænia*, is erected for a new form which is unarmed, has no rostellum, and displays the peculiarity of union of uterus and shell-gland in the ripe proglottis to form a common chamber containing the eggs.

Rejection of the Species Bothriocephalus cristatus.†—Dr. Bruno Galli-Valerio has had an opportunity of examining this alleged rare parasite of man, which is characterised by the presence of a projecting longitudinal ridge on each of the flat surfaces of the head. On this account Davaine made a species out of it. But the author agrees with Blanchard that it is only *B. latus* slightly disguised by a deformity.

New Heteronemertean.‡—Miss C. B. Thompson describes, from Wood's Holl, *Zygeupolia litoralis* g. et sp. n., one of the Eupolidæ, characterised by the following peculiarities:—(1) A layer of inner circular muscle in the anterior intestinal region, formed by a continuation ventrally of the circular muscle of the proboscis-sheath so as to surround the intestine; (2) a crossing of muscle-fibres from the circular muscle of the proboscis-sheath to the circular muscle of the body-wall; (3) a pair of pits or grooves in the epidermis above the lateral nerves a short distance in front of the end of the anterior intestinal region.

New Diplostomum.§—L. A. Jägerskiöld found in the alimentary canal of *Telmatias major* specimens of what appears to be a hitherto undescribed species of *Diplostomum*, which displays some interesting peculiarities. The buccal sucker is exceptionally large, and between it and the ventral sucker there lie two pits recalling the so-called accessory suckers of *Hemistomum* and *Holostomum* and of the larvæ of *Diplostomum* and *Tetracotyle*. The pits are not like suckers in appearance, and as they have never been previously described in a sexually mature *Diplostomum*, their minute structure was thought to be worth investigation. Sections show that they are surrounded by numerous unicellular glands which open into the lumen of the organ at each side. They cannot therefore be regarded as organs of attachment, and as they are common in the larvæ of other species, the new species, *D. macrostomum*, must be regarded as a primitive form, while the genus itself must be regarded as primitive as compared with the other members of the family.

Genus Clinostomum Leidy.‖—M. Braun comments on the confusion which exists in regard to the species of this genus, and describes in full the nine species which are known from mature specimens. In addition there are not a few specimens of which the young forms only are known. These cannot be definitely included in any species. The genus appears to reach its highest development in South America, and those (immature) forms which have been observed in Central Europe probably have their true home in North Africa or Southern Europe.

* Zool. Anzeig., xxiii. (1900) pp. 91–8.
† Centralbl. Bakt. u. Par., xxvii. (1900) pp. 305–9.
‡ Zool. Anzeig., xxiii. (1900) pp. 151–3.
§ Centralbl. Bakt. u. Par., xxvii. (1900) pp. 33–7 (5 figs.). ‖ Tom. cit., pp. 24–32.

Echinoderma.

Cuvier's Organs in Holothuroids.*—Sig. A. Russo has studied these in *Holothuria forskali* and *H. helleri*, where they arise as evaginations of the cloacal wall directly under the opening of the respiratory trees. The cavity of the diverticulum has its epithelium modified to form the axial canal of the fully formed organ; but sometimes, as in *H. helleri*, this quite disappears. The cœlomic epithelium covering the external surface becomes glandular. Russo regards the organs as equivalent to the interradial cæca of starfishes, and as functionally defensive.

Development of Asterina gibbosa.†—Prof. E. W. MacBride discusses the points at issue between Mr. Seitaro Goto ‡ and himself on this subject, and figures some new sections which he thinks confirm entirely his own views. In the first place, Goto believes that the symmetry of the larva and adult are identical, though this fact is rendered obscure by the bending of the præoral lobe to the right side. MacBride finds no trace of this secondary bending, and believes that the slight and inconstant flexures which may occur, either to the right or the left, are due to the action of preservatives only. He finds no correspondence between the planes of symmetry of the larva and the adult. Further, his renewed observations fully confirm his former statements that the cœlom on each side of the larva is divided into an anterior and a posterior part by a transverse septum, while Goto states that a posterior enterocœle arises at the left side of the larva only. Again, Goto denies that the structure described by MacBride as the right hydrocœle deserves this name, for he believes that it arises from the left cœlomic sac. MacBride holds that this is an error due to the fact that Goto did not observe the earliest stages of the development of the structure. Finally, MacBride is able to confirm his previous statement that the distal portions of the radial perihæmal canals are cœlomic in origin, as against Goto's assertion that they are formed by the hollowing out of masses of mesenchyme.

Connection between Blastomeres in Sea-Urchin Eggs.§—Prof. J. Aug. Hammar discusses the bearing of recent observations on his view that there is a primary protoplasmic connection between the blastomeres of segmenting eggs. The existence of such a connection is denied by no one, but certain authorities have regarded it as being of membranous nature. By a careful comparison of the statements of different observers, the author shows that these all tend to confirm his view that it is truly protoplasmic. Other authorities, however, such as Flemming, admit the protoplasmic nature of the connection, but deny that it is primary. In the investigation of this problem the author has studied the segmentation of the egg in the sea-urchins *Echinus miliaris* and *Amphidetus cordatus*. He finds that in both cases the first segmentation furrow has two components; its outer and less important part is formed by an indimpling, its more central part by a splitting of the protoplasm. This internal cleft constitutes the first rudiment of the segmentation cavity, and at the close of the first segmentation is traversed by a slight protoplasmic band, which connects the two blastomeres. These are also connected together by a

* Monit. Zool. Ital., x. (1899) pp. 133–41 (1 pl.). See Zool. Centralbl., vii. (1900) pp. 140–1.

† Zool. Anzeig., xxiii. (1900) pp. 98–104 (3 figs.). Cf. this Journal, 1896, p. 421.

‡ Journ. Imp. Coll. Sci. Tokio, xii. Cf. this Journal, 1899, p. 40.

§ Arch. Mikr. Anat., lv. (1900) pp. 313–36 (1 pl.).

peripheral ring of protoplasm, placed in the peripheral furrow. Of these two connections the first is very transient, disappearing before the four-cell stage, but the second persists. In the later divisions the segmentation cavity becomes more complex, but always retains its primitive character of a cleft in the protoplasm. In addition to the peripheral protoplasmic band which is undoubtedly primary, other secondary connections of a less constant nature may also occur.

Growth and Food-supply in Starfish.*—Mr. A. D. Mead has made a series of observations on the rate of growth in *Asterias forbesii*, and finds that it is extraordinarily rapid and extraordinarily variable. The date when the larvæ begin to "set" was noticed, and about a month later minute specimens were obtained which were kept as nearly as possible under natural conditions until November. It was found that the rate of growth depended on one factor only—the supply of food; where this is abundant, the starfishes eat voraciously and grow rapidly; where it is scanty, growth is arrested, though the animals may remain perfectly healthy. Again, a starfish does not become sexually mature until it has attained a certain size, so that an abundant food-supply hastens maturity, while an inadequate supply retards it. The growth phenomena of the starfish are thus very different from those of a vertebrate, where the relation between size and age is tolerably constant. A practical corollary is that in observations on variation, size cannot be taken as affording any index of age; this is probably true of other invertebrates also.

'Albatross' Ophiuridæ.†—C. F. Lütken and Th. Mortensen deal with 66 species, of which 53 are new, from the tropical regions of the eastern Pacific. A new genus *Gymnophiura* is established near *Ophioglypha*; the central dorsal part of the disc is more or less naked. Four Atlantic forms were found, and seven others are at least nearly related to Atlantic species. The collection did not include a single viviparous form.

Studies on Synapta.‡—Mr. H. L. Clark has studied *Synapta tenuis* Ayres (= *S. girardii* Pourt. and apparently agreeing thoroughly with the European *S. inhærens*), and *S. roseola* which is a very distinct species. Both forms can be readily kept in aquaria with a deep bed of sand for burrowing in. The reproductive period is in midsummer. The anchors, which increase in size and number at the posterior end, support the animal in its movements in the sand.

Experiments showed that the "auditory vesicles" are not auditory, but statocysts or "positional organs." The ciliated funnels are large "lymph-stomata" and are excretory. Regeneration occurred only on the excised head-portion including the mouth and fore-gut.

Cœlentera.

North Atlantic Hydroida.§ — Kristine Bonnevie reports on the collection of the Norwegian North Atlantic Expedition, which com-

* Amer. Nat., xxxiv. (1900) pp. 17–23 (1 fig.).

† Mem. Mus. Zool. Harvard, xxiii. (1899) 208 pp., 22 pls., 1 map. See Zool. Centralbl., vii. (1900) p. 139.

‡ U.S. Fish. Comm. Bull., 1899, pp. 21–31 (2 pls.). See Zool. Centralbl., vii. (1900) p. 140.

§ Norske Nordhavs-Expedition, xxvi. (1899) 104 pp., 8 pls., 3 figs., 1 map.

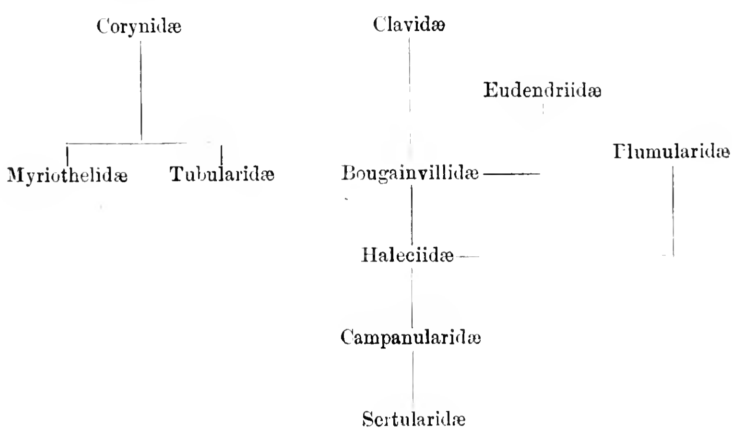
prised 45 species, of which 16 are new. Among them are several forms whose structure is of great interest, and the results of their investigation will to some extent affect the present views with regard to the systematic relationships of Hydroids.

A survey of the various families and genera shows a progress from homogeneity to more or less high differentiation. This is most noticeably expressed in the position of the reproductive elements (gonophores) in the colony. With *Clava* as a point of departure, we see in the athecate hydroids which have spindle-shaped hydranths with filiform tentacles a series of stages in differentiation. All the hydranths in a colony of *Clava* bear gonophores; there is thus complete homogeneity within the colony. The same is the case with *Perigonimus*, where the gonophores are found scattered over stems and branches throughout the colony. A somewhat higher stage is seen in *Bougainvillia*, the gonophores being congregated on the stems of a few hydranths, while the rest of the colony is sterile, the earliest commencement of blastostyle formation. In *Dicoryne* and *Hydractinia*, the blastostyle formation is complete, as those hydranths which bear the gonophores are more or less atrophied, and are thus no longer used in nutrition.

From these we come to the thecophorous hydroids, where the unity of the atrophied hydranth and its gonophores is yet more distinctly emphasised by their being covered with a common chitinous sheath.

Starting from *Coryne*, and looking at the families that must be derived from it, we see the same development, but with greater breaks. In this series the differentiation is found to be yet further advanced than in *Hydractinia*, the blastostyles (atrophied hydranths) being completely transformed, and from representing persons in a colony have become organs in a person. This change is introduced in *Myriothela*, where the blastostyles, which exactly resemble those in *Hydractinia*, are found on the lower part of the only unatrophied hydranth in the colony. In *Tubularia* it is found at its highest degree of development, the blastostyles, which are scarcely recognisable as such, being placed like a circle of raceme-like organs within the hydranth's proximal crown of tentacles.

The following scheme of derivation is proposed :—



At present, the two lines of evolution represented by the Corynidæ and Clavidæ must be left distinct. In the family Corynidæ there is a development in two directions, towards Myriothelidæ (*C. gigantea*) and towards Tubularidæ. The family Pennaridæ dissolves itself into Corynidæ and Tubularidæ. The other branch of atheeate hydroids, with Clavidæ as its starting point, forms a fairly compact series; the Bougainvillidæ deserve to be kept distinct, and the Eudendridæ have a peculiar position as an independent family. The Haleciidæ form the starting-point for the various families of the thecophorous hydroids, and are in turn derived from Bougainvillidæ. Here, as in many other points, K. C. Schneider's arguments are accepted. In Haleciidæ, the genus *Ophiodes* forms the transition to Plumularidæ, while, on the other hand, the Campanularidæ must also seek their origin in this family.

Caryophyllia of Port-Vendres.*—Prof. H. de Lacaze-Duthiers discusses a peculiar habitat and the associated structural peculiarities. The form in question seems to be *C. clavus*, which usually lives at a depth of 200 metres. The embryos have been carried into a novel environment, and the result is a local modification. They multiply by forming "bouquets" by the superposition and fixation of individuals which show neither fissiparity nor blastogenesis.

Porifera.

Skeleton of Astrosclera.†—Mr. J. J. Lister, in describing the structure of *Astrosclera willeyana*, a new sponge obtained by Dr. Willey in the Loyalty Islands, points out certain resemblances between its skeleton and that of certain fossil sponges belonging to the Pharetrones. The elements of the skeleton differ however in structure, for while those of *Astrosclera* are polyhedral masses consisting of radially arranged crystals of aragonite, those of the Pharetrones are more or less modified three- or four-rayed spicules of calcite. In certain specimens of Pharetronids from the Tyrol, however, the skeleton has a radiating structure resembling that of *Astrosclera*. Close examination confirms the usual view that this radiation is secondary and due to recrystallisation; but the fact of its occurrence as the result of a physical process in Pharetronids, and as the result of the activity of living protoplasm in *Astrosclera*, is of some importance in relation to the problem of the origin of sponge-spicules.

Species of Hyalonema.‡—Prof. F. E. Schulze finds that *H. affine* W. Marshall, *H. apertum* F. E. Sch., and *H. mährenthali* F. E. Sch., must be united in one species. But the Japanese and Indian specimens are distinct enough to warrant their being regarded as sub-species,—*H. affine japonicum* and *H. affine reticulatum* respectively.

Protozoa.

North Atlantic Thalamophora.§—Herr Hans Kiær reports on the collection of the Norwegian North Atlantic Expedition (1876–8). There

* Arch. Zool. Expér., vii. (1899) pp. 529–62 (1 pl.).
† Proc. Cambridge Phil. Soc., x. (1900) pp. 189–90.
‡ SB. Ges. Naturfreunde Berlin, 1899, pp. 112–29 (1 fig.).
§ Norske Nordhavs-Expedition, xxv. (1899) 14 pp., 1 pl. and 1 map.

were no pelagic forms, though *Globigerina bulloides* is known to be abundant in the plankton between Trondjem and Iceland. Nor were there any Radiolarians, though a few species, e.g. *Acanthonia echinoides* Haeckel, is known to appear sometimes in immense numbers in plankton off the west coast of Norway. The author's tables take account of 166 species, and he has special notes on *Crithionina abyssorum* sp. n., *Biloculina lævis* Defrance, *Bigenerina sarsi* sp. n. (which is dimorphic like the former species), and *Lagena lucida* Will. In his survey of the occurrence of Thalamophora in all the ocean-depths investigated by the expedition, the author distinguishes three different centres of distribution, viz.:—A. The southern grey clay, which includes the fjords and banks along the Norwegian coast, about as far as to 19 E. long., and the grey clay near Iceland and Jan Mayen Island; B. The northern grey clay, to which the fjords and banks along the Norwegian coast east of 19 E. long., near Bear Island and Spitzbergen, belong, and the *Rhabdammina* Clay; C. The brown clay, which is divided into the *Biloculina* Clay proper and the Transition Clay.

Recent Foraminifera.*—Dr. J. M. Flint records in a descriptive catalogue the results of an examination of a portion of the bottom material obtained during the dredging operations of the U.S. Fish Commission steamer 'Albatross.' It furnishes, with its 80 plates of photographs, a valuable book of reference for students of the Foraminifera. Brady's classification is followed.

Parasitic Infusorians.†—Dr. Bruno Galli-Valerio describes *Trichomonas caviæ* Dav., which he found to be the cause of an epidemic among guinea-pigs. He has also a note on sub-serous intestinal nodules in *Totanus chalidris*, which seemed to be due to a ciliated Infusorian recalling *Balantidium coli*.

Botryomonas, a New Genus of Flagellata.‡—In plankton-material from Lake Nyassa, Africa, Herr W. Schmidle finds an organism which he makes the type of a new genus of Flagellata, under the name *Botryomonas natans* g. et sp. n., with the following diagnosis:—Familiæ fuscæ, initio adnatæ, demum natantes, e filis crassis brevibus tubulosis radiantibus et postremo corymboso-dichotomis et monadina in excipulis sedentia gerentibus; monadina parva, ovoidea aut elliptica, amyligera, uninucleata, apice (ut videtur) biciliata; excipula crateriformia, terminalia, ad basin angustata, et in apice aperta.

The Tentaculiferous Infusoria.§—M. René Sand publishes the first or general part of a memoir on these Protozoa. The present instalment includes a general account of the anatomy and physiology, of the process of conjugation and of the development, and a discussion of the affinities. It is to be followed by a systematic part, and includes both an account of the author's own observations, and a summary of the observations of others since the publication of Bütschli's Protozoa. The author's own observations have been made on 44 different species, obtained both from

* Ann. Rep. Smithsonian Inst. for 1897; Rep. U.S. Nat. Mus., part i., Washington, 1899, pp. 251–349 (80 pls.).

† Centralbl. Bakt. u. Par., xxvii. (1900) pp. 305–9 (3 figs.).

‡ Engler's Bot. Jahrb., xxvii. (1899) p. 229 (1 fig.). See Beih. z. Bot. Centralbl., ix. (1900) p. 120.

§ Ann. Soc. Belge Micr., xxiv. (1899) pp. 57–189 (8 pls.).

fresh and from salt water. In regard to the interpretation of the life-history, the author wholly rejects the suggestion that the ciliated embryo indicates affinity with the Ciliata, and indeed denies that the fundamental biogenetic law is applicable to the Tentaculifera at all. The ciliated embryo he regards as adaptive, its ciliation being quite different from that of the Ciliata. He equally rejects the statement that such forms as *Peitiadia*, *Mesodinium*, &c., show a transition between the characters of the Ciliata and the Tentaculifera, and wholly denies the existence of any affinities between the two groups. On the other hand, he believes there is clear evidence of affinity with the Heliozoa, and points to similar nuclear phenomena (presence of a centrosome, chromosomes, a spindle, and a spiral stage), to similar methods of reproduction (by fission, by gemmæ, and by embryos), to the similarity between tentacles and pseudopodia, and to certain minor cytological peculiarities, as well as to the slow movements and the slight specialisation of structure as compared with the active highly organised Ciliata.

Atlantic Tintinnodea.*—P. T. Cleve describes a small collection of Atlantic plankton forms, and makes notes on the condition of the water in which the specimens occurred. The collection includes a rare form with porous house for which a new genus—*Porella*—is erected. Another interesting form is *Leprotintinnus brandtii* (Nordquist) which was taken off S. America, and has been previously described only in the Baltic.

Alternation of Generations in Coccidium.†—Dr. Fritz Schaudinn has made a long series of observations on the species of *Coccidium* which infect *Lithobius forficatus*. In the grounds of the Zoological Institute at Berlin, *Lithobius* is exceedingly common and is practically always infected with the parasite, a fact which is no doubt due to the somewhat confined space in which the hosts live. In the open woods, on the other hand, only about 10 per cent. of the Myriopods were infected. Three species of *Coccidium* occur in the host, and these are present in all combinations in the different individuals. No difficulty was experienced in keeping the hosts in captivity and in infecting them with the different species. The greater part of the observations were made on *Coccidium schubergi* sp. n., which is rarer than the two other previously known species, but is in some respects better adapted for study, and was obtained in large amount by infection experiments. In this species the youngest stage is a sickle-shaped embryo, which is capable of free movement, and ultimately finds its way into one of the cells of the gut of the host. Here it grows at the expense of the cell, its nucleus divides up, and it ultimately breaks up into a number of new sickle-shaped embryos which infect the other gut-cells of the host. In the author's nomenclature this process of asexual multiplication is known as *schizogony*, the mother-cells are *schizonts*, and the daughter-cells *merozoites*.

These merozoites, then, develope further in one of three ways:—(1) They may grow rapidly, accumulate no reserves, and become converted into schizonts; (2) they may become filled with reserve food, grow slowly, and become converted into female reproductive cells (macrogametes); (3) they may grow slowly but accumulate no reserves, and

* Öfvers. af K. Vetensk.-Akad. Förhandl., 1899, pp. 969–75 (12 figs.).
† Zool. Jahrb., xiii. (1900) Abth. Anat., pp. 197–292 (4 pls.).

later divide up into a number of flagellate male cells (microgametes). In the first case the result is the self-infection of the host, in the two latter the ultimate result is the infection of new hosts. The macrogametes are fertilised by the microgametes, and in each case an oocyst is formed round the conjugates. The new nucleus (sporont-nucleus) divides, the daughter-nuclei also divide, and later the protoplasm, so that four sporoblasts are formed within the oocyst. Each of these sporoblasts becomes invested by a thick coat within the original cyst, and thus becomes converted into a sporocyst. Each sporocyst gives rise to two sporozoites, as well as to a residual core of protoplasm. Thus each pair of conjugates give rise ultimately to eight sporozoites. The sexual process occurs slowly, and the oocyst may be ejected from the host at any stage in development. When taken up by a new host, the coats dissolve, and the sporozoites emerge as sickle-shaped embryos, to begin the life-cycle anew. There is thus a definite alternation of sexual and asexual generations. The cytological characters of each of the different forms is described in careful detail, and comparisons are instituted with the stages of the other species.

The question as to the natural means of infection is somewhat obscure, for *Lithobius* is purely carnivorous. One method of infection is due to the occasional cannibalism which always occurs where several specimens are kept in confinement. The usual food consists of *Oniscus* and *Porcellio*, but it was found impossible to infect these with the parasites, for the cysts passed unaltered through the body. Nevertheless, as the animals often consume the fæces of *Lithobius*, the unaltered cysts within their bodies must be regarded as possible sources of infection. As to the effect of the parasites upon the host, it was found that, much as in the rabbit, acute coccidiosis is a disease which runs its course, and from which spontaneous recovery occurs if the animals are able to withstand the acute stage. This is due to the fact that the process of asexual reproduction has its limits, and no longer occurs after a certain period. As sexual reproduction does not result in auto-infection, the host ultimately becomes free from parasites, and the injured intestinal epithelium is regenerated.

Special mention should be made of the figures, especially of an admirable diagram of the life-history.

Alternation of Generations in Sporozoa.* — Dr. F. Schaudinn expounds the life-history of *Coccidium* and *Proteosoma*, showing (*a*) the probability of close relationship between Coccidia and Hæmosporidia, and (*b*) the occurrence of a genuine alternation between sexual and asexual generations.

New Gregarine.†—MM. L. Legèr and O. Duboscq record that in the mid-gut of *Gryllomorpha dalmatina* Oesk. they always found a Gregarine belonging to the genus *Gregarina* Duf. (*Clepsidrina* Hamm.). It is a neighbour of *G. macrocephala* Schm., and of *Nemobius sylvestris* Fabr., but is specifically distinct. The authors propose the name *G. davini* for it.

* SB. Ges. Nat. Freunde Berlin, 1899, pp. 159–78 (11 figs.).
† Arch. Zool. Expér., vii. (1899) Notes et Revue, pp. xxxviii.–xl. (1 fig..)

Glugea lophii.*—Herr Al. Mrázek discusses the cysts of *Glugea lophii* Doflein, infecting the ganglion-cells and neurites of *Lophius*, and gives reasons showing that Doflein's account † of their formation cannot be accepted. But what the correct version of the story is remains obscure.

Malaria and Mosquitos.‡—The interesting account of the connexion between malaria and mosquitos given by Major Ronald Ross deserves a much greater space than can be afforded, but it may be useful to recapitulate the stages of the life-cycle of this plasmodium malariæ. He starts with the amœbula, or that form of the parasite which is seen in the red corpuscles, and which usually contains pigment-granules, melanin, derived from the hæmoglobin. After a day or two the amœbulæ reach maturity and then become sporocytes. The spores are set free and attach themselves to fresh red corpuscles. Other amœbulæ become gametocytes, i.e. male and female reproductive cells. The sexual stage takes place in nature within the stomach of the mosquito, but has been observed *in vitro*, while the presence of the flagellated organism has been noted frequently. The flagella are long motile filaments, spermatozoa in effect, if not in fact, and are extruded from the male gametocyte. These, after the manner of spermatozoa, having encountered a macrogamete, fertilise it, the result of the connexion being a zygote. The zygote finds its way to the outer part of the wall of the mosquito's stomach and rapidly increases in size. Here its capsule thickens and its contents undergo subdivision, until the zygote membrane becomes packed with thin spindle-shaped spores, termed blasts, which are about 12–16 μ in length. When ripe, the zygote membrane ruptures, and the blasts being set free, find their way to the salivary gland, from which they are expelled along with the poison, when the mosquito punctures the host.

Insects and Blood-Parasites.§—Dr. A. Libbertz gives an interesting historical sketch of the present state of knowledge as to the part played by blood-sucking insects in conveying blood-parasites from one host to another. The following subjects are discussed, and the parasites and the parasite-carrying insects figured and described:—The malarial parasite of Southern Europe, and the more deadly form of the tropics, which are probably not specifically distinct, and which both have a secondary host in the mosquito; the parasite of Texas fever (*Pyrosoma bigeminum*), which is found in the blood of infected cattle in North America, and is probably conveyed by *Boophilus bovis*; the parasite of Fly disease (*Trypanosoma*) which is conveyed by the Tsetse fly; the remarkable parasites of the blood of birds (*Halteridium* and *Proteosoma*), whose life-history has only recently been worked out, and which appear to be transported by mosquitos. These last are interesting because of certain resemblances to malarial parasites, especially in the formation of ciliated forms which play the part of spermatozoa. The bird parasites are also of importance in offering greater facilities for research than the malarial parasites. The illustrations are numerous and excellent.

* SB. K. böhmisch. Ges. Wiss., 1899, No. xxxiv., 8 pp. and 1 pl.
† Cf. this Journal, 1899, p. 289. ‡ Nature, lxi. (1900) pp. 522–7.
§ Ber. Senckenberg. Naturf. Ges., 1899, pp. 105–18 (6 pls. and 46 figs.).

Hæmatozoa of Beri-Beri.* — Dr. F. Fajardo alludes again to the protozoa observed by him in cases of beri-beri.† The present communication is really supplementary to the first, and supplies drawings of the appearances observed in the brain. All the parasites, which have much general resemblance to those of malaria, contain more or less pigment in the form of granules. Lively movements were noticed in these granules as long as forty-eight hours after death.

Infectious Jaundice of Dogs.‡—P. Leblanc has found that the infectious jaundice of dogs is due to the presence of a hæmatozoon, quite like those described by Marchoux in dogs of Senegal. Though having some resemblance to the parasites causing hæmoglobinæmia in cattle and sheep, they are much larger, varying in size from 2 to 4 μ. They are most frequent in the red corpuscles, wherein two or three may be observed; in the plasma they are rare. The nucleus is a small spot or line, always lying close to the periphery of the parasite. They were often observed undergoing division within the corpuscles. In shape they are mostly spherical or oval, rarely pyriform. They are best stained by Laveran's method.

* Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 249–51 (1 pl.).
† Cf. this Journal, 1899, p. 43.
‡ C.R. Soc. de Biol., lii. (1900) pp. 70–1, 168–9.

BOTANY.

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

a. Anatomy.

(1) Cell-Structure and Protoplasm.

Framework of the Nucleus.*—Herr C. van Wisselingh has carefully followed out the process of karyokinesis in the embryo-sac of *Leucojum* and *Fritillaria*, and finds it to differ in some important points from that which he has already described in the case of *Spirogyra*.† After fixing with Flemming's solution, the object was placed in 50 per cent. chromic acid, in which the whole of the cytoplasm and the nuclear membrane first of all dissolve, then the framework of the nucleus, and finally the nuclei, leaving only the nucleolar threads. The following are given as the more important results.

The framework of the resting nucleus consists of lumps (*Klümpchen*) and granules, which are connected with one another by fine threads; there is no purely filamentous structure, and no distinction between chromatin-threads and linin-threads. The knot-stage (*Knäuelstadium*) results from the union into threads of the lumps and granules; the fine connections between the lumps and granules contract; the rest of the fine connections mostly disappear. The nuclear threads become shorter and thicker; they run from the polar to the opposite side, and attach themselves by their ends to the wall of the nucleus; they usually remain more or less coiled. Rosettes or fan-like figures arise after the absorption of the nuclear wall; the threads approach the polar region, and become more firmly connected; in other spots the fine connections between the threads disappear. In the formation of the nuclear plate the connection of the threads becomes looser, and their free ends bend towards opposite sides. In the plate the united ends of the threads are sharply curved, and lie in the equatorial plane.

The nuclear threads are not, as stated by Strasburger, composed of alternate plates of chromatin and linin, but of flattened lumps and granules and fine contracted connections; they show transverse lines where the fine connections have finally contracted together. In the knot stage the nuclear threads show a longitudinal striation. When the nuclear plate is formed they split longitudinally, and the two halves move in opposite directions towards the poles of the spindles; the curved ends remain united with one another; the free ends turn inwards. In *Leucojum* an exception to the curving is afforded in some of the threads.

When the halves of the nuclear plate have approached near to the poles, the mutual connection of the threads becomes firmer; they draw together and form a dense knot, and are connected in many spots by fine threads. They then again move apart, and run from the polar to the opposite side. Gradually they break up into granules which are connected with one another by fine threads. The wall of the nucleus is formed round the framework, and the nucleoles make their appear-

* Bot. Ztg., lvii. (1899) 1te Abth., pp. 155–76 (1 pl.).
† Cf. this Journal, 1899, p. 186.

ance in the cavity of the nucleus, though the granular condition may commence earlier.

The nucleoles do not exhibit any structure, and differ altogether from those of *Spirogyra*, the only feature which they possess in common with these being their occurrence within nuclei. Went's statement that they take part in the formation of the nuclear threads is incorrect. When the wall of the nucleus becomes absorbed, the nucleoles disappear. In *Fritillaria* this occurs at a very early period; in *Leucojum* it takes place more gradually. They are again formed in the daughter-nuclei.

An incomplete karyokinesis sometimes takes place.

Peculiar Kinds of Nucleus.*—Prof. H. Molisch finds three peculiar kinds of nucleus, not hitherto described, all occurring in the latex or mucilage of plants.

(1) *Bladder-nuclei*; furnished with a comparatively large sap-bladder, resembling nothing else known either in the animal or vegetable kingdom. These were found in the latex of several species of *Musa*, of Aroideæ, and of the hop, and apparently multiply by direct division. The nuclei have the appearance of lying in large sap-vacuoles, and are accompanied by peculiar crystals of an organic probably proteinaceous substance, also imbedded in vacuoles.

(2) *Thread-nuclei*; drawn out into enormously long threads or knots of threads:—in the mucilage of the leaves of *Lycoris* and other Amaryllideæ. They are usually unbranched, and vary in length from 13 to the enormous magnitude of 1510 μ. Their breadth is in inverse proportion to their length, varying between 16 and $0 \cdot 1$ μ.

(3) *Giant-nuclei* of species of *Aloë*. These are the largest yet observed in the vegetable kingdom, measuring from 50–82 μ in length, and from 20–46 μ in breadth.

Amitosis.†—Herr W. Pfeffer gives an account of Nathansohn's observations on direct nuclear division in *Spirogyra* (*S. orbicularis*) by the action of ether. The nucleus divides gradually into two halves, which separate from one another and occupy central positions in the daughter-cells. Cell-division takes place in the same way as in mitosis, the formation of the septum commencing at the periphery and proceeding centripetally. When again placed in normal conditions, karyokinetic takes the place of direct division. It is clear that, at least in *Spirogyra*, mitotic and amitotic divisions may replace one another, and are so far equivalent to one another that the product possesses in both cases the same properties. Every cell preserves its full embryonal quality, i.e. its capacity to regenerate the entire organism. It is probable that *Spirogyra* possesses the property of propagating itself to an unlimited extent exclusively by amitotic division of the nucleus.

Chromatolysis of the Nucleus.‡— Sig. B. Longo describes a pathological condition of the nucleus in cells of the bracts of *Cynomorium coccineum*, corresponding to that known to zoologists as "pycnosis." The chromatolytic condition begins with a contraction of the chromatin

* Bot. Ztg., lvii. (1899) 1te Abth., pp. 177–91 (1 pl.).

† Ber. Verhandl. k. sächs. Gesell. Wiss. Leipzig, li. (1899) pp. 4–12.

‡ Ann. r. Ist. Bot. Roma, ix. (1899) p. 7 (1 pl.). See Bot. Centralbl., lxxxi. (1900) p. 400.

framework, the branches of which partially unite and apply themselves to the wall of the nucleus. The wall of the nucleus also contracts, so that the volume of the nucleus is reduced. But, after the entire framework of the nucleus has fused into irregular anastomosing masses, always closely attached to the wall of the nucleus, the nucleole remains enclosed within it. In the last stages of chromatolysis, the whole nucleus has shrunk into a strongly refringent erythrophilous mass, which assumes a red, red-violet, or pink colour.

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

Violet Chromatophores in the Coffee.* —Herr A. Tschirch finds, in the pericarp of *Coffea arabica*, dark violet almost blue-black chromatophores, both in the epiderm and in the hypodermal layer, along with a red cell-sap. They are often needle-shaped or branched in an arborescent manner.

Chloroglobin.†—In investigating the question whether carotin and chlorophyll are not the chromophorous constituents of a more complicated substance, possibly of a proteid character, Dr. M. Tswett has succeeded in isolating a green compound closely allied to proteids in its physico-chemical properties, to which he gives the name *chloroglobin*, apparently a combination of carotin and chlorophyll. It is associated with a colourless substance, possibly Pringsheim's hypochlorin. The microchemical reactions of chloroglobin are given in detail.

Oxidising Ferments in Phanerogams.‡ — In about 100 species of flowering plants, belonging to 49 families, Sig. N. Passerini finds evidence, from the guaiacum test, in all but about 20, of the presence of at least a trace of an oxydase in some organ or other. The part in which it is most constantly present is the root; the reaction being generally more intense than in the stem. It is often stronger in the bark than in the pith. In the leaves oxydases are most commonly either entirely wanting or are present only in very small quantities, and are then generally localised in the veins. In the flower, these ferments, when present, are more abundant in the pistil than in the stamens; in the latter they occur chiefly in the filaments. In the fruit they are most abundant in the pericarp; in the seeds they disappear before maturity. In general the reaction is strongest in those organs which change colour rapidly on exposure to the air. In aquatic plants (*Posidonia*, *Fucus*, *Ulva*) they appear to be wanting.

Formation of the Oil in the Olive.§—Sig. G. Spampani describes the mode of the formation of the oil in the fruit of the olive. This takes place in the cells of the epicarp, and especially in those of the mesocarp; the oil has not been transferred to the cells where it is ultimately found, but has been actually formed in them. The presence of a small quantity of an oily substance in active protoplasm is a universal phenomenon, and in the oil of the olive we have only a very strongly marked illustra-

* Schweiz. Wochenschr. f. Chemie u. Pharmacie, xxxvi. (1898) No. 40. See Bot. Centralbl., lxxxi. (1900) p. 23. † Bot. Centralbl., lxxxi. (1900) pp. 81–7.
‡ Nuov. Giorn. Bot. Ital., vi. (1899) pp. 296–321.
§ Bull. Soc. Bot. Ital., 1899, pp. 139–43.

tion of this law. The oil is not a result of the degeneration of the protoplasm, but is formed when this substance is in its most active condition.

Hydrocyanic Acid in Plants.* — Dr. M. Soave concludes, from a series of experiments on the bitter almond and on *Pangium edule*, that cyanogen compounds are, in plants, transitional substances from which they obtain their nitrogenous food-materials. At the time when the seeds begin to swell, as long as the embryo is dormant, the bitter almond contains no trace of hydrocyanic acid; it makes its appearance only when the seeds begin to germinate, and then only in the stem, and not either in the root or in the cotyledons. Sweet almonds contain no trace of amygdalin.

Formaldehyde in Plants.† — According to Sig. G. Pollacci, when leaves which have been exposed to the light are macerated and distilled with water, the first portion of the distillate contains formic aldehyde, the presence of which was determined by several distinct tests employed by the author.

Myrosin and Gum in Moringa.‡ — M. F. Jadin finds, in various organs of *Moringa pterygosperma*, a ferment formed in special cells, identical with myrosin. The gum which the plant produces is formed in lacunæ in the pith of the stem and occasionally of the leaf-stalks; it is wanting in the flower-stalks and in the root.

Presence of Molybdenum, Chromium, and Vanadium in Plants.§— By the use of spectrum analysis, M. E. Demarsay finds traces of these elements in a number of plants examined.

(3) Structure of Tissues.

Secretion in Healing-tissue and Duramen.‖—According to Herr A. Will, the product formed in the interior of the cells in healing tissue is not a gum, but a substance of the nature of bassorin, formed in a special bassorinogenous layer. It is produced out of the substances in solution in this layer, apparently not directly out of starch. The formation of the bassorinogenous layer depends on the vital activity of the plant; it is not formed in winter, but most actively when the leaves are fully unfolded. The right time for cutting back trees is therefore in the spring. It is not prevented, though somewhat hindered, by covering up the wound with cotton-grease, &c. The black pigment of the duramen of ebony is a secondary product of the secretion of the alburnum. The chemical nature of the contents of the duramen may differ in different forms of cell in the same species.

Influence of Parasites on the Host-plant.¶—M. C. Sauvageau has taken advantage of the property of all species of Sphacelariaceæ—a property confined to this family among Algæ—of turning black with eau-de-javelle, in order to determine whether the parasite produces a change

* Nuov. Giorn. Bot. Ital., vi. (1899) pp. 219–38.
† Boll. Chim. Farm., xxxviii. pp. 601–3. See Journ. Chem. Soc., 1900, Abstr. ii. p. 160.
‡ Comptes Rendus, cxxx. (1900) pp. 733–5. § Tom. cit., pp. 90–1.
‖ Arch. f. Pharmacie, ccxxxvii. (1899) pp. 369–72. See Bot. Centralbl., lxxxi. (1900) p. 23. ¶ Comptes Rendus, cxxx. (1900) pp. 343–4.

in the cells of the host-plant. The stain, which is very dark and always fugitive, is due to an organic substance excreted by the cell and impregnating the cell-walls. The observations were made on *Sphacelaria Hystrix* parasitic on *Cystoseira ericoides*, on *S. furcigera* parasitic on *C. discors*, and on *S. amphicarpa* sp. n. parasitic on *Halidrys siliquosa*. The conclusion arrived at was that the parasitic alga induces, in some of the cells of the host-plant with which it comes into contact, the production of the same peculiar substance as a product of excretion. No similar reaction was exhibited by other algæ epiphytic on the *Sphacelaria*.

Elasticity of Tension of Vegetable Organs.*—Dr. L. Nicotra gives formulæ for the elasticity of vegetable tissues. As a general conclusion he states that the amount of distension would be injurious to a plant if it were not counteracted by a proportionate elasticity. The elastic resistance of the distended cell-wall is one of the most important factors in turgor. Continuous distension without elasticity would be injurious to the plant. To obviate such injury, the pressure is regulated by the law of periodicity, rendering it possible to return to the physical conditions which are favourable to further growth.

Modification of Tissues by a Longitudinal Strain.†—M. Thouvenin describes the changes induced in the structure of a stem of *Zinnia elegans* by subjecting it to a moderate traction in the direction of its axis. As a general result it may be stated that it causes a diminution of the pericyclic stereome and retards the development of the secondary fibrovascular bundles. The diameter of the vessels is somewhat increased; while the medullary rays are rather broader, not having been used up in the formation of the secondary vascular bundles.

(4) Structure of Organs.

Female Flower of Salisburia.‡—Prof. R. v. Wettstein describes a number of abnormalities in the female flower of *Salisburia adiantifolia* (*Gingko biloba*), from which he draws the following conclusion. The normal flower consists of a structure homologous to a shoot which bears merely two transverse carpels. Each carpel bears normally a single ovule. The separation of the two carpels, and the stalk-like development of their bases, give rise to the stalked ovules. The fruit is normally 2-seeded, but may become 3–4-seeded by division of the carpels, 1-seeded by abortion of one of the carpels. The normal female flower of *Salisburia* is an axillary shoot, with two transversely placed fertile carpels. In this respect *Salisburia* is more nearly allied to the Coniferæ than to the Cycadeæ; but properly constitutes a family by itself, the Gingkoaceæ.

Fruit of Sambucus Ebulus.§—Dr. P. Radulescu has investigated the nature of the colouring matter of the juice of the berries of the danewort, largely used for colouring red wines in Roumania. Its chemical and spectroscopic characters are given in detail. It possesses no injurious properties.

* Atti e Rend. Accad. Sci. Acireale, 1899, 16 pp.
† Comptes Rendus, cxxx. (1900) pp. 663–5.
‡ Oesterr. Bot. Zeitschr., xlix. (1899) pp. 417–25 (1 pl.).
§ Bull. Soc. Sci. Bucharest, viii. (1899) pp. 636–41.

Integument of the Seed of Impatiens.*—Pursuing his observations on the structure of the seed of various species of *Impatiens*, M. C. Brunotte finds it to illustrate a general fact that the integument of the seed often presents a great variety of structure in plants belonging to the same family, and even in species of the same genus nearly related to one another. In the species of Balsamineæ examined, this variability applies especially to the external parts. The crushing up, at maturity, of the inner integument appears to be a constant character, as well as the presence of raphides and of mucilage.

Ovary of Cytinus.†—M. L. Lutz records an abnormality in the ovary of *Cytinus Hypocystis*, where the ovary, ordinarily unilocular with from 6–9 branching parietal placentæ, has become plurilocular by the joining of these placentæ in the centre of the ovary, and the placentation axile. This appears to be the archaic structure of the ovary, the unilocular condition resulting from the gelification of the axis, the product of which fills up the cavity in the form of gum.

Placenta of Angiosperms.‡—Prof. L. J. Celakovsky defends the position he took up in 1876 that the placentæ are always a portion of the carpels, and that hence the ovules must always be regarded also as products of the carpels, even in those cases where the ovule occupies a terminal position at the apex of the axis, or where, from the elongation of the floral axis, a free central placenta is formed from which the ovules spring. In other words, the apex of the axis from which the placenta or the ovule arises, is not really axial, but belongs to the carpels. Among Pteridophytes *Selaginella* furnishes the only exception to the derivation of the sporange from the rudiments of the carpels.

Celakovsky reviews all the important subsequent literature on the subject, and maintains that a study of abnormal structures shows the incorrectness of Bower's view that sporanges are organs *sui generis*, and cannot be transformed into vegetative organs such as leaves or portions of leaves.

The sporange (pollen-chamber, ovule) may have the value of a leaf —which is rare, but occurs in Gymnosperms—or it may spring from a sporophyll as a segment of a leaf. The caulome, consisting of all the sterile segments of the axis, cannot produce a sporange. The growing point of a shoot is not properly a caulome, but rather a thallome in which the axis and leaves, with their potential archespores, are not yet differentiated.

Phylloclades.§—Herr A. Schulz has investigated the structure and function of leaf-like shoots, especially in *Danae racemosa*, *Ruscus aculeatus*, *R. Hypoglossum*, and *Asparagus officinalis*. They result from an excess of lateral shoots of normal origin in exceptionally crowded conditions. They serve for assimilation or transpiration, or for the storing up of reserve or nutrient substances, or as protecting organs. The leaves have hence become superfluous, and have more or less entirely disappeared.

* Comptes Rendus, cxxx. (1900) pp. 181–4. Cf. this Journal, 1896, p. 435.
† Bull. Soc. Bot. France, xlvi. (1899) pp. 299–301 (5 figs.).
‡ SB. k. böhm. Gesell. Wiss., 1899, 35 pp. and 1 pl.
§ 'Beitr. z. Entwickgesch. d. Phyllocladien,' Rostock, 1898, 40 pp. and 20 figs. See Beih. z. Bot. Centralbl., ix. (1900) p. 178.

Metamorphosis of Shoots.*—Herr M. Raciborski discusses the conditions under which, in species with heteromorphic branches (*Langtriebe* and *Kurztriebe*), one kind may be made to replace the other kind. As a general rule, decapitation incites the lateral buds to form branches of the former kind; while a transformation in the opposite direction is the result of depriving a climbing stem of any support round which it can twine.

Theory of the Displacement of Lateral Organs by Mutual Pressure.†—From observations of the cones of several conifers and the capitules of *Chrysanthemum Leucanthemum*, Herr L. Jost disputes Schwendener's theory that, in the course of the development of the plant, young lateral organs may shift their place on the main axis owing to displacements from mutual pressure. He finds the organs always to retain the same position in relation to one another; the elongation of the axis takes place in such a way that all the individual points move in lines parallel to one another and to the direction of growth.

Alteration of Phyllotaxis in Ascending Shoots.‡—Herr A. Weisse has made further observations on the effect produced on the arrangement of the leaves by decapitation of the shoot. He finds that, in the case of the hazel, the bilinear phyllotaxis is very readily changed into a spiral one; while this alteration is effected only in a few instances in *Tilia platyphyllos*, and not at all in *Ulmus campestris*. In trees or shrubs with a decussate phyllotaxis—*Syringa*, *Acer*, *Fraxinus*, *Æsculus*—it is not uncommon for a three-membered verticillate arrangement to result; less often a change to a spiral phyllotaxis.

"Fore-runner Point" of Leaves.§—By this term (*Vorläuferspitze*) Herr M. Raciborski designates a form of leaf-apex especially common with tropical leaves, in which a region near the apex becomes well-developed and performs all the functions of assimilation, before the basal portion of the leaf has attained any considerable development. This suppression of the development of the greater part of the lamina is especially displayed in those orders—Menispermaceæ, Malpighiaceæ, Combretaceæ, &c.—in which the young ascending shoots are at first comparatively bare of leaves and possess an exceptionally strong circumnutation. This "fore-runner point" of the leaves closely resembles the draining-point described by Stahl,‖ but differs from that structure entirely, both in its function and in its development. Very good examples are also furnished by tropical Apocynaceæ and Asclepiadeæ. The same function is in some instances performed by the early formation of stipules.

Aruncoid Leaves.¶—Herr R. Anheisser applies this term to the form of leaf or leaflet of which that of *Spiræa Aruncus* may be taken as the type. They have a lanceolate or ovate form, and are moderately apiculate; they are almost always opposite; the stomates occur on the under

* Flora, lxxxviii. (1900) pp. 28–37 (7 figs.).
† Bot. Ztg., lvii. (1899) 1te Abth., pp. 193–226 (1 pl.).
‡ Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 343–78 (1 pl.).
§ Flora, lxxxvii. (1900) pp. 1–25 (8 figs.).
‖ Cf. this Journal, 1894, p. 82.
¶ Flora, lxxxvii. (1900) pp. 64–94 (1 pl.)

surface only; the margin is doubly serrate; a lateral vein of the first order runs into every primary tooth. The aruncoid form of leaf is very widely distributed, occurring in the Rosaceæ (*Spiræa*, *Rubus*, *Rosa*), Umbelliferæ (*Angelica*, *Chærophyllum*, *Ægopodium*), Compositæ (*Eupatorium*), and many other orders. They are mostly shade-loving plants with thin leaves. The double serration appears to be a protection against tearing by the wind.

Position of the Lamina of the Leaf of Grasses.*—Dr. E. Paratore discusses the theory of Duval-Jouve (supported by Darwin) that the semi-torsion of the leaf of many grasses in an adaptation for the purpose of protecting the stomatiferous surface of the leaf from too intense light; and comes to a conclusion different from that of these two observers. The movement which brings about this position of the leaf he regards as purely passive, and without relation to the distribution of the stomates on the two surfaces of the leaf.

Apical Pores of the Leaves of Aquatic Plants.†—Herr P. Weinrowsky classifies the water-pores or apical openings in the leaves of water-plants under two heads:—In the first group (*Sagittaria sagittæfolia*, *Alisma sparganiifolium* and *natans*, *Sparganium ramosum*, *Stratiotes aloides*, *Ceratophyllum demersum*, *Myriophyllum verticillatum*, and several species of *Potamogeton*), the apical pore is formed by the disorganisation of superficial cells on and immediately beneath the apex of the leaf. In the second group (*Callitriche verna* and *autumnalis*, *Ranunculus aquatilis*, *Veronica Anagallis*), the pore is formed by the absorption of the two guard-cells of water-fissures. *Hippuris vulgaris* presents a structure intermediate between the two. The leaves of *Typha angustifolia*, *Nuphar luteum*, *Salvinia natans*, *Elodea canadensis*, *Utricularia vulgaris*, and *Aldrovanda vesiculosa* have no apical pores. Their function appears to be to promote the escape of the current of water which circulates through the plant.

Leaves of Chloranthaceæ.‡—Herr H. Schulze has examined the structure of the leaves in a number of species belonging to the three genera of this order, *Chloranthus*, *Hedyosmum*, and *Ascarina*, and finds them to agree in the following general characters:—The presence, in all species, of an ethereal oil or resin, in spherical glands situated in the mesophyll, never in the epiderm; the presence, in all species, of a branched palisade-parenchyme; the absence of hairs on the leaves; and the limitation of the stomates to the under side of the leaf.

Hairs, Anthocyan, and Extra-nuptial Nectaries of Ailanthus glandulosa.§—Sig. L. Macchiati describes two kinds of hair in this plant, one of a deep red colour, the other uncoloured. Like the colouring matter of the epidermal cells of the leaf, the pigment was determined to be anthocyan. At the base and on the margin of the young leaves are two or more nectariferous glands which constitute an extra-nuptial nectary, the plant furnishing a good illustration of myrmecophily. The nectar of these glands is greedily devoured by ants,

* Malpighia, xiii. (1899) pp. 237–51 (1 pl.).
† Beitr. z. wiss. Bot. (Fünfstück), 1898, 47 pp. and 10 figs.. See Beih. z. Bot. Centralbl., ix. (1900) p. 176.
‡ Beih. z. Bot. Centralbl., ix. (1900) pp. 81–5.
§ Bull. Soc. Bot. Ital., 1899, pp. 103–12.

which stand as sentinels at the base of the pedicel throughout the day, and ward off other insects, arachnids, and the larvæ of Lepidoptera, which would otherwise attack the young leaves. The anthocyan serves as a protection against too strong solar radiation. The simple non-glandular hairs are coated with a waxy substance which protects the young leaves against the injurious action of dew and frost.

Extra-nuptial Nectaries of Prunus Laurocerasus.* — Sig. L. Macchiati describes in detail the red or brown patches at the base of the young leaves of the cherry-laurel, in which is secreted a nectariferous fluid. He regards it as incontestable that this bright colour attracts ants and other Hymenoptera which would be injurious to the plant. When growing in very shady places these spots are destitute of colour, but still produce the nectariferous secretion. In mature leaves they have disappeared altogether.

Anatomy and Morphology of Rhus vernicifera.†—Prof. M. Möbius contributes an exhaustive account of the anatomy and morphology of the Japanese lacquer-tree. Among the very numerous details the following may be especially mentioned. The formation of thyllæ in the secreting canals altogether resembles that which occurs in the Simarubeæ, but which has not hitherto been observed in the Anacardiaceæ. The species is strictly diœcious, no intermingling of male and female flowers having been observed. The wax exuded from the mesocarp forms a thick incrustation on the inner side of the cell-walls. Its purpose appears to be the attraction of birds, especially pigeons, which feed on the mesocarp and pass the seeds without digesting them. The seeds contain a thin layer of endosperm within the thin testa.

Outgrowths on Hibiscus vitifolius.‡—Miss E. Dale has studied the outgrowths which occur commonly on the green parts of this plant, and concludes that they are of a pathological character, and are produced by the direct influence of external conditions, chiefly light and moisture. The intumescence consists exclusively either of the epiderm alone or of the epiderm and the cells lying immediately below it.

Intumescences of Eucalyptus and Acacia.§—Herr P. Sorauer has investigated the nature of these structures found on several species of the genera named, which frequently have a moss-like appearance at the apex. They appear to be the result of a depressed assimilation due to a deficiency of light. A high temperature, together with an abundant supply of water, then causes an irritation which can be responded to only by elongation of the cells at the expense of the cell-contents already contained in them.

Histology of the Root-tubercles of the Leguminosæ. ‖ — After a copious synopsis of the results obtained by, and the views of previous observers, accompanied by a very complete bibliography, Dr. E. Paratore gives an account of his own observations on the microscopic structure and the contents of the tubercles on the roots of several species of

* Bull. Soc. Bot. Ital., 1899, pp. 144–7.
† Abhandl. Senckenberg Naturf. Gesell., xx. (1899) pp. 201–47 (1 pl. and 29 figs.).
‡ Proc. Cambridge Phil. Soc., x. (1900) pp. 192–209 (3 pls.).
§ Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 456–60 (1 fig.).
‖ Malpighia, xiii. (1899) pp. 211–36 (1 pl.).

leguminous plants. In the main they agree with those of Van Tieghem and Douliot.

Nitragin in the Nodules of Leguminous Plants.* — Pursuing her investigations on this subject, Miss Maria Dawson has come to the conclusion that there is probably only one organism capable of producing nodules on leguminous plants, but that in each particular host special physiological conditions exist to which the organism becomes so specially adapted as to make it difficult for successful reaction to take place between plants not nearly allied. Experiments on *Pisum*, *Phaseolus*, *Desmodium*, *Robinia*, *Acacia*, and other genera, show that no definite line of distinction can be drawn between genera in which filaments occur in the nodules and those in which they have not yet been observed. Peculiar anatomical characters were observed in certain genera, e.g. a definite crystal layer in some cases; apple-green nucleus-like bodies in *Desmodium* and *Robinia*, organisms of an unusually large size in *Desmodium*, *Coronilla*, *Psoralea*, and others.

β. Physiology.

(1) Reproduction and Embryology.

Double Impregnation in Tulipa.†—M. L. Guignard has extended his observations on the process of double impregnation or "pseudo-fecundation" to other genera besides *Fritillaria* and *Lilium*. In *Endymion* (*Scilla*) *nutans* nothing of the kind could be detected. The two polar nuclei, whose union gives rise to the secondary nucleus of the embryo-sac, approach one another long before the entrance of the pollen-tube into the ovule, remaining, however, perfectly distinct from one another. *Endymion* presents in this respect a phenomenon intermediate between that of *Lilium* and that of *Fritillaria*.

In *Tulipa* there is a remarkable difference between the processes in the cultivated varieties of *T. Gesneriana* and those in the wild species *T. Celsiana* and *T. sylvestris*. In the former there is no important departure from the ordinary structure of the embryo-sac. In the last-named two species the embryo-sac is ovoid, and contains at its base a large vacuole. Eight nuclei are formed in the usual way by three successive bipartitions of the primary nucleus; but, instead of these being grouped into two tetrads, they all remain, at nearly equal distances from one another, in the protoplasm above the vacuole. Two of the eight are smaller, and evidently represent the synergids; of the remaining six, one is situated on a lower level than the others, and has a delicate chromatic framework and numerous nucleoles. But the nucleus which corresponds to the oosphere does not differ in any conspicuous respect from the other nuclei. When the pollen-tube enters the embryo-sac, one of its "antherozoids" fuses with the nucleus which represents the oosphere, the other with the nucleus which represents the superior polar nucleus; the two combined then reuniting with the basal nucleus. The coalition of the polar nuclei presents essentially the same characters. The remaining nuclei are gradually resorbed.

M. Guignard records that he has observed a process of double fecundation also in the Ranunculaceæ.

* Proc. Roy. Soc., lxvi. (1900) pp. 63–5. Cf. this Journal, 1899, p. 296.
† Comptes Rendus, cxxx. (1900) pp. 681–5. Cf. this Journal, 1899, p. 409.

Embryogeny of Thea. * — Among observations with regard to the structure and development of the fruit of *Thea chinensis* by Dr. F. Cavara, the following relate to the development of the embryo-sac and embryo. The formation of the embryo-sac does not follow the usual course in Apopetalæ; it is the first cell resulting from the division of the initial cell which becomes the mother-cell of the embryo-sac. After the impregnation of the oosphere a period of rest ensues, which may extend to as much as eight months, during which the impregnated oosphere behaves like a germinating spore. The suspensor is remarkably long, and may consist of as many as 18 or 20 cells. The first division of the mother-cell of the embryo is not longitudinal, as is usually the case, but transverse.

Embryo-sac of Sparganium.†—Prof. D. H. Campbell has investigated the development of the flower and embryo-sac in several species of *Sparganium*, especially in *S. simplex*, *ramosum*, and *Greenii*.

The egg-apparatus is small in *S. simplex*, and the polar nuclei fuse completely before the "egg" is fertilised; while in *S. Greenii* they remain separate until after fertilisation. The antipodal cells are three in number, and in *S. simplex* are very inconspicuous; after fertilisation there is a remarkable secondary growth in the antipodal cells, resulting finally in a large cell-mass consisting (in *S. simplex*) of over 150 cells. The suspensor remains undeveloped, as in Gramineæ. The embryo undergoes three transverse segments, of which the terminal one gives rise to the cotyledon, stem-apex, and a part of the root. The young embryo is completely invested by the endosperm. The plerome of the root is derived entirely from the terminal segment. The enlarged antipodal cells appear at first to perform the function of endosperm-cells. The large endosperm-nuclei have often several nucleoles formed by fragmentation of the original nucleole. Large crystalloids are abundantly developed in the older endosperm-cells of *S. simplex*.

As regards the systematic position of *Sparganium*, Prof. Campbell does not consider it to be nearly allied to *Typha*, but to have a closer affinity with the Gramineæ than with any other family except possibly the Pandanaceæ.

Embryogeny of Cephalotaxus.‡—Herr W. Arnoldi finds the development of the embryo in *Cephalotaxus Fortunei* to agree in several important points with those already described in *Taxus*, § differing from that in all other Gymnosperms at present known, and presenting a transition from that of the oldest known Gymnosperms, the Cycadoideæ.

The archegone has a two-celled neck and an ovum-cell. During the growth of the latter it becomes filled with a peculiar albuminoid substance, formed in the nuclei of the covering layer with the assistance of the nucleole, and being at first in the condition of small drops. When these drops have passed from the cells of the covering layer into the ovum-cell, they grow to a considerable size and acquire a complicated structure, serving as the first nutrient substance for the developing embryo.

* Bull. Soc. Bot. Ital., 1899, pp. 238-41.
† Proc. California Acad. Sci., i. (1899) pp. 293-328 (3 pls.).
‡ Flora, lxxxvii. (1900) pp. 46-62 (3 pls.). § Cf. this Journal, 1899 p 504.

The nucleus of the ovum-cell divides shortly before fertilisation without the formation of a ventral canal-cell. The upper part of the ovum-cell, with its nucleus, becomes converted into mucilage, destroys the neck-cells, and escapes from the archegone. The pollen-tubes have two nuclei, in addition to those of the two generative cells. Each of the generative cells has a nucleus entirely filled with metaplastic substance surrounded by a thin layer of dense protoplasm. After the contents of the pollen-tube have passed into the ovum-cell, one of the generative nuclei fuses with the ovum-nucleus; the second generative nucleus remains in the upper part of the archegone, undergoing later amitotic division. The fertilised ovum-nucleus moves to the centre of the ovum, where it divides karyokinetically three or four times. A number of cells are formed in the lower end of the archegone from the daughter-nuclei by free cell-formation. These cells are arranged in stories; from the lower story is formed the so-called rosette; the next one producing the suspensor-tube. Above this is a layer of cells from which the embryo is produced. The morphological apex of the embryo is formed of a single cell.

Development of the Pollen in Convallaria and Potamogeton.*— Mr. Karl M. Wiegand has followed out the development of the microsporange and microspores in *Convallaria majalis* and *Potamogeton foliosus*. The archesporial cells arise from the division of a hypodermal cell at one corner of the anther; the archespore, therefore, does not originate from a layer of hypodermal cells, but from only one or two. No division of the tapetal nuclei could be detected in *Potamogeton*. The growth and segmentation of the spirem in *Convallaria* are almost identical with the same processes in *Lilium*; the longitudinal splitting of the ribbon is especially noticeable. In *Potamogeton* the process is somewhat different. The number of chromosomes after reduction was eighteen in *Convallaria*, seven in *Potamogeton*. In the formation of the spindle the multipolar condition was evident in both genera. The splitting of the chromosomes in the heterotypic division was in *Convallaria* similar to that in *Lilium*. The generative nucleus of the pollen-grain is cut off by a distinct wall in *Convallaria*; the division of the nucleus probably takes place in the pollen-tube. In both cases the two male nuclei, each enclosed within its own cell-wall, still remain attached to one another, even when they enter the egg-apparatus.

Cross-pollination and Self-pollination.—Mr. John H. Lovell † describes the mode of pollination—giving a list of the pollinating insects —in a number of American species of Caprifoliaceæ, adding the following general remarks. The rotate flowers of *Sambucus* contain no honey and are sparingly visited by flies and pollen-collecting bees. *Viburnum*, which has also a rotate corolla, but secretes nectar, attracts a large number of bees, flies, beetles, and Lepidoptera. The corolla of *Symphoricarpus* is bell-shaped, and is visited chiefly by wasps. The funnel-shaped flower of *Linnæa* is adapted to slender flies. *Lonicera alpigena* is a wasp-flower; some of the species of *Lonicera* are visited by bees in general, while others are pollinated only by humble-bees; *L. capri-*

* Bot. Gazette, xxviii. (1899) pp. 328–59 (2 pls.).
† Amr. Natural., xxxiv. (1900) pp. 37–51.

folium and *periclymenum* are nocturnal flowers pollinated by hawk-moths; *L. sempervirens* is pollinated by humming-birds.

Dr. W. Taliew * describes the mechanism of pollination in *Borrago officinalis*. It is visited by hive-bees and humble-bees, which use the tooth-like appendages of the stamens as holdfasts to grasp with their legs, as well as the scales (staminodes) which form a whorl external to the stamens. The sucking out of the honey shakes out the pollen on to the abdomen of the insect. Similar contrivances are found in other Borragineæ—*Cerinthe*, *Symphytum*, &c.

From a series of observations made by MM. S. Korshinsky and N. Monteverde † on the pollination of the buckwheat, *Polygonum Fagopyrum*, they conclude, from its pronounced heterostyly and the occurrence of nectaries, that it is almost entirely dependent on the visits of insects for the production of fertile seeds; artificial self-pollination hardly ever resulted in complete fertilisation.

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

Assimilation of Free Atmospheric Nitrogen by the Aerial Parts of Plants.‡—Dr. L. Hiltner brings forward evidence to show that the power of assimilating the free nitrogen of the atmosphere is by no means confined to the bacteroids which inhabit the root-tubercles of the Leguminosæ and other plants, but is possessed also by endotropic mycorhiza in the underground or aerial parts of plants. This has been shown to be the case by the author in the case of the mycorhiza of *Podocarpus*; and he believes it to be so also with the mycorhiza of other Coniferæ, as well as that of the Ericaceæ and Orchideæ. He now gives experimental reasons for the belief that the fungus found by Nestler and others § in the ovary of *Lilium temulentum* has also the property of increasing, by absorption from the atmosphere, the small amount of nitrogen contained in the host-plant.

Absorption of Potassium by Plants. ‖ — M. Th. Schloesing, jun., has determined that plants can utilise the potassium salts in the soil when present even in the proportion of only a few millionths. The alkali is taken up in the form of potassium phosphate.

Variation produced by Grafting.¶—Continuing his observations of the effect of grafting on *Phaseolus vulgaris*, M. L. Daniel states that the effect of grafting one race on another is manifested in three different ways:—the tendency to a dwarf habit is increased; a combination results, more or less complete, of the characters of the two races; and a tendency is brought about towards the production of new varieties. This tendency is greater if the plant grafted is a cultivated than if it is a wild variety.

Culture of the Lupin.**—From prolonged culture of two species of lupin, *Lupinus albus* and *angustifolius*, MM. P. P. Dehérain and E. De-

* Bot. Centralbl., lxxxi. (1900) pp. 1–3. † Tom. cit., pp. 167–72.
‡ Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 831–7.
§ Cf. this Journal, 1899, p. 191.
‖ Comptes Rendus, cxxx. (1900) pp. 422–4. ¶ Tom. cit., pp. 665–7.
** Tom. cit., pp. 20–4, 465–9.

moussy state that the first species reaches only a very moderate development when it does not produce root-tubercles. The second species also is unable to utilise the atmospheric nitrogen without external assistance. It can, however, acquire a normal development without nodosities; but in that case it appears to obtain its nitrogen from bacteria which carry on a parasitic life on certain algæ—*Phormidium autumnale* and *Ulothrix flaccida*—present in the soil. While the root-tubercles of this species sometimes contain bacteria which assist in the nourishment of the host-plant, in other cases the bacteria contained in these nodules appear to exercise no function of the kind, but simply to carry on a parasitic existence on the host.

Influence of Carbon dioxide on the Growth of Plants.* — M. E. C. Téodoresco has carried on a series of experiments with a number of species of flowering plants, and with Hepaticæ (*Marchantia polymorpha*, *Lunularia vulgaris*), as to the effect on their form and structure of growth in an atmosphere containing more than the normal amount of carbon dioxide (2 per cent.), and growth in an atmosphere deprived as completely as possible of that gas. With the Hepaticæ growth is much more luxuriant when the atmosphere contains an excess of CO_2, and the propagules are formed only in the presence of this gas. With flowering plants, CO_2 appears to retard growth as long as the plant is consuming the food-reserves in the seed; but after that period, when the amount of CO_2 is increased, the leaves become thicker, the palisade-tissue better developed, and the aeriferous chambers larger both in the palisade and in the lacunar tissue.

Influence of External Conditions on the Length of the Growing Zone.†—Prof. A. P. Popovici has carried out a series of experiments on the influence of different conditions of growth on the growing zone, chiefly on *Vicia Faba*, *Phaseolus multiflorus*, and *Cucurbita Pepo*, from which he draws the following general conclusions:—The length of the zone capable of growth varies with the external conditions. This is especially brought out by changes in temperature and in the moisture of the soil.

Action of Light on the Germination of Seeds.‡ — In the case of *Veronica peregrina*, Herr E. Heinricher supplies another example of the influence of light in promoting the germination of seeds. Even a small amount of light makes an appreciable difference, and in full daylight the seeds germinate from five to eight days sooner than in the dark. The rays of the less refrangible half of the spectrum are the most efficient.

Germination of Cuscuta.§—By causing a number of *Cuscuta* seeds to germinate in close proximity to one another, Herr W. Kinzel ascertained that they put out haustoria which penetrated into others of the seedlings, and that they are, therefore, independent for their development on the presence of their proper host-plant.

* Rev. Gén. de Bot. (Bonnier), xi. (1899) pp. 429–44 (11 figs.).
† Bot. Centralbl., lxxxi. (1900) pp. 33–40, 87–97.
‡ Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 308–11. § Tom. cit., pp. 318–9.

Germination of Ximenia americana.* — M. E. Heckel records a peculiarity in the germination of this species of Olacineæ from the French Congo. Near the insertion of the petioles of the hypogæous cotyledons the stem bears two small linear scales which display positive geotropism, and penetrate between the cotyledons; they become concrescent with the petioles of the cotyledons, the embryo being imbedded in a copious oily endosperm. The author regards these structures as being of a foliar character, with the function of assisting the embryo in absorbing and digesting food-materials from the endosperm.

Excretion of Water by Leaves.† — Herr A. Nestler has continued his observations on the conditions under which drops of water are exuded by leaves, in the examples of *Phaseolus multiflorus* and various species of Malvaceæ. In all cases the water so exuded is found to contain potassium carbonate, a substance which eagerly absorbs moisture from the atmosphere. It is probable that the potassium salt also attracts water from the epidermal cells of the leaf.

Expulsion of Air from Detached Parts of Plants.‡ —From experiments on the annulus of ferns, sporanges of *Equisetum*, elaters of Hepaticæ, &c., Herr C. Steinbrinck has established the fact that even air of the ordinary atmospheric pressure can, under certain circumstances, be rapidly expelled from water.

(3) Irritability.

Influence of Various Factors on Circumnutation.§ — Herr C. Fritzsche has confirmed, by a series of experiments, Darwin's and Wiesner's general conclusion that, when the influence of external factors —light, gravitation, temperature, injuries, &c.—is excluded, the circumnutation of the apex of a shoot describes a very irregular curve. This was found to be the case with seedlings of *Avena sativa*, *Hordeum distichum*, *Triticum æstivum*, *Zea mais*, *Lupinus luteus*, *Cucurbita pepo*, *Brassica napus*, and *Trifolium pratense*; only with seedlings of *Helianthus annuus* and sporangiophores of *Phycomyces nitens* did the curve approach an ellipse. The curve described by circumnutating roots—*Zea*, *Cucurbita*, *Helianthus*, *Phaseolus*—was always an irregular one.

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

Formation of Proteids in the dark in Germinating Wheat.‖ — According to Herr J. Goldberg, the processes which go on in the embryo and in the endosperm during the germination of wheat are quite opposite to one another. While the amount of proteids in the endosperm is continually decreasing, the proportion in the embryo is continually increasing. This can only be the result of the synthesis of albuminoids in the embryo at the expense of amides obtained from the endosperm.

Production of Alcohol by Plants.¶—M. P. Mazé confirms his previous observations on the production of alcohol by plants, especially in

* Rev. Gén. de Bot. (Bonnier), xi. (1899) pp. 403–8 (10 figs.).

† Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 332–7. Cf. this Journal, 1898, p. 650.

‡ Tom. cit., pp. 325–30.

§ 'Ueb. d. Beeinflussung d. Circumnutation durch verschiedene Factoren,' Leipzig, 1899, 35 pp. and 30 figs. See Bot. Centralbl., lxxxi. (1900) p. 279.

‖ In Russian, Warsaw, 1899. See Beih. z. Bot. Centralbl., ix. (1900) p. 130.

¶ Comptes Rendus, cxxx. (1900) pp. 424–7. Cf. this Journal, 1899, p. 509.

the germination of oily seeds. He concludes that these seeds are capable of transforming substances of the group CH_2 into substances of the group CHOH by the fixation of oxygen. He found the plant most convenient for these experiments to be the castor-oil plant.

Recent Researches on Nitrification.* — Prof. R. Warington gives the following summary of recent researches on nitrification.

"During recent years, the chief investigations on the character and properties of the nitrifying organisms have been carried out in Winogradsky's laboratory in St. Petersburg, none having been executed in this country. Formerly, investigators have been unable to obtain pure cultures of the organisms; their chemical characters had, however, been studied, as their capacity for growth in a purely mineral solution allowed of their separation from most of the other organisms in the soil. It had been found that the process of nitrification consisted of two distinct pieces of chemical work, effected by two agents, which could be separated from each other; by the first (the nitrous organism) ammonia was converted into a nitrite; by the second (the nitric organism) the nitrite was oxidised to nitrate. These facts were first ascertained at Rothamsted.

"To isolate the nitrous organism from soil, Winogradsky commences by a series of cultures in an inorganic solution containing an ammonium salt and the ash constituents of plant food. From this solution, cultivations on solid media are started. For some years silica jelly was employed, but Omeliansky now prefers plates of magnesia-gypsum saturated with the mineral solution already mentioned.† To isolate the nitric organism, the preliminary cultures are made in a solution containing sodium nitrite and ash constituents. As a solid medium, purified agar, with nitrite and ash constituents, is made use of. The fermentable constituents of the agar have been previously removed by Beyerinck's method.

"Winogradsky has examined soils from many parts of the world. He finds but one nitrous and one nitric organism in any soil. The nitric organism is everywhere the same species. The nitrous organism may vary. In Europe, North Africa, and parts of Asia, the same species occurs, with variations in size and in tendency to adopt a zooglœa or motile condition; the latter condition displays the greater chemical energy. The nitrous organism from Java is a distinct species, having an extraordinarily long flagellum. The organism from South America and Australia is generically different; it is a giant coccus. A few other investigators have described different nitrifying organisms, but the evidence adduced has in some cases proved erroneous, and is in other cases as yet insufficient to warrant its acceptance.

"Winogradsky had proved by quantitative experiments that the nitrous organism derives its carbon from carbonic acid; the nitric organism possesses the same power. As both organisms flourish in darkness, the energy necessary for the construction of organic matter out of carbon dioxide and water is apparently derived from the oxidation, respectively, of ammonia or a nitrite. Later experiments have shown that the carbonic acid is, in every case, probably taken from a supercarbonate. The nutrition of the bacteria which exist with the nutrifying organisms in a mineral solution requires further study.

* Proc. Chem. Soc., xvi. (1900) pp. 65–7. † Cf. this Journal, 1899, p. 544.

Stutzer states that his hypomicrobium grows in a mineral solution, and needs carbonic acid for its nutrition, yet possesses no nitrifying power; its source of energy requires explanation.

"The refusal of the nitrifying organisms to grow on gelatin and on most organic media is well known. Winogradsky and Omeliansky have lately studied the influence of various kinds of organic matter on the nitrifying process. The presence of 0·5 of glucose in 1000 of liquid is sufficient to retard the action of both the nitrous and nitric organisms, while about 2 per 1000 entirely prevents nitrification. Glucose has thus as great an influence upon the nitrifying organisms as phenol has on ordinary bacteria. Of simpler forms of organic matter, as sodium acetate, a much larger quantity is required to hinder nitrification.

"The influence of ammonia in preventing the action of the nitric organism is very remarkable; 5 parts per million was sufficient to retard its action, and 150 parts per million prevented it altogether, a proportion which is comparable with an effective dose of mercuric chloride. It seems, however, probable that an increase in the quantity and energy of the nitric organism enables it to bear a somewhat greater quantity of ammonia.

"It appears from careful trials that the nitrifying organisms are without action upon nitrogenous organic matter; even methylamine is unaffected by them. For nitrification of organic matter to take place, the aid of other organisms is necessary to decompose it and bring the nitrogen into the form of ammonia. The behaviour of the nitrifying organisms towards organic matter and ammonia is of great practical importance."

Lactic Acid Ferments and Cheese Ripening.* — MM. Ed. von Freudenreich and O. Jensen record a series of elaborate experiments on the relation between lactic acid ferments and the ripening of Emmenthal cheese. Their main conclusions are that *Tyrothrix* bacilli have no share in the ripening of Emmenthal cheese. They do not multiply in normal cheese, and even when added in large numbers to the cheese, exert no influence on the formation of decomposition products. On the flavour of cheese their influence is entirely harmful. The chief share in the ripening of Emmenthal cheese is taken by lactic acid ferments, which increase with great rapidity, render the casein in the cheese soluble, and generate the products characteristic of cheese ripening. It is not improbable that the natural milk enzymes discovered by Babcock and Russell † participate in the ripening, since, by solubilising the casein, they facilitate the operations of the lactic acid ferments. Pasteurisation of milk, at any rate so far as Emmenthal cheese is concerned, deteriorates the quality of the cheese. The observations show that a loss in the soluble constituents of cheese occurs during ripening, and also indicate the presence of lecithin and traces of glycerophosphoric acid.

Fermentation of Galactose.‡—The researches of M. F. Dienert on the fermentation of galactose and the accustoming of yeasts to this sugar may be summarised as follows. Galactose is a fermentable sugar when a yeast has become accustomed to it. The duration of the acclimatisa-

* Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 12-6, 38-45, 72-9, 112-9, 140-7.

† Cf. this Journal, 1899, p. 525.

‡ Ann. Inst. Pasteur, xiv. (1900) pp. 139-89.

tion varies, and is feeble for lactose ferments. Glucose is fermented 1·6 times more quickly than galactose by acclimatised yeasts. Acclimatisation is gradually lost if sugar, other than galactose, lactose, or melibiose, be offered to the yeast, and if multiplication be favoured this may happen in a few hours. The morphological characters of the yeasts are in no way altered by acclimatisation. Certain substances (boric acid, toluene) may prevent acclimatisation without preventing the fermentation of glucose. Alcohol is more harmful to the fermentation of galactose than to that of other sugars. When a yeast has lost its zymase by cultivation in a medium rich in pepton, it cannot be acclimatised to galactose until it has been revived with glucose; but if it has been previously acclimatised it can be revived on galactose. Yeast may become acclimatised to galactose in presence of glucose, and also in presence of levulose, but only with difficulty. With certain yeasts the process of acclimatisation is accompanied by a greater secretion of melibiase or of lactase. During the process of acclimatisation only one zymase undergoes a change of constitution, and this change is attended by profound alteration in the constitution of the protoplasm. The phenomenon of acclimatisation is, in this case then, a profound modification of the condition of the cell induced by a carbohydrate closely allied to glucose. Finally, reference is made to the acclimatisation of leucocytes to toxins and toxin substances, and a comparison is made between the yeast ferments and antitoxins, which latter not only accustom the leucocytes to toxins but also act as the antidote.

Rancidity of Butter.*—The more important results of an investigation as to the causes of butter becoming rancid carried out by Herr R. Reinmann, may be summed up shortly as follows.

There does not appear to be any relation between the rancid taste and odour and the quantity of free acids formed in butter. The greater the amount of casein and of milk-sugar in butter, the more quickly does it become rancid. Light and air (oxygen) do not appear to exert any direct influence. Butter made from sterilised cream will rarely become rancid, but if brought into contact with rancid butter will turn in a few days. At the present time the data for determining whether rancidity is due to microbes or enzymes are insufficient.

γ. General.

New Theory of Myrmecophilous Plants.†—From observations made during a stay in South America, Dr. L. Buscalioni and Herr J. Huber doubt the correctness of the ordinary symbiotic theory of myrmecophilous trees and shrubs, viz. that the ants protect the plant against the attacks of other injurious insects, especially leaf-cutting ants. They find these species to abound especially in localities which are frequently submerged by floods, where leaf-cutting ants do not exist. This is particularly the case with species of *Cecropia*. The authors believe that the habit is simply one for the advantage of the inhabiting ants themselves, and that the myrmecophilous habit is confined to species which inhabit localities liable to be flooded, or which have been at some previous period liable to be flooded, or to species descended from those which inhabit such localities.

* Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 131–9, 166–76, 209–14.
† Beih. z. Bot. Centralbl., ix. (1900) pp. 85–8.

Myrmecophilous Plants.*—Herr M. Raciborski describes a number of fresh myrmecophilous plants from Java. *Pterospermum javanicum* (Sterculiaceæ) possesses "pearl-glands" contained in cups, which serve as food for the ants; the cups appear to be metamorphosed stipules. Raciborski was, however, quite unable to determine that the ants exercised either a favourable or a hurtful effect on the host-plant. All the climbing species of *Gnetum* in Java produce similar pearl-glands; they are here borne on the surface of the nodes and internodes. Here also they did not appear to present any special attraction to ants.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Lignin in Vascular Cryptogams.†—Using the phloroglucin test, Dr. K. Linsbauer has come to the conclusion that lignin is much more widely distributed in Vascular Cryptogams than has generally been supposed. He finds it in all families, and in a great variety of organs;—in the xylem elements, the mechanical elements, the epiderm, especially in the guard-cells of the stomates, and in the outer wall of the sporanges.

Conditions of Spore-formation in Acrostichum.‡—Herr M. Raciborski notes that in an *Acrostichum* sp. indet., no sporophylls are produced in ordinary conditions of growth; but that when the rhizome is made to grow in a vertical position, fertile fronds make their appearance. The same is the case also with other ferns.

Muscineæ.

New Genera of Mosses.—In a final instalment of his paper on South African Mosses, the late C. Müller § describes a new genus of Fabroniaceæ, *Fabronidium* g. n., with the following diagnosis:—Habitus *Fabroniæ*. Inflorescentia monoica; peristomium simplex; dentes 16, anguste lanceolato-subulati, rufuli, linea longitudinali secedente usque ad basim dicranoideo-divisi, cruribus linearibus articulatis plus minus solitariis vel cohærentibus.

Cryptoleptodon is the name of a new genus of Musci from Western India, described by MM. F. Renauld and J. Cardot,|| with the following diagnosis:—Caulis secundarius, pendulus, flexuosus, pinnatim et bipinnatim ramosus; folia obtusa, costata, lævia, siccitate transversim undulata; flores dioici; vaginula pilosa; calyptra cucullata, pilosa; capsula immersa; peristomium duplex; exostomii dentes 16, intus trabeculati; endostomium e membrana ultra medium dentium elata, in 16 processibus irregularibus fugacibus dilacerata compositum.

MM. F. Renauld and J. Cardot ¶ now regard the moss (from Congo) which they previously described under the name *Cyathophorum* (?) *Dupuissii*, as (provisionally) the type of a new genus to which they give the name *Rhacopilopsis*, with the following diagnosis:—Habitu Rhacopiloideo. Caulis repens, rami erecti, uno latere rectangulariter pinnati;

* Flora, lxxxvii. (1900) pp. 38–45 (6 figs.).
† Oesterr. Bot. Zeitschr., xlix. (1899) pp. 317–23.
‡ Flora, lxxxvii. (1900) pp. 25–8 (2 figs.).
§ Hedwigia, xxxviii. (1899) p. 132. Cf. this Journal, 1899, p. 416.
|| Bull. Soc. Roy. Bot. Belgique, xxxviii. 1899 (1900) 2me fasc., p. 30.
¶ Rev. Bryol., xxvii. (1900) p. 47.

folia ramea distiche complanata, asymmetrica, ovata, raptim in acumen plus minus flexuosum producta, ecostata; rete densiusculo, cellulis basilaribus elongate rectangulis, mediis elongatis lineari-subrhombeis, superioribus oblongo-rhombeis; folia stipulæformia multo minora, deltoideo-lanceolata, sensim acuminata, cuspidata, enervia, e cellulis uniformibus lineari-subrhombe reticulata.

Hermaphrodite Gametophore in Preissia commutata.*—Miss Anne B. Townsend records an example of this representative of the Marchantiaceæ in which, instead of the gametophore bearing one kind only of sexual organs, it bears both kinds. It appears to be primarily an archegoniophore modified to adapt it to its peculiar conditions.

Algæ.

Movements in Bornetia secundiflora.†—Sig. A. Preda has noticed that when this seaweed is immersed in fresh water, an apparently spontaneous movement sets up in the frond after a few seconds, the branches suddenly contracting spasmodically. These movements continue until the thallus has completely lost its turgidity, and are accompanied by a strong crackling, due to the successive rupture of the cells, which expel their contents to a considerable distance. The author attributes the phenomenon to a violent endosmose.

Fertilisation of Batrachospermum.‡—Herr W. J. V. Osterhaut has followed out this process in the case of *B. Boryanum*. The "spermatia" (pollinoids), each of which contains a single nucleus, attach themselves to the trichogyne near its tip. At the point of contact the cell-wall of both trichogyne and pollinoid are completely absorbed, and the nucleus of the latter passes into the trichophore; and the author has been able actually to observe its fusion with the ovum-nucleus. The formation of the gonimoblasts and spores was also followed out. The author does not confirm the statement of Schmidle § that each pollinoid contains two nuclei.

Thorea.‖—Mr. G. G. Hedgcock and Mr. A. A. Hunter describe the structure of this alga, their account agreeing in all essential points with that of Schmidle. They find the three distinct stages:—(1) The prothallium stage, consisting of more or less branched cellular fibres, which develope directly from the spores; in this stage neither spores nor tetraspores were found; (2) The chantransia stage, developing directly from the first; in this stage non-sexual spores are produced; (3) The branching plant, constituting the most highly developed form, in which carpogones are formed in addition to the other organs of propagation.

Phæocystis globosa sp. n.¶—Herr A. Scherffel describes this new species obtained in plankton from Heligoland. The colour of the chromatophores, the arrangement of the cell-contents, the presence of leucosin, the formation of the primary and secondary flagella in the swarming stage, and the structure of the colonies, indicate a close

* Bot. Gazette, xxxviii. (1899) pp. 360–2 (1 fig.).
† Bull. Soc. Bot. Ital., 1898, pp. 230–2.
‡ Flora, lxxxvii. (1900) pp. 109–15 (1 pl.). § Cf. this Journal, 1899, p. 628.
‖ Bot. Gazette, xxxviii. (1899) pp. 425–9 (1 pl.).
¶ Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 317–8.

alliance with the Flagellata; but the author regards the organism not as belonging to the Flagellata, but rather as a Thallophyte, probably a transitional form to the Phæocapsaceæ, the probable phylogenetic origin of the Phæophyceæ.

Chambers and Pores in the Cell-wall of Diatoms.*— Herr O. Müller records the result of further observations on these points in the structure of diatoms in connection with centrifugal growth in thickness and extraneous protoplasm. He emphasises Schütt's distinction between pores and dots, understanding by the former an actual perforation, by the latter simply a thin spot in the cell-wall; small circular dots which resemble pores he calls "poroids." Pores in this sense are by no means universal in the valve of diatoms. When present, it is not always certain that the pores serve for the passage of protoplasm. In *Melosira undulata* the pore-canals serve for metastasis and for pedicel-formation. In *Pleurosigma* metastasis takes place through the pores, while locomotion is effected by the raphe. In *Epithemia* the function of the pores is unknown, locomotion is effected through the raphe, metastasis through the dots. In *Isthmia* the function of the pores is also unknown; metastasis takes place through the dots.

Pores through which a mucilage is excreted from which the pedicel is formed (*Gallertporen*), can be detected without much difficulty in *Diatoma*, where they occur only at one of the poles, and in many species of *Synedra*; with great difficulty in *Tabellaria*; in *Grammatophora* there is one at each pole.

The author maintains that the centrifugal growth of the cell-wall is not due to the extraneous protoplasm, but, like the centripetal growth, is completed within the cell.

Polymorphism in the Chlorophyceæ.†—Herr T. Hedlund has cultivated about twenty species of aerobic Chlorophyceæ in the following method. The alga is placed on a transparent lamella of the periderm of the birch only a few cell-layers in thickness, which is then replaced in its natural position on the tree, removed from time to time, and examined under the Microscope. He finds in this way that alterations in the external conditions—light, moisture, temperature, &c.—will often cause great variations in a species in a single generation; but that not unfrequently a return to the original form will take place in the second generation, even when the new conditions still remain. Such variations he terms "modification-forms." A single species may thus include forms which produce and forms which do not produce gonids; forms with smooth and forms with spiny membrane; spherical forms and spindle-shaped forms with rounded ends; forms with one and forms with two chromatophores, &c. Modification-forms have been erected into species in the genera *Dactylococcus*, *Glœocystis*, *Stichococcus*, *Pleurococcus*, *Cystococcus*, *Hormidium*, and *Prasiola*.

Development of Green Algæ without Carbonic Acid Assimilation.‡—Dr. A. Artari has tried a series of experiments on some green algæ—

* Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 423-52 (2 pls. and 1 fig.). Cf. this Journal, 1899, p. 308.

† Öfv. k. Vetensk.-Akad. Förhandl., 1899, pp. 509-35 (5 figs.). See Bot. Centralbl., lxxxi (1900) p. 272.

‡ Bull. Soc. Imp. Nat. Moscou, 1899, pp. 39-47 (2 figs.).

chiefly *Pleurococcus vulgaris* and *Scenedesmus caudatus*—and lichen-gonids, for the purpose of ascertaining whether they will still grow in the dark when the assimilation function of chlorophyll is suspended. He states that growth does take place, though with diminished energy, in the dark, in a nutrient medium containing sugar and nitrogen in the form of asparagin or ammonium nitrate.

Cell-nuclei of Acrosiphonia.*—Prof. N. Wille finds in this genus of Algæ two quite different types of cell-structure:—in one (*A. bombycina*) each cell has only a single nucleus; in the other type (*A. hamulosa*) the cells are multinucleate. In both cases there is a relation between the nucleus or nuclei and cell-division. The author proposes to remove all the uninucleate species from *Acrosiphonia*, and place them under Kützing's old genus *Spongomorpha*.

Botrydium granulatum.—M. L. Ivanoff † has followed out the life-history of this alga, with the following results.

Hypnosporangium is not a stage of *Botrydium granulatum*, but an independent organism. *Botrydium granulatum* Wor. et Rost. is made up of three distinct species:—*B. granulatum* Grev., *B. Wallrothi* Kütz., and *Protosiphon botryoides* Klebs. The root-cells are a stage of *B. granulatum*, and do not produce hypnosporanges.

In *B. granulatum* Grev. the zoospores from one of the large bladders give birth to the ordinary form, which may be propagated by zoospores, spores, or root-cells. Zoospores may become transformed into spores, and, after a time, may proliferate. The spores may either germinate directly, or may produce fresh spores, or probably also zoospores. The root-cells may either germinate directly, or may produce zoospores or spores.

In *B. Wallrothi* the zoospores, like the cells of *B. granulatum*, form, on germinating, a bladder up to 500 μ in diameter. It is propagated by spores and zoospores; there are no root-cells, but, on the other hand, hypnosporanges. In both species zoospores and spores may arise in all stages of development of the bladder. The zoospores may proliferate or may form spores. The spores may produce new spores or zoospores, or may proliferate. Hypnosporanges may give birth to either spores or zoospores.

Mr. H. Wager ‡ gives a full description of this alga, including the colourless underground rhizoids, the structure of which had not before been described. He gives three different modes in which the non-sexual swarmspores are formed, including the formation of hypnosporanges. The alleged sexual reproduction by the conjugation of biciliated swarm-spores is uncertain.

Boueina, a Fossil Genus of Codiaceæ.§—In the Upper Neocomian beds of south-east Servia, Herr G. Steinmann finds the remains of a fossil alga, which he makes the type of a new genus nearly allied to *Halimeda*. It has an unbranched cylindrical thallus; the calcareous structure is

* S.B. Biol. Selsk. Christiania, Nov. 30, 1899. See Bot. Centralbl., lxxxi. (1900) p. 238.

† Arb. k. St. Petersburg. Gesell. Naturf., xxix. (1898) pp. 1–10. See Beih. z. Bot. Centralbl., ix. (1900) p. 163.
‡ Proc. Leeds Nat. Club, iv. (1899) pp. 9–15.

§ Ber. Naturf. Ges. Freiburg-i.-Br., xi. (1899) pp. 62–72. See Bot. Centralbl., lxxxi. (1900) p. 346.

permeated by canals, which in the central portion are parallel to the longitudinal axis, in the peripheral portion vertical to the surface. The ultimate branches of the canals dichotomise freely.

Platydorina, a New Genus of Volvocineæ.* — Dr. C. A. Kofoid finds, in the plankton of streams in Illinois, a colonial alga, which he makes the type of a new genus of Volvocineæ, under the name *Platydorina caudata* g. et sp. n. The cœnobe or colony is composed of 16 or 32 biflagellate cells, and is of a horseshoe shape, somewhat twisted on its axis, and is remarkable for having at one end 3 or 5 projections or tails, which are extensions of the gelatinous sheath. The following is given as the diagnosis of the new genus:—Colony flattened, the two faces compressed, so that the cells of the two sides intercalate; flagella upon both faces of alternate cells; anterior and posterior poles of major axis differentiated by the arrangement of the cells and by the structure of the envelope; long and short transverse axes differentiated by the flattening of the colony; cells similar, biflagellate, each with stigma, chromatophore, and pyrenoid; non-sexual propagation by repeated division of all the cells, each forming a daughter-colony. The locomotion is chiefly in one direction. The author regards the cœnobe as really a unit rather than a colony.

A clavis follows of the genera of Volvocineæ, *Gonium*, *Stephanosphæra*, *Pandorina*, *Eudorina*, *Platydorina*, *Pleodorina*, and *Volvox*.

Fungi.

Nitrogenous Constituents of Fungi.† — According to Herr E. Winterstein, the chemical composition of Fungi differs in several important points from that of flowering plants. In addition to carbohydrates, the membranes contain a nitrogenous substance, chitin. Neither in fresh nor in dried fungi (*Boletus edulis*, *Cantharellus cibarius*, *Agaricus campestris*) was the author able to isolate proteids. From *B. edulis* and *A. campestris* leucin was crystallised, and the presence of tyrosin was demonstrated by Millon's reagent.

Effect of Deleterious Agents on Fungi.‡ — Mr. J. F. Clark has a lengthy article on the toxic effect of deleterious agents on the germination and development of certain filamentous Fungi. Among the more important results may be mentioned the following.

Fungi are in general much more resistant to most deleterious agents than the higher plants. In the case of mineral acids, a concentration of from 200 to 400 times the strength fatal to the higher plants is required to inhibit the germination of mould-spores under otherwise favourable conditions; but different species of fungi present very great differences in their power of resistance to the various agents. Even spores taken from the same pure culture may differ from one another in this respect. The protoplasm of moulds is in general most sensitive to the action of deleterious agents in the conidial stage. Hydrocyanic acid is a very violent poison to moulds, while strychnine is nearly innocuous.

* Bull. Illinois State Lab., v. (1899) pp. 419–40 (1 pl.).

† Hoppe-Seyler's Zeitschr. f. Phys. Chem., xxvi. (1899) p. 438. See Beih. z. Bot. Centralbl., ix. (1900) p. 167.

‡ Bot. Gazette, xxviii. (1899) pp. 289–327, 378–404 (10 diagrams).

Structure of the Entomophthoreæ.—Dr. F. Cavara * has made a detailed study of the cytological structure of this family of Fungi, chiefly in two species, *Empusa Muscæ* and *Entomophthora Delpiniana* sp. n.

The reticulate structure of the cytoplasm is contrasted with the alveolar structure (Bütschli) and the fibrillar structure (Flemming). It has, at the same time, a granular structure comparable to that of the Chlamydomonadineæ; the granules vary greatly in size, and are generally erythrophilous. The author regards them as the source of the activity of the cytoplasm, rather than as a secondary product of it. The granules are the essential constituents of the cytoplasm, through the activity of which it increases, undergoes transformations, migrates, and perpetuates itself; while the reticulation is a secondary phenomenon more or less precarious, and destined to inevitable death.

The nuclei of the two species examined agree in structure, though differing in size. The nucleus is composed of a chromophilous vesicle containing granules of chromatin and often one or more nucleoles. As in the Saccharomycetes, the vesicle and the vacuole correspond to the nuclear membrane and the nuclear framework, taken together, of the nucleus of other plants. The process of division in the vegetative cells is intermediate between that of direct division and that of karyokinesis.

The conidiophores, often incorrectly called basids, spring directly from the hyphal body. The conid may have from 15 to 20 nuclei, all of which have passed into it from the conidiophore. Two forms of azygospore were found in *E. Delpiniana*.

The characteristics of the cytoplasm seem to suggest an affinity between the Entomophthoreæ and the Saccharomycetes.

M. P. Vuillemin † confirms the observation of Cavara, of the production of azygospores by *Entomophthora*, in the case of *E. glœospora*. He deduces the phylogenetic conclusion that the Entomophthoreæ are an independent group derived from the Phycomycetes, and that the multinucleate condition of *Empusa* is anterior to the uninucleate condition of certain species of *Entomophthora* and *Basidiobolus*.

Endogenous Formation of Conids by the Ascomycetes.‡—Herr T. Vestergren enumerates all the cases hitherto known of the endogenous formation of conids in fungi belonging to various families of Ascomycetes:—Hyphomycetes, Pyrenomycetes, Perisporiaceæ, &c. He further describes a remarkable instance of this phenomenon in *Hymenella Arundinis*, a rare fungus forming cylindrical incrustations on dead haulms of *Phragmites communis*. The conid-receptacles are flask-shaped, and always produce within them four conids which escape, imbedded in mucilage, through the neck of the receptacle.

Parasitic Fungi.—MM. E. Prillieux and G. Delacroix § have investigated the cause of a disease of the vine very prevalent in vineyards in the Caucasus, and find it to be due to the attacks of a parasitic fungus nearly allied to that which produces the black-rot in France and in America, but not identical with it. It is named *Guignardia reniformis* sp. n.

* Nuov. Giorn. Bot. Ital., vi. (1899) pp. 411–66 (2 pls.); Bull. Soc. Bot. Ital., 1899, pp. 55–60.

† Comptes Rendus, cxxx. (1900) pp. 522–4.

‡ Öfv. k. Vetensk.-Akad. Förhandl., lvi. (1899) pp. 837–45 (3 figs.) (English).

§ Comptes Rendus, cxxx. (1900) pp. 298–301.

According to MM. L. Ravaz and A. Bonnet,* the prevalent disease of the vine in the Caucasus is entirely due to *Phoma uvicola*, and not partially also to *P. reniformis.*

On old yeast-cultures M. K. Purjewicz † finds a new species of *Aspergillus*, which he names *A. pseudoclavatus*, distinguished from *A. clavatus* by its branched sterigmas.

Herr H. Boltshauser ‡ describes the injuries done to cherry-trees in Thurgau by the attacks of *Clasterosporium Amygdalearum.*

Herr P. Magnus § describes in detail the life-history of *Melampsorella Caryophyllacearum*, parasitic on species of *Dianthus* and *Cerastium.* He identifies with it *Exobasidium Stellariæ* Syd.

Herr W. Rothert ‖ finds the seeds of *Melampyrum pratense* to be constantly infested by a sclerote which imparts to them a dark grey colour; but the systematic position of which he was unable to determine.

Prof. M. Shirai ¶ identifies *Peridermium giganteum* Tub. and *Cronartium Quercuum* Miy., as belonging to one cycle of generations, the former being parasitic on species of *Pinus*, the latter on evergreen oaks. The two fungi are found (in Japan) only in localities where the two host-plants grow in close proximity.

A new species of *Tubercularia*, *T. Sbrozzi*, is described by Sigg. F. Cavara and P. A. Saccardo ** as parasitic on the leaves of *Vinca major.*

Effect of Mould-fungi on Wall-papers containing Arsenic.††—Herr H. R. Schmidt has tested the truth of the current opinion that the effect of mould-fungi on hangings or papers coloured by a pigment containing arsenic, is to reduce the arsenic compound and to set free arseniuretted hydrogen, by growing a number of different species in nutrient solutions containing arsenic. He finds this reducing property to be especially marked in four of the commonest species of mould-fungi, viz. *Penicillium glaucum*, *Aspergillus flavus*, *Mucor mucedo*, and *Dematium pullulans*, and to be displayed also to a less extent by nearly every one of 24 species examined.

Influence of Inorganic Salts on the Formation of Conids in Aspergillus niger.‡‡—The following is the result of a series of experiments on this subject made by Prof. A. Yasuda:—The formation of conids is retarded in proportion to the concentration of the nutrient fluid; the size of the conidial fructification also decreases under the same condition; the conid-bearing hyphæ become shorter; the black colour of the conids is greatly promoted. When the solution is very concentrated, the formation of conids altogether ceases.

* Comptes Rendus, cxxx. (1900) pp. 590-2.

† Schriften d. Naturforschgesell. in Kiew, xvi. (1899) 9 pp. and 1 pl. See Bot. Centralbl., lxxxi. (1900) p. 109.

‡ Mitth. d. Thurgauer Naturf.-Gesell., xiii. See Beih. z. Bot. Centralbl., ix. (1900) p. 142.

§ Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 337-43 (1 pl.).

‖ Flora, lxxxvii. (1900) pp. 98-108.

¶ Bot. Mag. (Tokyo), xiii. (1899) p. 74. See Bot. Centralbl., lxxxi. (1900) p. 367.

** Nuov. Giorn. Bot. Ital., vi. (1899) pp. 322-8 (1 pl.).

†† S.B. Phys.-med. Soc. Erlangen, xxx. (1898) p. 18. See Zeitschr. f. angew. Mikros., v. (1899) p. 176.

‡‡ Bot. Mag. (Tokyo), xiii. (1899) p. 85. See Bot. Centralbl., lxxxi. (1900) p. 340.

Fungi in Juniper-berries.*—Herr A. Nestler finds the mycele of a fungus almost universally present in the so-called "berries" of the juniper, not in the year in which they are formed, but in the following year, and in the second year, in which they ripen. Experiments on infection seemed to show that the change in colour from green to the black or blue-black colour of the ripe berries was due to the action of the fungus. The exact nature of the fungus was not determined; but the incipient formation of spores resembling those of *Aspergillus* was observed; and there is probably more than one species.

Association of Alga and Fungus in Lichens.†—From observations made largely on hanging-drop cultures of *Ramalina reticulata*, Prof. G. J. Peirce sees reasons to doubt the current commensalism theory of the association of the algal and fungal constituents of lichens.

It is demonstrated, by both cultures and microtome sections, that the hyphæ and gonids are in the most intimate contact; the hyphæ develope branches which may merely clasp the gonidial cells, or may penetrate them as definite haustoria. This clasping or penetration stimulates the gonids to internal cell-divisions in the effort to form individual cells free from hyphal investment. The haustoria consume the protoplasmic contents of the gonidial cells which they have entered, leaving only the empty cell-wall. It is evident, therefore, that the fungus is fed by the alga; and there is no evidence that the gonids develope more luxuriantly in connection with the hyphæ than they would elsewhere; while the fungus portion of every lichen is absolutely dependent upon the gonids for all of its non-nitrogenous food.

The author further states that the algal element of *Ramalina*, *Usnea*, and *Sphærophorus*, is *Cystococcus humicola*, and that the central body of the gonidial cells is a nucleus, not a pyrenoid.

Spores of Lichens.‡—Sig. A. Jatta suggests a classification of Lichens into two primary groups Homolicheni, in which the gonids are variously disseminated, and Heterolicheni, in which they are stratified in the thallus. The Homolicheni comprise the two groups Byssacei and Collemacei; the Heterolichenes eleven families, viz. the Ramalinacei, Cladoniacei, Sphæophoracei, Parmeliacei, Umbilicariacei, Endocarpacei, Lecanoracei, Lecideacei, Graphidacei, Caliacei, and Verrucariacei. A table is given showing the constancy or otherwise, in the different families, of characters derived from the spores.

Rickia, a New Genus of Laboulbeniaceæ, and some New Species.—Under the name *Rickia Wasmannii* g. et sp. n., Dr. F. Cavara§ describes an obligatory parasitic fungus found on an ant, *Myrmica lævinodis*. It is of a remarkably coriaceous rigid consistency, resembling one of the lower animals. The diagnosis of the genus, which appears to furnish a connecting link between the Laboulbenieæ and the Peyritschielleæ, is thus given:—Receptaculum stipitatum, clavatum, asymmetricum, parenchymatico-contextum, duabus appendicum lateralium seriebus constitutum; antheridia simplicia, unicellularia, supra appendices inserta, ab hisque annulo scleroso discreta; antherozoidia endogena; perithecia

* Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 320-5 (1 pl.).
† Proc. California Acad. Sci., i. (1899) pp. 206-40 (1 pl.); Amer. Nat. xxxiv. (1900) pp. 245-53.
‡ Nuov. Giorn. Bot. Ital., vi. (1899) pp. 493-515 (1 pl.).
§ Malpighia, viii. (1899) pp. 173-88 (1 pl.).

singula v. raro bina, lateraliter inserta, sessilia, trichogyno simplici prædita; cellulæ ascogenæ tres v. plures?; asci maturi non visi; sporæ septatæ.

Mr. R. Thaxter * publishes preliminary diagnoses of no less than 96 new species of *Laboulbenia*, found on zoological specimens in various public museums.

Multiplication of Yeast without Fermentation and with Limited Quantity of Air.†—M. A. Rosenstiehl records instances of the multiplication of yeasts in saccharated media and in presence of a limited quantity of air.

The occurrence of this lowered vitality was observed in yeasts obtained from fermenting cider and isolated on plates composed of apple-juice thickened with gelatin or agar. When transferred to a medium composed of acidulated malt infusion, invert sugar, and tartaric acid, they were found capable of fermenting apple-juice after two or three cultures in the artificial must; but if transferred directly from the plates to the juice, they were powerless to excite fermentation; they sank to the bottom of the fluid and began to increase in bulk. Examined microscopically the sediment showed that the yeasts were budding actively. Experiments are then recorded indicating that the tannin of the apple or some analogous substance coagulable by gelatin is the cause of the phenomenon. Hence, of the two forms of vital activity exhibited by yeast, fermentation is extinguished before reproduction when the vitality of the organism is lowered or enfeebled.

Parasites of Wheat.‡—M. L. Mangin has studied in particular the disease of wheat produced by *Septoria graminum* and that known as *piétin*.

The spores of *Septoria graminum* put out germinating filaments which perforate the epiderm, but do not enter through the stomates; their action is purely chemical. The specific characters of this fungus at present given are not constant. Its ascospore form is as yet unknown.

Piétin is a disease which attacks the haulm of the wheat, and is caused by *Leptosphæria herpotrichoides*, often accompanied by *Ophiobolus graminis*; also by *Pyrenophora trichostoma*, and by the conidial forms of *Dictyosporium opacum* (?), *Coniosporium rhizophilum* (?), and *Aspergillus circinatus* sp. n. The peritheces of *Ophiobolus* emit their asci, which discharge bacilliform spores. These, on germinating, give out a short promycele or none at all, and develope minute motile sporids. The asci of *Leptosphæria* burst within the perithece, and discharge the ascospores, enclosed in a gelatinous matrix which swells up and becomes disintegrated in water. Culture experiments demonstrate that *Dictyosporium opacum* (?) is the conidial form of *Leptosphæria herpotrichoides*, and that *Coniosporium rhizophilum* (?) is the conidial form of *Ophiobolus graminis*.

Teleutospores of Puccinia.§—Mr. H. H. Hume describes and figures examples of several species of *Puccinia*—*P. heterospora*, *tomipara*,

* Proc. Amer. Acad. Arts and Sci., xxxv. (1899) pp. 153–209. Cf. this Journal, 1897, p. 319.
† Comptes Rendus, cxxx. (1900) pp. 195–8.
‡ Overs. k. Danske Vidensk. Selsk. Forhandl., 1899, pp. 213–72 (3 pls. and 17 figs.) (French).
§ Bot. Gazette, xxviii. (1899) p. 418–23 (6 figs.).

irregularis, *Montanensis*, *graminis*, and *rubigo-vera*—in which the teleutospores exhibit great variation in the number and position of the septa. The writer traces, in this variation, the evolutionary development of several genera of Uredineæ,—*Uromyces*, *Puccinia*, *Triphragmium*, and *Phragmidium*.

Mannite in the Tuberaceæ.* —Prof. O. Mattirolo has extracted from a number of different species of Tuberaceæ—*Tuber excavatum*, *Elaphomyces variegatus*, &c.—a substance identical in properties and in chemical composition with the mannite of the mountain ash $C_6H_{14}O_6$. It can be crystallised out from an aqueous solution in the form of small white shining needle-like crystals.

Poisonous Property of Pleurotus olearius. † — According to Prof. G. Arcangeli, this alleged poisonous fungus is readily eaten by the larvæ of some insects, and by snails, without appearing to do them any harm. Although rabbits refuse it in the wild state, it does not appear to have any special injurious effect upon them in small quantities. With dogs it acts as an emetic, as it does with man.

Pigments of Amanita muscaria. ‡— M. A. B. Griffiths gives the formula for the green pigment of the "fly amanita" as $C_{29}H_{20}O_{10}$, and for the red pigment $C_{19}H_{18}O_6$.

Mycorhiza of Pyrola.§—Herr O. Kramár describes the mycorhizæ of *Pyrola rotundifolia* and *minor*, which combine the characters of an ectotropic and an endotropic mycorhiza, developing intracellular hyphæ, and also forming a conspicuous mantle outside the root. The roots of *P. minor* often have the coral-like appearance characteristic of roots infested with mycorhiza; those of *P. rotundifolia* swell up into tubers. The root-cap is greatly reduced, and root-hairs are usually altogether wanting.

Mycorhiza of Hepaticæ. ‖ — Dr. B. Němec finds an endophytic mycorhiza in all the species of Jungermanniaceæ examined, with the exception of *Jungermannia bidentata*. In some species, however, it appears to occur only in special conditions. In the Marchantiaceæ, on the other hand, no symbiont could be detected. The mycorhiza of *Calypogeia trichomanis* is described in detail. The plant was infested with numbers of the receptacles of *Mollisia Jungermanniæ* (Pezizeæ), but a genetic connection between this fungus and the mycorhiza could not be determined with certainty.

Thallophyte Blood-Parasite.¶—Dr. E. W. Tunzelmann states that he has found in the blood of persons residing in China a parasite which he presumes to be causally connected with a febrile disorder widely endemic in this region. The parasite is a fungus exhibiting branched hyphæ and spores. The spores, which are enveloped in a thick structureless membrane, are of three kinds: zoogonids, tubular bodies open

* Malpighia, xiii. (1899) pp. 154–5.
† Atti Soc. Toscana Sci. Nat., xii. (1900) pp. 22–8.
‡ Comptes Rendus, cxxx. (1900) p. 42.
§ Abhandl. Böhm. Akad. Prag, viii. No. 29, 28 pp. and 1 pl. See Bot. Centralbl., lxxxi. (1900) p. 376.
‖ Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 311–17 (1 pl.).
¶ Journ. of Pathol. and Bacteriol., vi. (1900) pp. 356–67 (1 pl.).

at each end, and zygospores. They are extremely resistant to external influences, though methylen-blue is quickly toxic. The thallophyte is easily cultivated on the ordinary media.

The author has found that the presence of the parasite is so constant that during the past two years he has searched in vain for a specimen of blood in any warm-blooded animal which is free from it.

Lophophyton gallinæ.* — MM. L. Matruchot and Ch. Dassonville describe a dermatomycosis of fowls which they find is caused by a fungus called *Lophophyton* (and also *Epidermophyton*) *gallinæ*. The disease manifests itself as white patches on the comb and wattles, and from these becomes generalised over the surface of the body after the manner of ringworm, and may also affect the intestinal tube. Microscopical examination shows the presence of a fungus composed of a mycele consisting of short joints with 3–4 cells. Pure cultures were easily obtained on most media. The mycele exhibits terminal and intercalary chlamydospores, the latter being cylindrical or spherical and the former fusiform.

The authors are of opinion that *Lophophyton gallinæ* is a Gymnoasc which appears to have lost the power of producing ascospores and lateral chlamydospores (conids), but has retained that of forming intercalary and terminal chlamydospores. It should be placed at one extremity of a Ctenomyces series, being connected therewith through *Trichophyton*, *Microsporon*, and *Achorion*.

Blastomycetes of Carcinoma.†—The researches of Dr. K. W. Monsarrat were undertaken to confirm, if possible, the observations of Sanfelice, Roncali, Plimmer, and others, on the Blastomycetes of carcinoma. With regard to the arrangement of the cells, which by most pathologists is considered a very important point, the author states that the deposits in animals produced by inoculation of pure cultures of the Blastomycetes did not exhibit any alveolar arrangement or any appearances resembling the endotheliomata in man. No description of the histological appearances of the cancers from which the Blastomycetes were isolated is given; they are merely stated to be carcinomata of breast and uterus. Intraperitoneal injections produced nodules on the serous membrane, and secondary deposits in the lungs, liver, spleen, and kidneys. These growths are composed of accumulations of endothelial cells. The organisms occur within the cells, but most are free.

The organisms were isolated on glucose-agar, but were afterwards cultivated on wort-agar, wort-bouillon, neutral-gelatin, neutral-agar, neutral-bouillon, and potato. On wort-agar and wort-bouillon the organism grew aerobically at 37° C. On potato the growth is dark brown after forty-eight hours, and development is better under anaerobic than under aerobic conditions. In the former case the growth is white, in the latter brown; the reverse is the case on agar. For staining, carmin in some form was used, the preference being given to acetic carmin. The tissue was fixed with Flemming's fluid, and the sections, first stained with carmin, were placed in 1 per cent. aqueous solution of methyl-violet for 2 minutes, then in 0·25 per cent. picric acid, washed, mopped up, and decolorised in clove oil.

* Rev. Gén. de Bot. (Morot), xi. (1899) pp. 429–44 (2 pls. and 11 figs.).
† Proc. Roy. Soc., lxvi. (1900) pp. 58–60.

In cultures the fresh specimens are spherical, 4–10 μ in diameter, have a delicate capsule, and multiply by budding. In tissue there are, in addition, two peculiarities, viz. delicate connecting processes between adjacent organisms, and a capsule so thickened as to form a kind of halo. In the secondary deposits spore-bearing forms were observed. The spores are irregular in number and shape, and are devoid of capsule. They stain deeply with chromatin stains, and are finely granular.

Protophyta.

β. Schizomycetes.

Structure of Bacteria.* — Dr. Feinberg has used Romanowski's staining method in the study of various kinds of *Micrococcus* and *Bacillus*, and finds that it is always possible to differentiate one substance staining red to reddish-brown and another staining blue. As the nuclei of malarial plasmodes, amœbæ, &c., stain red to reddish-brown with the stains used for the bacteria (methylen-blue and eosin), while the plasma stains blue, it is argued that the bacteria also show, in variable form, a differentiation of nucleoplasm and cytoplasm.

Nuclei of Bacteria.†—Prof. A. Meyer maintains that certain small round bodies which become evident, both in the rodlet and spore forms, when bacteria are stained with a solution of fuchsin, are nuclei; the alternative being, that if they are not nuclei, they must be regarded as new organs of the cells. In number these bodies vary from one to six, and, according to the illustrations, they are located in a promiscuous way.

Formation and Structure of Bacterial Spores.‡—Dr. Mühlschegel thus sums up the results of his researches on the formation and structure of bacterial spores. Spore-formation is usually preceded by the appearance of globules in the protoplasts; then, towards one pole, there appears a grey spot, having approximately the same size as the future spore, and the globules disappear. Spore-formation is brought about, apparently under the incentive of a nucleus, by the combination of the globules with the interstitial plasma; and, although the presence of the globules is not an absolute necessity, their potential equivalent is distributed throughout the protoplast. The combination of the globules and the interstitial plasma in the spore substance is demonstrable by staining reagents. The structural differentiation of the spore proceeds from within outwards, ending in the formation of a membrane composed of two layers, the endosporium and ectosporium. The difficulty experienced in staining spores is due, in greatest measure, to the resistance of the spore-plasma, and also in a less degree to the membrane. The endosporium is stained with difficulty, and may allow pigments to permeate it without being itself affected. The endosporium is converted into the sheath of the young rodlet, and the ectosporium is cast off during germination. While still young the rodlet appears to contain substances similar to those of the spore-plasma.

* Anat. Anzeig., xvii. (1900) pp. 225–37 (5 pls.).
† Flora, lxxxvi. (1899) pp. 449–61 (1 pl.).
‡ Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 65–71, 97–108.

Formation of Sulphuretted Hydrogen in Town Drains, and Genus Aerobacter g. n.*—The attention of Prof. W. Beijerinck was originally directed to the formation of sulphuretted hydrogen in town drains by the discovery of an essentially anaerobic non-sporing spirillum which, owing to its sulphate reducing-properties, was designated *Spirillum desulfuricans.* As the result of further research in this direction, he now suggests that the presence of H_2S in drains arises not only from the reduction of sulphates, but also from free sulphur and from albuminous bodies. This decomposition of albuminous bodies must be brought about either by aerobic organisms or by microbes which are potential, or, to express the idea more fitly, temporary anaerobes.

These organisms were found by a special method of investigation (see p. 391) to form sulphide, and were thus easily detected in the lead-medium used for their cultivation. The outcome of the present research is the suggestion that these gas-forming species endowed with this temporary anaerobism should be classed together in the genus *Aerobacter*, a detailed account of the general characters of which is given. A special description of the more prominent species is also supplied; but as these are known under other names, it will suffice to mention their designations:—(1) *Aerobacter aerogenes* = *Bacillus lactis aerogenes*; (2) *Aerobacter viscosum*; (3) *Aerobacter coli* = *B. coli communis*; (4) *Aerobacter coli* var. *infusionum*; (5) *Aerobacter liquefaciens.*

The author concludes by discussing the different sources from which *Aerobacter* derives its sulphur; these sources are albumen, sulphur itself, sulphites, and sulphates.

Fat-reserves of Bacteria.†—Prof. A. Meyer identifies the granules and droplets seen in bacteria as fat-globules, partly by specific staining and partly by chemical reactions. The stains used were methylen-blue, Sudan iii., and a yellow stain (dimethylamidoazobenzol), the fat being coloured red or yellow. The chemical reaction was obtained by first breaking up a bacterial mass with quartz sand, extracting with ether, and treating with petroleum benzin. After evaporation the residue was found to leave a greasy mark on paper, and to become saponified on treatment with alcohol and caustic potash. On the addition of sulphuric acid fatty acids separated out. The glycerin test applied to the filtrate failed. The fat is to be regarded as reserve-substance, which is accumulated when the conditions of nutrition are favourable, and is used up in spore-formation. The foregoing remarks apply chiefly to *B. tumescens*, but the substance containing a fatty acid found in tubercle bacilli is alluded to. Beyond the fact of its existence little is known of it; its location is not yet settled, and what part it plays in the biology of the plant is dubious.

Iodine-Staining Polysaccharides of Bacteria.‡—Prof. A. Meyer gives reasons for believing that there are two carbohydrates which stain with iodine, and which are stored up by bacteria as reserve-substances. One is red staining, the other blue staining. These reserve-substances are colourless, highly refractive, diffuse with difficulty, cannot be ex-

* Centralbl. Bakt. u. Par., 2^te Abt., vi. (1900) pp. 193–206.
† Flora, lxxxvi. (1899) pp. 431–9 (1 pl.).
‡ Tom. cit., pp. 440–9.

tracted from the dead bacteria with water, and are completely dissolved by sulphuric acid, malt extract, and saliva, so that the resulting fluid no longer reacts with iodine. Towards iodine these substances behave after the manner of β-amylose, amylodextrin, and glycogen. The relation of the red staining carbohydrate to glycogen and amylodextrin is discussed, and it is held that, while the identity of the red staining carbohydrate to glycogen has not been satisfactorily established from a microchemical point of view, there is undoubtedly a close relation between it, glycogen, and amylodextrin. Any definite opinion based on microchemical methods is, of course, still less satisfactory.

Influence of the Temperature of Liquid Air on Bacteria. *— Dr. A. Macfadyen records experiments which show that bacteria may be cooled down to $-190°$ C. for a period of 20 hours without losing any of their vital properties. Numerous organisms were used, the extremes of susceptibility being *Spirillum choleræ asiaticæ* and the spores of *Bacillus anthracis*. In no instance was any impairment of the vitality of the organisms detected; even the photogenic bacteria, which when cooled down became non-luminous, when thawed, reassumed their luminosity with unimpaired vigour; an excellent proof, moreover, of the dependence of this luminosity on the vital activity of the cells.

Thermophilous Bacteria.†—Herr G. Michaelis isolated four species of thermophilous bacteria from different wells:—(1) *B. thermophilus aquatilis liquefaciens*; (2) *B. thermoph. liq. aerobius*; (3) *B. thermoph. aquatilis chromogenes*; (4) *B. thermoph. aquatilis anguinosus.* These bacteria are thin rodlets 2–4 μ long; they are motile, and form spores; they do not form indol. All four, except 1, attack grape-sugar, and, except 2, are potential anaerobes. They are stainable by Gram's method and are not pathogenic. Their optimum temperature lies between 50° and 60°. At 57° they grow strongly and quickly; motility is well marked; spore-formation is copious; pigment-formation and fermentation are good. At 70° involution forms are frequent. At 37°, except in 3, growth is either absent or scanty.

Fruit-Ether-forming Bacteria.‡—Herr A. Maassen describes four new species of bacteria which, under certain conditions, produce an agreeable odour resembling fruit-ether. *Bacterium esterificans stralaunense* developes a faint aroma, and when cultivated in the ordinary media quite loses after a time its ester-forming power. *Bacillus esterificans* is a spore-forming species which on certain media developes a strong ethereal odour very much like that of fresh apples. In the presence of pepton it forms sulphuretted hydrogen and mercaptan. Glycerin and carbohydrates favour its growth, but not its ester production. These bodies are not fermented, but are decomposed with the formation of acid. *Bacillus esterificans fluorescens* decomposes grape-sugar. During the first few days the cultures exhale a faint ester aroma, but later the odour becomes disagreeable and resembles that of trimethylamin. *Bacillus præpollens* is distinguished from other ester-forming bacteria by numerous physiological characters. Its energetic peptonising action

* Proc. Roy. Soc., lxvi. (1900) pp. 180–2.

† Arch. f. Hygiene, xxxvi. (1899) p. 285. See Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) p. 154.

‡ Arb. a. d. Kaiserl. Gesund.-Amte Berlin, xv. (1899) pp. 500–13 (3 pls.).

enables it to dissolve and decompose coagulated albumen. Its ester-formation is strongly evinced on all media. It attacks albumen and carbohydrates simultaneously, and produces such a quantity of ammonia from the albumen that the acid formed from the carbohydrates is neutralised at once, and the reaction of the medium remains neutral. *B. præpollens* splits up urea and decomposes nitrites with production of free nitrogen. To milk it imparts a very agreeable aroma.

Dextran-forming Bacteria.*—Herr F. W. J. Boekhout had his attention called to dextran-forming bacteria by the mucoid coagulation of milk to which 8 per cent. cane-sugar had been added. From the slimy fluid was obtained a streptococcus, *Str. hornensis*, which is endowed with the power of converting saccharated media into a mucoid mass. Dextran-formers occur not only in milk but in water and on flowers. By inoculating bouillon and gelatin containing 20 per cent. cane-sugar by means of flower-blossoms, several varieties of dextran-forming bacteria were obtained. Only one of these, *Str. hornensis*, receives attention. This organism stains well with anilin dyes. It was cultivated on solid and in liquid media containing cane-sugar. On the former the growth was white, gelatinous, and placentiform; while liquid media are converted into a slimy or gelatinoid fluid according to the less or greater amount of sugar. Its optimum temperature lies between 22° and 30° C. It is a potential anaerobe. Experiments with pepton, asparagin, ammonium tartrate, calcium nitrate, and ammonium sulphate, showed that pepton only was utilised as a source of nitrogen. It was also determined in a similar way that cane-sugar was the most suitable carbohydrate. The organism was killed in 5 minutes at 55°. The mucoid substance was obtained by cultivating on a saline medium containing pepton and cane-sugar; from this it was precipitated by means of alcohol and dried. Treated with sulphuric acid the substance was inverted, the sugar being right-turning and reducing. Hence the inverted mass must be dextrose and the previous substance dextran.

Coal Bacteria.†—M. B. Renault gives an account of some new bacteria found in coal.

(1) *Bacillus colletus.* The cells are short with rounded ends; there is marked tendency to form chains; reproduction usually takes place by arthrospores.

(2) Another bacterium, found, like the foregoing, in *Arthropitus* wood, is about 1·8 μ long and 0·5 μ broad; the ends are conical and the membrane is well defined and dark coloured. This bacterium, which often forms chains of three links, is associated with *Bacillus carbo.* This latter is observed in the cells and vessels, is 2·2–4 μ long, does not form arthrospores, and rarely chains. Attention is then called to the frequent presence in coal of transparent vacuoles of variable size and shape. They impart the impression of being gas-bubbles, imprisoned in a dried-up viscid substance.

Besides bacteria which have contributed to its formation, coal also contains microbes which have penetrated the vegetable tissues before its transformation into coal; and the occurrence in coal from St. Etienne of

* Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 161–5 (1 fig.).
† Comptes Rendus, cxxx. (1900) pp. 740–2. Cf. this Journal, 1898, p. 461.

fragments of a branching mycele suggested, when inspected under a magnification of 600 diameters, the possibility of *Streptothrix*, the joints forming short chains and the branches of the bifurcating filaments being unequal and often curved.

Bacteriosis of Beetroot.*—Herr A. Stift first describes the appearances found in diseased beet, and the results obtained by inoculating healthy plants with portions of diseased roots. The specific exciting cause is stated to be a bacillus, *B. Betæ*, which was isolated on agar, meat-pepton-gelatin, and beet-gelatin. The bacillus is about 4 μ long and 0·9–1 μ broad. Its ends are rounded. In the hanging-drop lively movements were observed, and the bacteria lay in pairs enclosed in a capsule. The flagella are numerous and delicate. In cane-sugar meat-pepton-gelatin the sugar was completely decomposed, but without development of gas, a fact which suggests that the conversion of the sugar was due to hydrolysis. Gelatin was liquefied. On agar slants the growth was white and of irregular shape.

Constitution of Tibi.†—M. L. Lutz describes Tibi, which is found in Mexico on *Opuntia*, as occurring in spherical transparent masses resembling boiled rice-grains. These vary in size from a pea to a pin's head. They ferment sugar-water and produce a light agreeable beverage. Microscopical examination shows that the Tibi grains are composed of bacilli, spirilla, and yeasts. When the fermented fluid has been allowed to stand for a time, a zooglœa scum consisting of bacilli and spirilla forms on the surface. It is not difficult to determine that these two forms are only developmental stages of one species, for the spirilla soon pass into bacilli. The organisms were isolated in liquid media and also on potato. The growth consists of capsule bacilli of variable size (1·5–3·3 μ long). The spirilla forms may attain a length of from 250–300 μ. The bacillus is an essential aerobe, and grows easily in the Tibi beverage, on carrot, *Opuntia*, and hay-infusion. It does not do well in bouillon or in neutral Raulin's fluid. Of the solid media it prefers potato and gelatin made up with the before-mentioned fluids. The bacillus is motile, does not produce indol, and does not stain by Gram's method.

The yeast is easily cultivated in fluid or gelatinised Raulin's medium. It is also cultivable in carrot and *Opuntia* infusions and on potato. Spore-formation takes place in aqueous solution of sugar-candy. Four spores are formed in each cell, and germination is easily effected. In order to reproduce the original symbiosis, carrot decoction is inoculated with the bacillus. After some days the scum is torn off and the fluid inoculated with the yeast. Grains are formed by the bacilli enveloping the yeast-cells. By the careful addition of sugar the process may be made to continue for a long time. The fermentation occurs only by the co-operation of the two organisms, either alone being insufficient.

Flagella of Bacillus asterosporus.‡—Prof. A. Meyer agrees that Migula's statement about the flagella of *B. asterosporus* is correct. By

* Oesterreichisch-ungarische Zeitschr. f. Zuckerindustrie u. Landwirthschaft, 1899, p. 605. See Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 184–7.

† Bull. Soc. Mycologique de France, 1899, p. 68. See Beihefte z. Bot. Centralbl., ix. (1900) pp. 121–2.

‡ Flora, lxxxvi. (1899) pp. 428–31 (1 pl.).

cultivating spores on agar flagella were demonstrable in nine or ten hours. The first flagella are short and thin as compared with those of older cultures. The flagella were mordanted by Lœffler's method and stained with fuchsin, but acid violet G B (1 grm. to 75 ccm. water and 75 ccm. alcohol) gave excellent results.

Physiology of Bacillus prodigiosus.* — Herr G. Ritter finds that pepton alone is insufficient for the anaerobic development of *Bacillus prodigiosus*, as it requires another source of carbon, such as grape-sugar, cane-sugar, or maltose. Nor does *B. prodigiosus* excite fermentation, i.e. it is unable to form gas in saccharated media. These results are contrary to those of Liborius, which have been accepted for a long time.

Bacteria in the Stomach of the Cat.† — Mr. J. Weiss isolated numerous organisms, bacteria and fungi, from the stomach of the cat. Though the number of animals operated on was limited, it is inferred from the results (given in tables) that the presence of bacteria in the stomach is more or less accidental, and seems to depend on their presence in the mouth or in the food. It is, however, to be noted that most of the bacteria produced acid and gas from saccharated media, and all had the power of disintegrating complex organic materials used as food-stuffs. In doing this they abstract from the medium substances which they need for their subsistence, and add to it excrementitious matters, often deleterious, the result of their metabolic activity.

Bacillus Parasites in the Blood-corpuscles of Rana esculenta.‡ — M. A. Laveran describes, under the name of *Bacillus Krusei*, a bacillus which is a parasite of the blood-corpuscles of the edible frog. Examination of the corpuscles discloses cavities, resembling vacuoles, filled with fluid and containing bacilli. These bacilli are 3–4 μ long, are easily stained, and are motile. Attempts to cultivate the bacteria failed. The vacuoles did not exhibit movement of any kind, and they were not affected by staining reagents.

Avian Tuberculosis in Frogs.§—MM. Auché and J. Hobbs obtained quite negative results from inoculating the dorsal lymph-sac of frogs with avian tubercle. Injections of the peritoneal sac were mostly negative, though in a few animals small granulations were observed after inoculation with avian tubercle. Inoculation with human tubercle was always followed by the appearance of large tuberculous granulations.

Bacillus of Dysenteric Enteritis.‖ — M. H. Roger isolated from seven cases of endemic dysentery a large bacillus which was pathogenic to animals. The morbid appearances were those of hæmorrhagic septicæmia associated with dysenteric ulceration of the colon. The microbe was easily cultivated on the ordinary media. It liquefied gelatin and coagulated milk, the reaction being acid. In anaerobic it did not grow so well as under aerobic conditions, but formed gas. The bacillus is motile; it somewhat resembles anthrax in general appearance; is easily stained, but is decolorised by Gram's method.

* Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 206–9.
† Journ. App. Microscopy, ii. (1899) pp. 628–32; iii. (1900) pp. 675–8.
‡ C.R. Soc. de Biol., sér. xi. i. (1899) pp. 355–8 (8 figs.).
§ Tom. cit., p. 816.
‖ Tom. cit., pp. 765–8.

Tubercle Bacilli in Butter. — Dr. O. Korn * found tubercle bacilli in four out of seventeen samples of market butter. The observations were verified by cultures and experiments on animals. Only once were bacilli resembling tubercle bacilli found. The chief interest in this series of observations on butter lies in the fact that all the samples came from the plains, and thus corroborates an observation of Petri, who called attention to the absence of tubercle bacilli in butter from mountainous districts.

The experiments of Herren Hormann and Morgenrot † relative to the presence of tubercle bacilli in butter, confirmed the suspicion that pure sterile butter, when injected into the peritoneal sac, was by no means harmless, as peritonitis was found in six out of eight cases. Hence it followed that suspensions of bacteria in butter, even though of low pathogenic power, would produce more marked changes than suspensions of the same bacteria in water. Experiment proved the inference to be correct. The authors report on finding tubercle bacilli in one out of three samples of butter. In this case the presence of tuberculous changes in the viscera was noted, and the disease was transferred to other animals by inoculating them with pieces of the tuberculous organs.

The authors also examined Camembert cheese, and found in three samples typical tubercle bacilli. The fact that tubercle bacilli can retain their vitality in whey-cheese for a long time is, however, by no means new.

Bacillus viscosus bruxellensis and Double-faced Beer.‡— Prof. H. van Laer's researches on double-faced beer form an important contribution to the knowledge of viscous fermentations. Beer is said to be double-faced when it is clear by transmitted light, but appears turbid and fluorescent when inspected by reflected light. The condition appears to be well known in Brussels, where the beers called lambic, faro, and mars not unfrequently become double-faced. The lambics are most prone to be affected. The germs are introduced along with the wort into the fermentation vats, and if subjected to certain conditions all their contents would undergo the change. When infected the beer becomes ropy, viscid, and double-faced. The ropiness passes off in course of time, but the optical phenomenon remains. From the infected fluid was isolated a rodlet, varying in length from $1 \cdot 7$–$2 \cdot 8$ μ, and in breadth from $0 \cdot 5$–$0 \cdot 8$ μ. In media which do not become viscous, or from which the viscosity has disappeared, the microbe is provided with a capsule, while in those which are ropy the capsules are united by a glairy zooglœiform substance. The bacillus was cultivated with success on gelatin-wort plates, on gelatin-broth, yeast-water, milk, and beer-wort.

Beer-wort when inoculated with a pure culture rapidly became ropy. At first the degree of viscosity increased, but afterwards decreased, so that by the sixth or seventh day it had returned to the initial degree. The degree of ropiness was found to depend on the composition of the wort. Comparative analyses of healthy and double-faced beers of the same brewings showed that in the latter the extractives are in-

* Archiv f. Hygiene, xxxvi. (1899). See Beihefte z. Bot. Centralbl., ix. (1900) p. 144.

† Hygienische Rundschau, 1898, No. 22. See Beihefte z. Bot. Centralbl., ix. (1900), pp. 145-6.

‡ Ann. Inst. Pasteur, xiv. (1900) pp. 82–101.

creased and the alcohol diminished. The conditions of ropiness or abnormal viscosity and of double-facedness seem to depend on a combination of two principal factors, namely, the composition of the wort, and the number of disease germs entering into competition with the yeasts, so that some worts would better resist the action of a given number of the bacilli than others. Other questions dealt with are the variations in the virulence of *B. viscosus bruxellensis*, its symbiosis with other organisms, and its action on the carbohydrates in the cultivation medium.

Meningococcus intracellularis in Suppurative Inflammation of Connective-Tissue.*—Dr. C. Fraenkel records three cases of suppuration of connective-tissue due to *Meningococcus intracellularis.* The preparations showed large numbers of cocci within the cells, and even in the nuclei, and cultivations on Loeffler's serum, serum smeared with human blood, and on glycerin-agar, exhibited the appearances characteristic of the microbe of cerebro-spinal meningitis described by Weichselbaum and others.

Bacillus typhosus and Pneumonia.†—Dr. V. Stühlern mentions two cases of typhoid fever complicated with lobar pneumonia from which the typhoid bacillus and diplococcus pneumoniæ were isolated during life. The bacillus was detected in the sputum, which in both instances contained much blood. Both specimens gave the Widal reaction.

Atypical Diphtheria Bacilli.‡—Dr. P. White exhibited at the Pathological Society of Manchester specimens of *Bacillus diphtheriæ* showing branching obtained from a 48 hours old agar-culture. The culture was remarkable for the large size of the club-shaped forms, some of which measured as much as 40 μ in length. These large forms, as well as those of normal size, showed well-marked true branching, the branches being clubbed at the extremities. Sub-cultures showed ordinary forms of the bacillus only.

Dr. J. R. Carver exhibited specimens of non-typical diphtheria bacilli. Some of these were of great length, interlaced with one another, showed doubtful branchings, and seemed to merit the term "streptothricial" bacilli. The long forms disappeared on sub-culture. Other specimens showed bacilli with enormous pear-shaped heads, and in some the sheath was faintly stained, while the protoplasm was collected into a chain of fine granules, giving the appearance of an encapsuled streptococcus.

Diplococcus pneumoniæ.§—Dr. J. W. H. Eyre gives an admirable *précis* of what is known of the morphology, biology, and pathogenesis of the *Diplococcus pneumoniæ.* Though most of the facts have been previously recorded by the author and other observers, a perusal of the article will amply repay those who are interested in pneumonia or the pneumococcus. Attention may, however, be drawn to the difference in the effect of this organism on man and on animals. In man its action appears to be directed chiefly towards producing an inflammatory con-

* Zeitschr. f. Hygiene, xxxi. (1899). See Beihefte z. Bot. Centralbl., ix. (1900) pp. 142-4.
† Centralbl. Bakt. u. Par., 1[te] Abt., xxvii. (1900) pp. 353-6.
‡ Lancet, 1900, i. p. 942.
§ Practitioner, March 1900, 24 pp. and 11 figs.

solidation of the lung (pneumonia), while in animals artificially inoculated with pure cultures the lungs are generally normal.

Bacillus myophagus cuniculi.* — M. C. Phisalix describes a bacterium which causes a peculiar and infrequent disease in rabbits, the symptoms being those of palsy or of contraction of the limbs. Usually there is little or nothing perceptible to the sight or touch, but occasionally there is swelling of the affected parts. The disease is confined to the muscles, which become softened, necrosed, and caseous. In the degenerated tissue, staining with gentian-violet easily demonstrates bacilli and delicate filaments, and the same organism developes in bouillon when infected with diseased muscle. In peptonised bouillon growth is visible in 24 to 48 hours; cottony fleecy filaments surround the bits of muscle; the medium becomes turbid, and clears again as the growth subsides. Gas-bubbles form, and a strong cheesy odour is developed.

In fresh unstained preparations the microbe appears as a motionless bacillus of variable length, and as long twisted filaments. It is easily stained, but not by Gram's method, and after staining with fuchsin the investing sheath is rendered clearly visible. The microbe does not grow in vacuo, and left in contact with air loses its virulence. When inoculated in the ear of a rabbit the characteristic muscular lesions are developed, and if the animal do not die too quickly, necrosis of bone and of the central nervous system may ensue. Pigeons and guinea-pigs are similary affected, but dogs are resistant.

Bacillus ferrugineus and its Hunger-form.† — Dr. W. Rullman, who had previously described *Bacillus ferrugineus*, and afterwards found that, when cultivated for a considerable period in inorganic media, this microbe underwent a morphotic change which he termed hunger-form, now states that he has converted this latter shape into the original rodlet form by cultivating it in meat-pepton-agar at 37°. The hunger-forms disappeared in 5 or 6 hours, and the typical bacteria, when further cultivated at 30°, produced again the dark brown pigment.

Experimetal Reproduction of Dental Caries.‡ — M. J. Choquet describes a bacillus which was isolated from carious teeth, and with which he has succeeded in reproducing the disease in healthy animals. The organism is a short motile bacillus presenting branched forms in bouillon cultures. It is decolorised by Gram's method and does not liquefy gelatin. It thrives in pepton-bouillon, but grows badly or not at all on the ordinary solid media. On pepton-gelatin opaque white growth appears in five or six days. The addition of 1 per cent. glycerophosphate of lime is markedly favourable to development. The bacillus is a potential anaerobe, and developes more readily in vacuo. It ferments glycerin, mannite, glucose, galactose, saccharose, lactose, maltose, dextrin, and inulin. It has no action on dulcite, erythrite, arabinose, or nitrates. It does not peptonise albumen, coagulate milk, liquefy starch-paste, or form indol.

An incisor of a sheep was infected with a pure culture of the bacillus. A hole was bored in the tooth, the culture inserted, and then the hole

* Comptes Rendus, cxxx. (1900) pp. 950–3 (1 fig.).

† Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 129–31. Cf. this Journal, 1899, p. 74.

‡ Comptes Rendus, cxxx. (1900) pp. 949–50.

stopped. The animal was slaughtered nine months afterwards, when the tooth was found to be softened and to contain the inoculated bacillus in pure culture.

BIBLIOGRAPHY.

FRAENKEL, E.—**Mikrophotographischer Atlas zum Studium der pathologischen Mykologie des Menschen.**
Hamburg, 1900, Bd. i. Lfg. i., 8vo, 22 pp. and 9 photograms.

HUEPPE, F.—**Principles of Bacteriology.** Translated by Dr. E. O. Jordan.
Chicago (The Open Court Publishing Co.) and London (Kegan Paul, Trench, Trübner, & Co.), 1899, x. and 467 pp., 1 pl. and 28 figs.

PARK, W. H., & A. R. GUERARD—**Bacteriology in Medicine and Surgery: a Practical Manual for Physicians, Health Officers, and Students.**
London, 1900, 8vo, 694 pp.

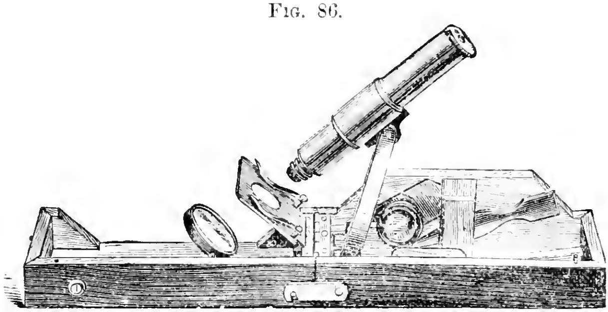
MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Portable Field Microscope.—This portable Field Microscope (fig. 86), which was exhibited before the Society at its meeting on March 21st, (see p. 270) by Mr. Ernest Barker, was first made some twenty-five years ago, by Mr. Henry Anderson, who was for many years with the late Mr. Andrew Ross. This Microscope has been in Messrs. Newton's catalogue for many years, they having kindly lent us this illustration.

Fig. 86.



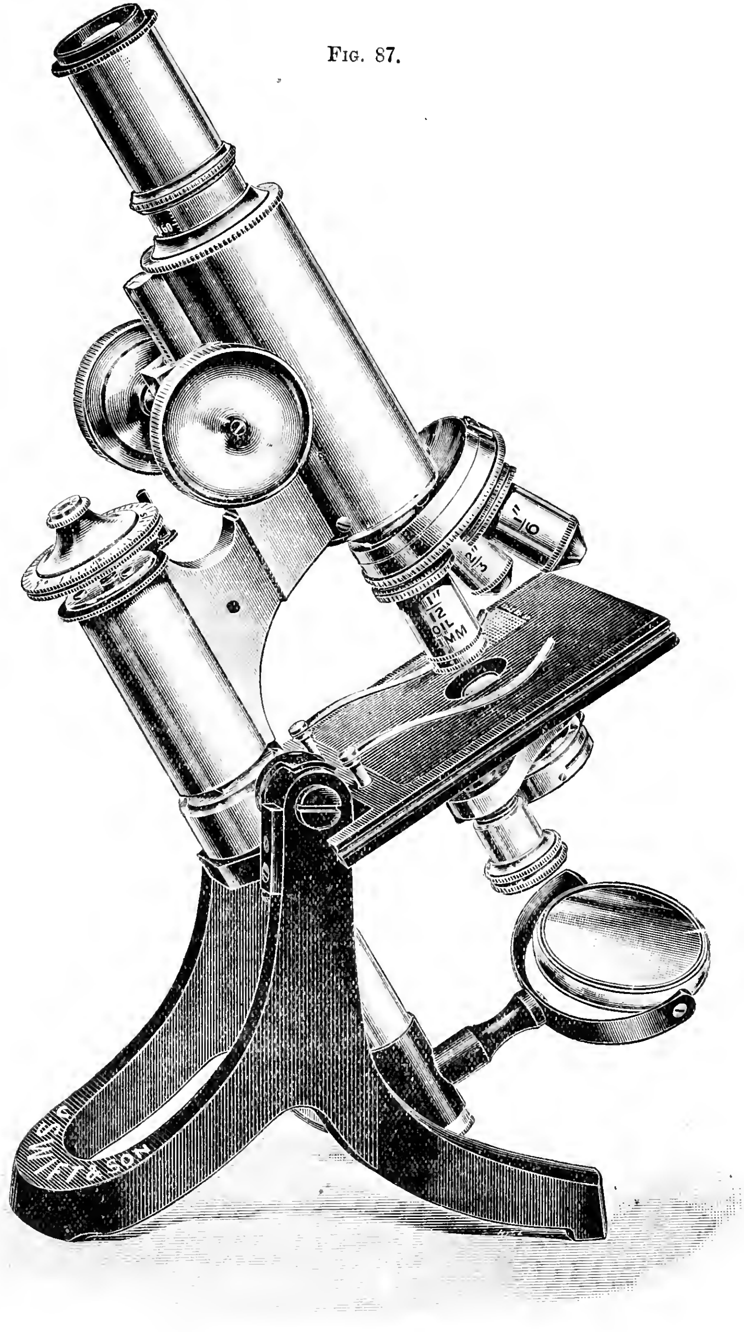
The Portable Field Microscope is specially designed and adapted for botanical and seaside work, as it can be brought into instant operation without any unpacking or screwing together. It is fitted with eye-piece, achromatic dividing object-glass, live cage, tweezers, and glass dipping-tube, and goes into a mahogany case $4\frac{1}{2}$ in. by $1\frac{3}{4}$ in. by 2 in.

Swift's New Student's Microscope.— Fig. 87 represents the new pattern Microscope exhibited by Mr. Swift at the Meeting of the Society on March 21st, fitted with the Campbell differential-screw fine adjustment (see p. 271).

Swift's New Portable Microscope.—This is seen set up in fig. 88. It will be noticed that a very low power can be used, owing to the great range of focus allowed by the rack-and-pinion and draw-tube. It is fitted with a substage condenser having an iris diaphragm and a push-tube focussing adjustment. The back leg is looped, so that when it is folded up to pack in its case, as in fig. 89, the limb with the head of the fine adjustment screw passes into this loop. This forms not only an efficient portable sea- or pond-side Microscope, but also one well adapted for bed-side diagnosis. (See p. 406.)

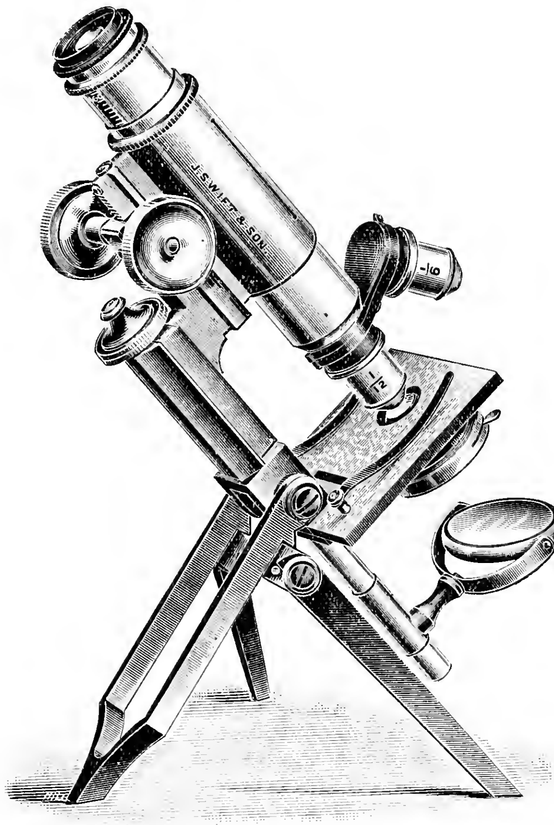
* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

Fig. 87.



Zeiss' Photomicrographic Stand. — In reference to Berger's New Microscope, already described in this Journal,* fig. 90 shows the way in which the "planar" projection lenses are adapted to this stand, and the manner of placing it on the bed of the projection apparatus.

Fig. 88.



(2) Eye-pieces and Objectives.

Spitta, E. J.—Achromatics versus Apochromatics.
Amer. Mon. Micr. Journ., 1899, p. 296.

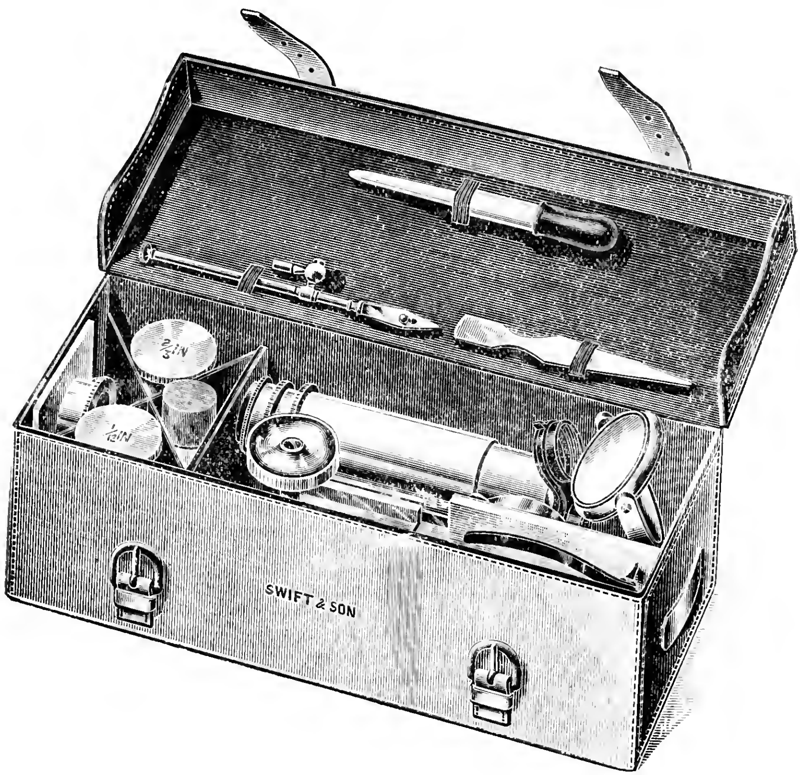
(3) Illuminating and other Apparatus.

Zeiss' Projection Arc-Lamp. — This is shown in Fig. 91, which gives elevation and plan. The carbons are always inclined at about 40° to the vertical, although by loosening the screw K they can be brought

* 1898, p. 583, fig. 98.

into the vertical if desired for spectrum observations. In this latter case, the iron cover, fastened with two milled heads, and carrying the chimney-like protuberance, has to be placed in such a way that the broad opening behind the lamp is covered up. The advantage of setting the carbon obliquely is that the light from the more brilliantly glowing pole (the positive) is thrown out almost horizontally, whereas in a vertical setting the light is thrown downwards. On each side of the box is a door for inserting the carbons; the door contains a dark glass window.

Fig. 89.



The two large screws S t' and S t'' are for centering the light. S t'' regulates the height, and S t', which terminates each end of a horizontal axle, adjusts the light sideways. The lamps require a tension of 45 to 50 volts. The lamps are also fitted with mechanism for automatically approximating the carbons so as to keep the incandescent crater in the same spot. In one form of lamp this is done by hand movement. In the selection of a lamp regard should be paid to the purpose in view. For micro-projection a current of 20 ampères is sufficient; for diapositive 20–30; and for episcopic projection 20–50 ampères. In the two latter cases the size of the lecture-hall must be considered.

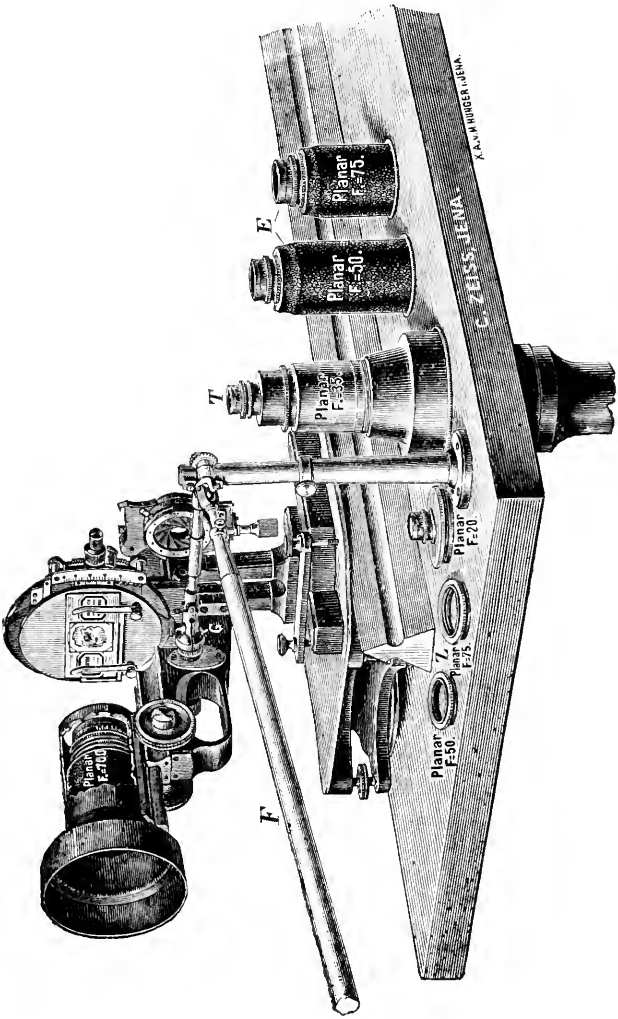


Fig. 90.

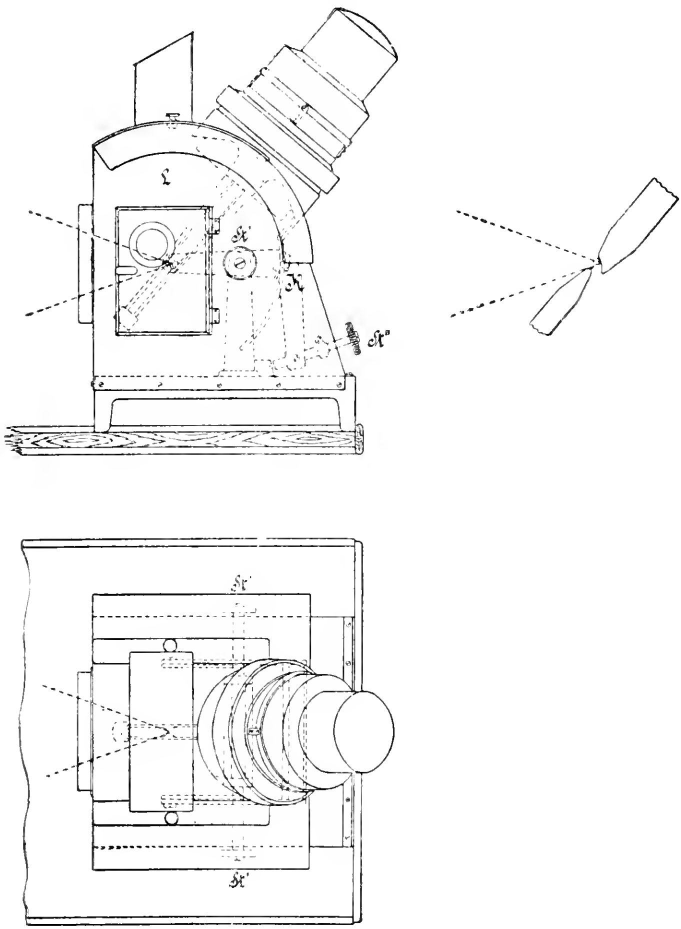
Zeiss' Projection Apparatus. — Figs. 92–95 are some of the diagrams of the complete arrangement; fig. 94 being a sectional elevation, and the others plans. The lettering is the same throughout. A, the water-chamber; B, illuminating mirror; D, lantern-slide carrier; F, horizontal push footplate; K, coupling screw; L, projection lamp; M *k*, Microscope; P, projection-system carrier; *r*, tube-mirror; S′ two-lens portion of collective lens; S, single-lens portion of collective lens;

S *p*, illuminating mirror for incident light; S *t'*, S *t''*, milled heads for centering light source.

Fig. 92 shows the setting up of the apparatus for micro-projection with Microscope stand.

Fig. 93 shows the change-over from micro-projection to macro-projec-

Fig. 91.



tion. The Microscope stand is pushed aside; the macro-objective is inserted into the projection-system bearer P; in the lantern-slide carrier P a suitable adaptation is made by sliding out the object-glass carrier.

Fig. 94 shows the arrangement for the micro-projection of fluid and wet preparations. The Microscope stand is set and adjusted vertically; it is fitted with mirrors B and *r*.

Fig. 95 shows the application of the mirror S *p* with vertical illuminator.

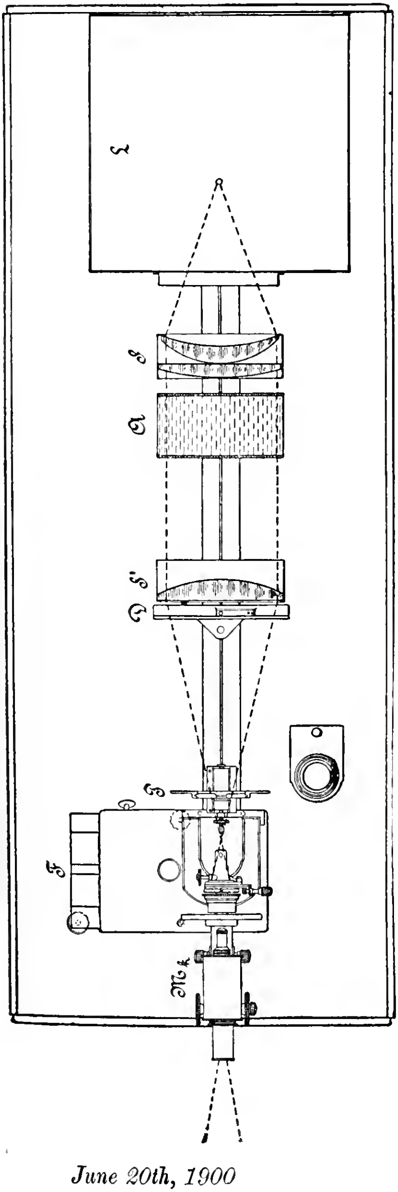


Fig. 92.

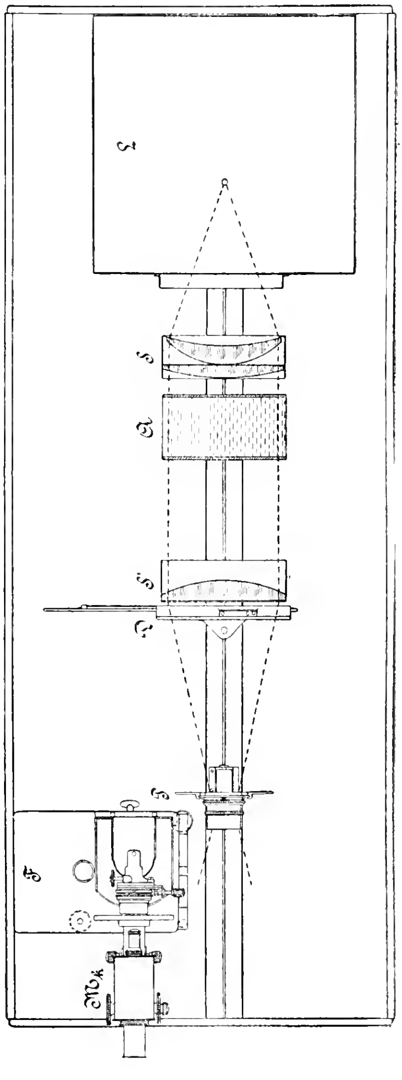


Fig. 93.

Lothian Dissecting Microscope and Table.* — This instrument, designed by Mr. A. Craig-Christie, and made by Baird of Edinburgh, is intended as an inexpensive aid to the student of botany and zoology.

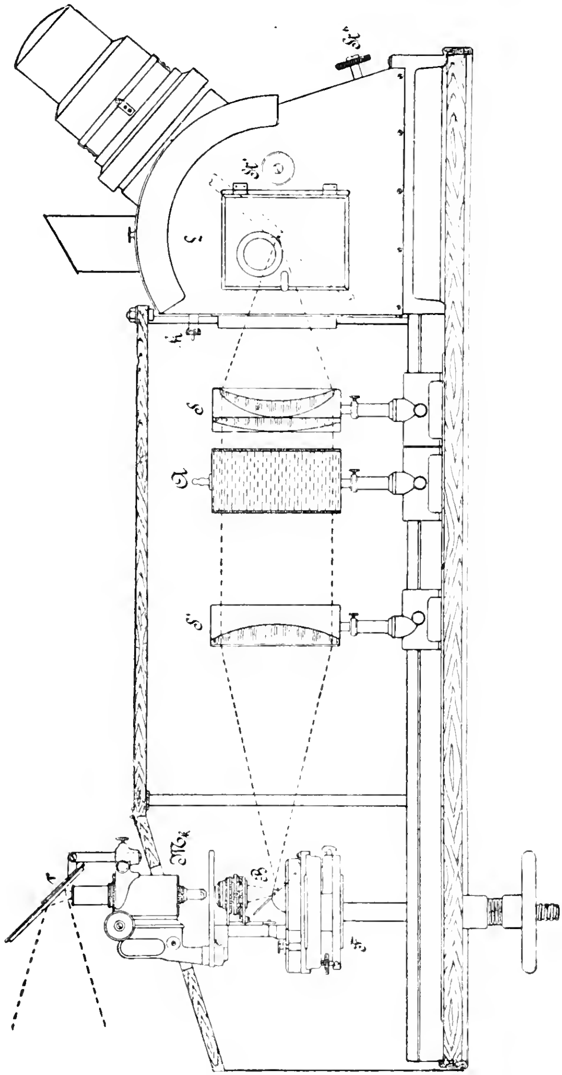


Fig. 94.

Fig. 96 represents a metal base and upright with a double arm, which, for focussing, slides up and down on the upright. One arm terminates in a ring into which is placed a watchmaker's eye-glass; to the other is

* Illust. Ann of Micr., 1900, pp. 123–4 (2 figs.).

attached a three-power pocket lens. The arms are of such a length that each lens is brought, by rotation, over the same spot; thus different

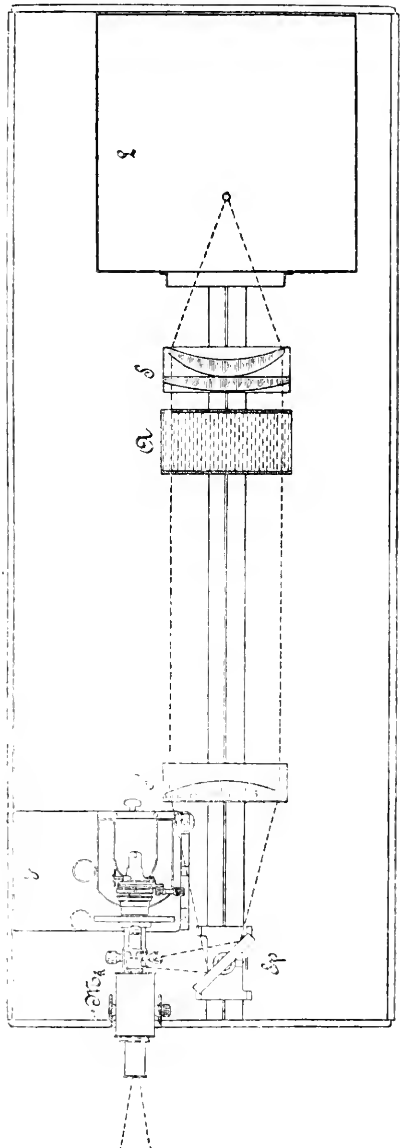


Fig. 95.

powers can be applied to the same object. Fig. 97 shows the dissecting table, which is made of sheet metal and is supplied with a glass top removable for cleaning. When dissections under water are required, the glass plate is replaced by a glass-bottomed metal tank which fits into a circular opening in the middle of the table. The table is without a bottom, so that a piece of white paper may be placed underneath

FIG. 96.

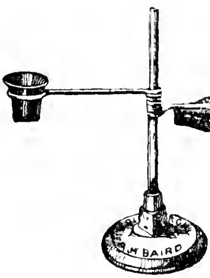
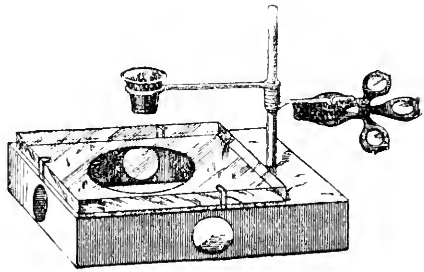


FIG. 97.



for reflecting light up on to the object. The lenses can be taken off and the whole apparatus dismounted and packed within the space of the dissecting table.

Reichert's Accessory Apparatus for Entomologists. — This apparatus (fig. 98) was constructed, on the suggestion of Prof. A. Korlevié of Agram, for the purpose of fixing small insects intended for observation in such a way that they can be moved and turned in all directions, and be observed with low-power objectives and illuminated by the mirror from all sides. The needle carrying the insect is placed in the cork roller K, which is provided with two ball bearings adjustable by means of the screw F in such a way that the roller is movable in all directions and yet can be fixed in every position. Should the needle be too long for the space under the objective, the substage is removed, and the traverse *h* is put into its mounting upside down, so that the roller comes under the stage. Then there is space enough for all ordinary objectives. The plane and concave mirror, which is movable in all directions, serves for illumination. The apparatus is intended for affixing to existing stands.

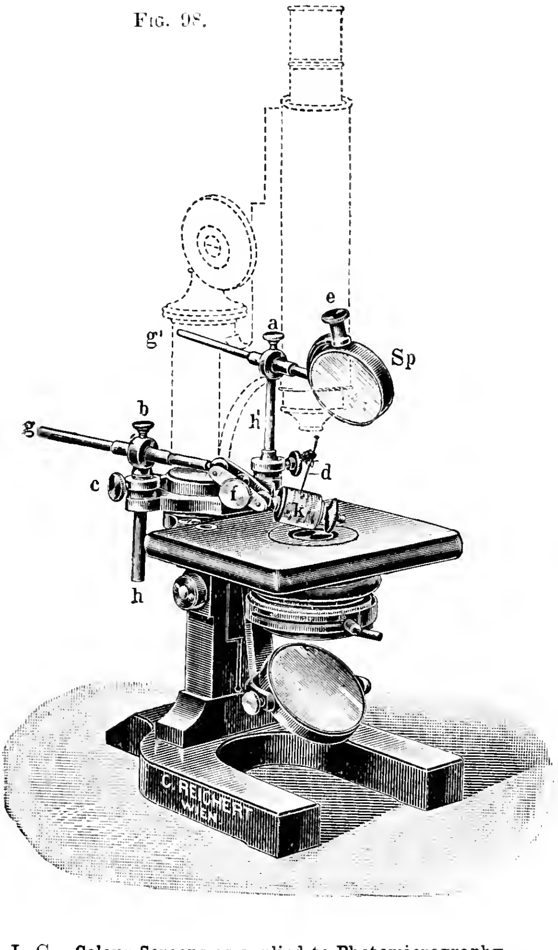
(4) Photomicrography.

Photomicrographic Notes.*—Under this title, Mr. Albert Norman gives some very useful practical hints addressed primarily to beginners. He recommends oil-light as the easiest and most certain luminant; in some cases, such as in photographing very delicate or stained specimens, he even considers it the best. He is of opinion that vibration has been greatly over-estimated, and that bad focussing or careless manipulation is a more frequent cause of blurs. Table legs should be insulated by felt wads. Sometimes blurring is due to a faulty connection between the fine adjustment of the Microscope and the long focussing rod of the camera. Lime-light is exceedingly useful for high-power work, such as the photography of bacteria at one to four thousand diameters; but at one thousand diameters it is not essential, for an oil-lamp with an inch

* Illust. Ann. of Micr., 1900, pp. 110 and 111.

wick used edge-on will fully expose a medium orthochromatic plate in from one to two minutes, using a 1/12th apochromatic objective and Zeiss' No. 4 projection ocular. For fine low-power work, the oil-lamp with a circular wick is indispensable.

Fig. 98.



HUBBARD, J. C.—**Colour Screens as applied to Photomicrography.**
Journ. Boston Soc. Med. Sci., III. (1899) No. 11, p. 297.

MARTENS, DR. F. F.—**Einige neue photometrische Apparate.** (Some new Photometric Apparatus.)
[The instrument is on the spectroscope principle, but by means of a mirror the absorption band is brought immediately under the fixed band, and so more perfect comparison is obtained.]
Zeit. f. angew. Mikr., March 1900, pp. 338–40 (1 fig.).

ROSTER, G.—**Le applicazioni della fotographia nella scienza.** (The applications of Photography in Science.)
Congr. Fotogr. Ital. Firenze, Atti ii. (1899) SA., 26 pp.

(6) Miscellaneous.

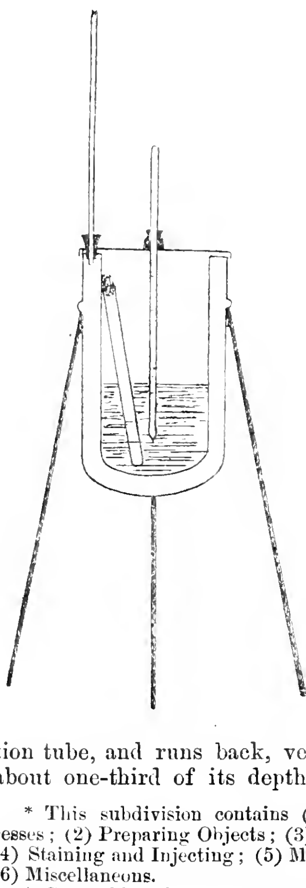
Illustrated Annual of Microscopy for 1900.
[Contains some twenty-four interesting articles on various subjects.]
Percy Lund, Humphries & Co., London.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

New Incubator.†—Dr. C. Tonzig describes a new incubator for gelatin cultures which is said to be very satisfactory in its action. It consists of a wooden case of which the horizontal measurements are 22 in. by 15 in., and the height 28 in. A tube of sheet zinc 3 in. in diameter passes vertically through the middle of the wooden case, and projects both above and below. At the lower end it is expanded into the shape of a flat-bottomed cone, beneath which a gas-flame is placed. At the upper end there is a thermometer, and a thermo-regulator for the gas supply. The zinc tube is filled with water, which is heated 10° C. above the temperature required in the incubator. Observations made in the bacteriological laboratories of the University of Padua showed that the temperature thus produced in the incubator was constant and uniform, and that when regulated to 20° C., it did not rise above 22°, so that there was no melting of the gelatin, even when the temperature of the room rose to 19° C. (66° F.)

Fig. 99.



Apparatus for Heating Cultures to separate Spore-bearing Micro-organisms.‡—Dr. C. B. Stewart has devised an apparatus which maintains a constant temperature of 80° C. without any attention. It is made of beaten copper, and spun afterwards; the inner chamber is 18 cm. deep and 9 cm. in diameter. The condensation tube (fig. 99) is 1 m. in height. To use the apparatus a small quantity of pure benzol, B.P. 80° C., is poured into the jacket through the hole for the condensation tube. A small flame keeps the benzol boiling, and as the vapour condenses in the condensation tube, and runs back, very little is lost. The chamber is filled to about one-third of its depth with water at 80° C. When the lid is

* 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.

† Lancet, 1900, i. p. 1014.

‡ Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 366–7 (1 fig.).

removed to introduce test-tubes, the temperature falls 10°–15°, but the loss is rapidly recovered, and in 15–20 minutes after the thermometer has risen to 70°, the tubes will have been exposed to a temperature of 75° or over, most of the time.

Nutritive Medium for detecting Sulphide Formers.* — Prof. W. Beijerinck detects sulphide formers by means of white lead. Carbonate of lead is added to ordinary meat-gelatin or meat-agar in quantity sufficient to make the plates of a snowy white. The substratum is inoculated by pouring over the surface drain-water diluted with distilled water. The plates are incubated at 23° C. In a couple of days the presence of sulphide-forming germs is rendered evident by the appearance of brown colonies, the growths of other bacteria being white. As the lead sulphide in the brown colonies is unaffected by air, the reaction is permanent, and is gradually intensified. In order to render the browning more distinct, part of the surface may be covered with a glass plate when the growth has well developed. This not only hinders diffusion, but prevents oxidation of the sulphuretted hydrogen.

New Covering for Culture-tubes.†—Dr. W. Hesse recommends the following method for covering the mouth of culture vessels for the purpose of preventing evaporation and loss of moisture during prolonged sterilisation and incubation. The cotton-wool plug is covered over with a square piece of coffer dam (sheet rubber used by dentists) the sides of which are about 3 cm. long. Over this is placed another piece of similar size, but having a hole about 2 mm. in diameter punched in the middle. This fastening is so tight that evaporation from the vessel even in the incubator is very slight, and cultures may be kept in the thermostat as long as a month without detriment, provided that the amount of the medium be not too small.

A similar expedient may be applied to Petri's capsules.

Substrata for Cultivating Tubercle Bacilli.‡—MM. F. Bezançon and V. Griffon recommend two media for cultivating tubercle bacilli. One of these is a potato disk covered with a thin film of glycerin-agar. The agar fixes the potato firmly in the culture-tube, so that the surface of the potato may be energetically rubbed with tuberculous material. This medium is extremely favourable to growth. The other substratum is made by passing blood from the artery (carotid of rabbit) into tubes containing agar-bouillon. The tubes are then sloped, and when set, a solid surface is obtained on which colonies of tubercle bacilli become evident in 6 days, and in 15 days the growth is extensive.

New Medium for Cultivating Tubercle Bacillus.§—Herr W. Hesse recommends the following medium for cultivating tubercle bacilli. The pepton is replaced by Heyden's aliment, which is a preparation of soluble albumen with properties intermediate between coagulated albumen and somatose. The medium is composed of Heyden's aliment 5 grm.; salt 5 grm.; glycerin 30 grm.; agar 10 grm.; normal soda

* Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) p. 196.
† Op. cit., 1te Abt., xxvii. (1900) pp. 258–9.
‡ C.R. Soc. Biol., vi. (1899) pp. 77–9.
§ Zeitschr. f. Hygiene u. Infektionskr., xxxi. (1899) p. 502. See Zeitschr. f. wiss. Mikroskop., xvi. (1900) pp. 492–3.

solution (28·6–100) 5 ccm.; distilled water 1000 grm. The Heyden's aliment is first dissolved in water, and then the agar-mixture containing the rest of the ingredients is added. The medium is filtered while hot, through a special apparatus. On this medium tubercle bacilli are said to be demonstrable from sputum after a few hours' incubation, and it is claimed that the procedure obviates the necessity of testing doubtful secreta in animals.

Effect of Varieties of the Medium on the Growth of the Typhoid Bacillus.*—Prof. E. J. McWeeney states that the experiments made by him on the effect of certain varieties of the nutrient medium on the growth of the typhoid bacillus show that:—(1) the growth improved with increasing addition of decinormal sodium hydrate to the unneutralised gelatin up to the beginning of alkalinity (indicator phenolphthalein); (2) the addition of salt in quantities varying from 0·1 to 1 per cent. to the fully neutralised gelatin made no difference in the amount of growth; (3) the omission of both salt and pepton exercised no appreciably unfavourable influence on the growth in gelatin made with meat decoction; (4) addition of phenol to gelatin in the proportion of 0·05 to 0·5 per cent. exercised an inhibitory influence on all growths when the addition exceeded 0·07 per cent.; between 0·05 and 0·07 the effect was to check the anaerobic growth; and (5) Parietti's solution added to ordinary bouillon suppressed the growth of the typhoid bacillus when the bacillus coli was also present.

Culture and Demonstration of Amœbæ.† — Herr G. Marpmann points out that pathogenic amœbæ are easily cultivable in the animal body, guinea-pigs and rabbits forming suitable hosts. Artificial cultures of earth, water, and intestinal amœbæ are obtainable only when the medium resembles the natural environment and when the temperature is normal. A good medium consists of agar 0·6, hay infusion 100, alkaline bouillon 10 parts. On this medium the mixed colonies of bacteria and amœbæ will be found in about twenty-four hours after inoculation. Without the presence of living bacteria amœbæ do not grow, and if the bacteria be killed off by means of alcohol or strong soda solution, they remain encapsuled and do not develope further.

Other media which may be recommended are:—(1) Hay or straw decoction, 30–40 grm. boiled for half an hour in 1 litre of water, filtered, and alkalised with carbonate of soda. (2) Hay or straw-agar. The foregoing decoction with the addition of 1·5 per cent. agar. (3) *Fucus crispus* substratum. A 5–15 per cent. solution of fucus in water or bouillon is boiled, mixed with 10 per cent. 1/10 normal caustic potash solution, filtered, and analysed. (4) Agar-medium:—agar 0·5, water 90, alkaline bouillon 10; boil, filter, sterilise.

The cultivation of blood amœbæ and of malaria and leukhæmia parasites has not yet been effected on artificial media, probably owing to the fact that as they are cell-parasites, a dead medium is insufficient for their wants. They are, however, cultivable in animals, as has been recently shown by Löwit, who injected rabbits with a mixture of leukhæmic blood, ascitic fluid, and blood drawn from the finger.

* Roy. Acad. Med. Ireland. See Lancet, 1900, i. p. 939.
† Zeitschr. f. angew. Mikr., v. (1900) pp. 325–38 (7 figs.).

The author, after describing various forms of incubators suitable for amœbæ cultures, addresses himself to staining procedures. The first of these is that of Romanowsky and Nocht. A few drops of 1 per cent. alcoholic solution of eosin are mixed with 2 ccm. of water, and this mixed with a solution of 1 per cent. methylen-blue in ½ per cent. soda solution. The latter is dropped in until the colour is a dark-brown violet. The fixed films are floated on this mixture for about ten minutes, and then, having been washed in water, are treated in the usual manner.

Löwit treats his specimens of leukhæmic blood as follows:—The films are dried for 1–1½ hour at 110°–115°, and are then stained in a mixture of 30 parts alkaline methylen-blue (Loeffler) and 15 parts of saturated aqueous solution of thionin. The preparations are stained for 15–20 minutes, washed in water, and differentiated in acid alcohol (0·3 per cent. HCl.) as long as the stain is given off. They are then treated in the usual way. The hæmatozoa are blue to green.

Another method is to stain the fixed film in saturated aqueous solution of thionin for half an hour, and, after washing and drying, immerse for 10–20 seconds in iodopotassic iodide solution; wash again and mount in balsam. The parasites are green.

A similar stain had been previously recommended by Mallory for *Amœba coli.* The film was fixed in alcohol, stained in saturated aqueous solution of thionin for 5–20 minutes, washed, differentiated in 2 per cent. oxalic acid solution for ½–1 minute, dehydrated in 55 per cent. alcohol, and mounted.

For demonstrating the malaria parasite, Korosko's mature solution of methylen-blue and eosin is mentioned. This consists of methylen-blue C or B. G. N. 1; distilled water 100; absolute alcohol 5; 20 per cent. caustic potash 12 drops. After standing for three months, 2 ccm. of the filtered solution are mixed with 4 ccm. of 1 per cent. eosin solution. The films are fixed for one hour at 105°–110°, and then stained in the foregoing mixture for 12–24 hours at 30°.

(2) Preparing Objects.

Value and Action of Fixative Fluids.* — Dr. W. von Wasielewski, after an exhaustive examination of the respective values of fixative solutions, lays it down that on the whole the best results are obtained from Flemming's fluid and its modifications, such as Hermann's and vom Rath's mixture. With these may be included other fluids which contain acetic acid, such as Zenker's, Carnoy's, Telyesniezky's, and also picroacetic acid, chromacetic and sublimate acetic acid, and some others.

With the exception of platinum chloride, fixative solutions containing only one ingredient are of less value than mixtures. The special properties of the chief media may be appreciated thus. Osmic acid and potassium bichromate are the best for retaining the cell-mass. Platinum chloride, as a simple fixative, does well for nuclear division, and the staining with safranin-gentian-violet-orange is excellent. Acetic acid holds the first position for its structure-retaining properties. Picric acid penetrates most rapidly.

Centrosomes are not demonstrable by any fixing or staining method.

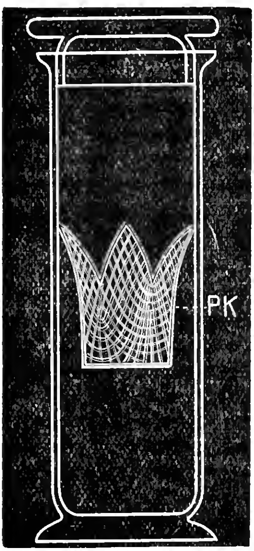
* Zeitschr. f. wiss. Mikr., xvi. (1900) pp. 303-48 (2 pl.).

The cell-nucleus is more resistant than the plasma, except in the case of potassium bichromate, which acts thereon injuriously. The size of the nuclear vacuole in which the nucleole lies greatly depends on the fixative; sublimate and mixtures containing nitric acid produce a large vacuole; while with picric acid, chromosmic acid, or Merkel's and Lindsay's fluids, it quite or almost disappears.

The structural appearances of the cell-plasma vary extraordinarily according to the fixative used. Thus the plasma is more or less homogeneous with formalin, potassium bichromate, osmic acid. It is finely or coarsely granular with hot water, sublimate picric acid, Merkel's mixture, sublimate, chromacetic acid, Hermann's and vom Rath's mixture. It may be filamentous or reticular with sublimate, picric acid, platinum chloride. The plasma mass is very variously preserved, sometimes quite filling the cell, as with osmic acid, while with others, as chromic acid, it is quite shrunk up. Some fixatives, such as formalin, produce a large number of vacuoles in the plasma.

Simple Apparatus for Rapid Dehydration.* — Prof. J. Schaffer describes a simple apparatus (fig. 100) which he has used for some time with great success for dehydrating histological objects. A square piece of platinum wire net, the sides of which are about 5 cm. long and the meshes about 1 mm. wide, is bent into the shape depicted in the illustration so as to form a sort of basket. The basket is made to fix itself automatically against the sides of the glass jar into which it is jammed by bending the corners outward. Of course the apparatus may be used for fixing, washing, or staining objects, and the only disadvantage that can be complained of is the dearness of the platinum net.

Fig. 100.



Celloidin Imbedding and Staining Tubercle Bacilli in Celloidin Sections.† — Mdlle. E. Wolff, in some remarks on celloidin imbedding, advises that the celloidin should be treated first with absolute alcohol, and afterwards with ether, as this sequence makes a clearer solution than the reverse procedure. The slow evaporation of the solvent mixture is strongly urged, for celloidin will not remain clear if direct access of air be permitted, and the slower the evaporation the better the mass will cut.

For demonstrating tubercle bacilli in celloidin sections, the following procedure is given. The sections are placed on slides, the superfluous alcohol drained off, and the section pressed down with blotting-paper. While still damp, carbol-fuchsin is filtered over the section, and the slide warmed until the solution begins to vaporise. This hot-staining must

* Zeitschr. f. wiss. Mikr., xvi. (1900) pp. 422-5 (1 fig.).
† Tom. cit., pp. 427-31.

be repeated four or five times. The slide is then plunged into distilled water, the section floats off, and then, after a short washing, is differentiated in 60 per cent. alcohol, to which nitric acid in the proportion of 20 drops to 100 ccm. has been added. A second bath in acid-alcohol is required to complete the differentiation. The acid is removed by washing freely in distilled water, and then the preparation may be contrast-stained with very dilute aqueous solution of methylen-blue, thionin, or iodine-green. After washing in water, the section is replaced on a slide, mopped up, rapidly dehydrated with absolute alcohol, cleared up in xylol, and mounted in xylol-balsam. The preparations keep well.

Modification of Nissl's Method.* — Sig. G. Boccardi has modified Nissl's method in the following way. Fixation in absolute alcohol for 24 hours or in 10 per cent. formalin for 12–24 hours, with consecutive gradual transference to absolute alcohol; paraffin imbedding. The sections are stuck on the cover-glass with water. After removing the paraffin with xylol, the preparations are transferred to absolute alcohol, and then stained with the following mixture:—erythrosin 0·1 grm.; toluidin 0·2–0·5 grm.; water 100 grm. Though not absolutely necessary, it is advisable to add 4–5 drops of aceton to the mixture. The staining requires 15–20 minutes at ordinary room temperature, and 5 in the thermostat at 37°, or one minute if heated over the flame. The preparations are then washed in water for a few seconds, and immediately afterwards differentiated in 0·5 per cent. alum solution. This takes a few seconds or at most a minute. After having been washed in distilled water, the preparations are passed through alcohol to xylol and mounted in xylol-balsam.

Point in the Technique of the Cox-Golgi Method.† — Dr. J. B. Nicholls calls attention to the importance of immersing sections of nervous tissue which have been treated by the Cox-Golgi method for a few seconds in 50 per cent. caustic alkali solution. This not only deepens the colour, but brings it out when the sections are apparently unstained.

Preparing Copepoda.‡—Mr. C. D. Marsh collects copepoda in a dredge, the mouth of which is covered with a cone of coarse wire gauze. The animals may be killed in some osmic acid solution; alcohol is, however, the best fixative and preservative. The specimens may be stained in 1–3 days, by pipetting off most of the alcohol, and putting a little picro-carmine in the bottle. The animals are best dissected on a slide and in glycerin. Care must be taken to substitute the glycerin gradually. The needles used should be ground flat so as to make minute scalpels. The best mounting medium is Farrant's.

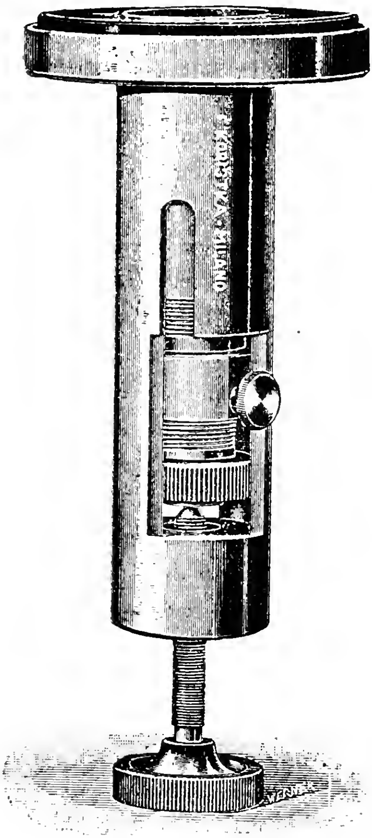
Preparing Earth-worms for Sectioning.§—Mr. R. Pearl stupefies the worms by placing them in 3 per cent. alcohol for an hour, and during the next hour gradually raising the strength to 6 per cent. Some 6 per cent. alcohol is then injected into the anus by means of a syringe. The intestinal contents are loosened by rolling and pinching the worm

* Monitore Zool. Ital., x. (1899) pp. 141–3. See Zeitschr. f. wiss. Mikr., xvi. (1900) pp. 471–2.
† Journ. App. Microscopy, iii. (1900) p. 674.
‡ Op. cit., ii. (1899) pp. 295–6.
§ Op. cit., iii. (1900) p. 680.

between the fingers. The canula is now inserted in the mouth, and the alimentary canal flushed out. When the stream runs clear, the animal may be killed in some fixative solution.

Fixing Intestine of Cat.*—Herr M. von Lenhossék states that he has obtained brilliant pictures of the mucosa and musculature of the intestine by the following method of fixing. A piece of intestine (small intestine of cat) about 2 sq. cm. was stretched on a cork frame and fastened down with quills, great care being taken to avoid touching the epithelial layer. The preparation was then fixed in the following mixture:— Apáthy's sublimate alcohol (alcohol 50 = 100 ccm., NaCl 0·5 grm., sublimate 4 grm.) 75; absolute alcohol 25; acetic acid 5; for 6 hours, and afterwards hardened in 90 per cent., 96 per cent., and absolute alcohol for 24 hours each.

Fig. 101.



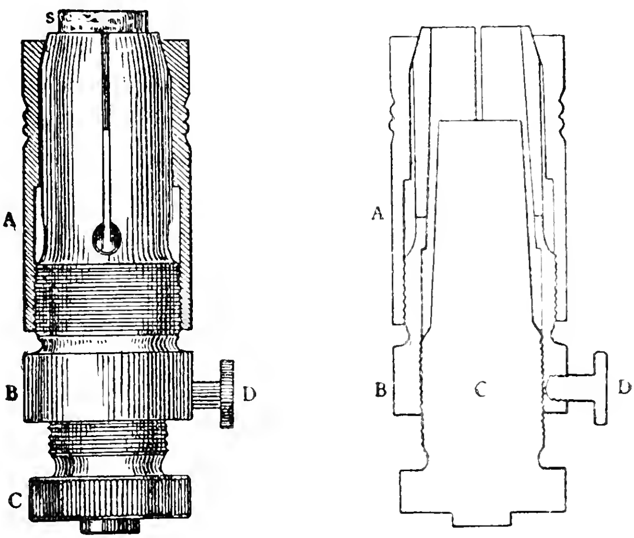
Preparing Specimens of Iron and Steel.†—Mr. W. M. Merrett describes the following procedure for preparing specimens of iron and steel for microscopical observation. Pieces 3/4 of an in. square and 1/4 of an in. thick are taken, and one surface is carefully ground on a series of emery papers, mounted on plate glass, finishing off with a very fine grade. Fine-grade papers are prepared by washing the finest slime from the best flour emery, mixing it with a solution of egg albumen in water, brushing it on paper free from grit, and then allowing it to dry. The specimen is rubbed on the fine emery paper, then on rouge paper, and finally on a wet rouge wheel. At this stage the specimen becomes lightly engraved, the harder constituents appearing in relief. The structure is not shown by polishing only, but must be made evident by physical or chemical processes. The constituents are usually shown up either (1) by rubbing the specimen with liquorice juice on parchment; (2) by attacking it with a very dilute solution of nitric acid in alcohol or in water; or (3) by heating it in air to about a straw colour (240° C.).

* Anat. Anzeig., xvi. (1899) pp. 334–42.
† Illust. Ann. Microscopy, 1900, pp. 46–51 (12 figs.).

(3) Cutting, including Imbedding and Microtomes.

New Hand Microtome with Tubular Clamp.*—Dr. Adr. Fiori has, with the aid of Koristka, invented a hand microtome which is intended for sectioning vegetable tissues. The apparatus is of the ordinary shape, i.e. it is cylindrical, is surmounted by a circular cutting-plate, and has a micrometer screw at the lower end for raising the object-carrier (fig. 101). The micrometer screw is marked off in ten divisions, each of which corresponds to a rise of five-hundredths of a mm., while a groove at the lower end of the body serves, due regard being observed as to levelling, as a guide for estimating the distance traversed by the screw. The body of the microtome is cut away to allow the piece C of the object-carrier to be screwed up and down. The opening has a narrow

Fig. 102.



prolongation upward for the passage of the screw D. Its edge, when D is not engaged in the prolongation, serves to prevent the clamp from projecting above the level of the cutting-plate. The object-carrier consists of three parts, a hollow tube (fig. 102 A) connected externally with the body and internally choke-bored above to a cone-shape. This tube is screwed below to a second hollow tube (fig. 102 B) terminating above in a tubular clamp. The internal diameter of this clamp is 14 mm., and its upper end is conical. The clamp is split longitudinally in four places, so as to make four jaws, which, when the tube A is screwed up, approximate and diminish the internal diameter of the clamp by $1\frac{1}{2}$ mm. after the manner of a crayon-holder. At the lower end of the second

* Malpighia, xiii. (1899) pp. 193–9 (3 figs.).

tube is a female screw into which is screwed the third piece (fig. 102 C), a conical block with a milled head at its lower end for screwing it up and down. In the piece B the screw D (fig. 102) works and serves as a lever for pushing out the object-carrier, for fixing the piece B, and for preventing the clamp rising above the level of the cutting-plate.

The manipulation of the apparatus is very simple. The object, inserted in elder pith, is placed within the jaws of the clamp after the object-carrier has been pushed up. The clamp is then tightened, and the carrier withdrawn until it comes in contact with the micrometer screw.

Modification of the Rutherford Microtome.*—Dr. D. F. Harris has devised a modification of the Rutherford microtome which differs from the primitive form in the following particulars. (1) The size of the freezing-box is considerably increased. (2) The gum-well is placed centrally in the elliptical ice-box. (3) Less of the well projects above the surface of the ice-box. (4) The upper surface of the platform which raises the frozen tissue is of brass, deeply corrugated. (5) The circular glass plate is replaced by a pair of rails which are covered by strips of glass having a convex surface.

(4) Staining and Injecting.

Staining Sections while Imbedded in Paraffin.† — Mr. S. Smith describes the following method for staining sections which have been imbedded in paraffin and cut with the rocking microtome in the ordinary way. The ribands are placed in the staining solution in a flat covered vessel, which is left in a warm place until the sections became perfectly flat. The vessel is then removed to a cool place for 12–24 hours, and then the staining solution poured off slowly so as to leave the ribands lying flat on the bottom of the dish. Water is then poured in to re-float, and also wash the sections. This done, the sections are placed on slides, allowed to dry, passed through turpentine or xylol, and mounted in balsam.

Fixing and Staining Blood Films.‡—Mr. R. Muir describes two methods for fixing and staining blood films.

(1) Dry method. The film having been dried in air, is fixed in a solution composed of 20 per cent. aqueous tannin solution, 2 parts; saturated aqueous solution of sublimate, 2 parts; saturated aqueous solution of potash alum, 5 parts. The fixative is filtered on to the film, and after 2–4 minutes the preparation is washed successively in water, methylated spirit, and again in water. It is now stained for 2–4 minutes with 2 per cent. aqueous solution of eosin, or for 15 minutes or more if to show the eosinophilous reaction. The film is again washed and then carefully dried over the flame in order to fix the eosin in the cells. When dried, it is dipped in water, and some saturated aqueous solution of methylen-blue filtered on. To this staining solution it is advisable to add saturated caustic potash solution in the proportion of one drop to the ounce. After about 2 minutes, the stain is washed off and the pre-

* Journ. Anat. Physiol., xxxiii. (1899) pp. 609–11.
† Op. cit., xxxiv. (1899) pp. 151–2.
‡ Journ. Pathol. and Bacteriol., vi. (1900) pp. 394–6.

paration dehydrated in absolute alcohol, cleared in xylol, and mounted in balsam.

(2) Wet method. The still wet film is fixed in corrosive sublimate (Muir) or in 2 per cent. formol, and then, having been washed, is treated with the fixative described in the dry method, which is allowed to act for 2 minutes. The preparation is then successively washed in water, alcohol, and water, after which it is stained with eosin and again washed. Some saturated solution of potash-alum is now dropped on and allowed to act for 2 minutes, after which the preparation is washed in water, and then stained with methylen-blue. The film is again washed, then dehydrated, cleared up, and mounted as before. In this method the film must not be allowed to dry at any stage. Carbol-thionin-blue may be used instead of methylen-blue; the film is then fixed in sublimate. These methods give good results with sections.

Safranin Staining.*—Dr. L. W. Ssobolew has found that sections, especially celloidin sections which have lain long in alcohol and do not stain well with safranin, may be successfully stained by remordanting them with Flemming's fluid. The sections should be immersed in a mixture of 10–15 drops of this fluid and 5 ccm. of distilled water for 5–10 minutes. They are then washed, and stained with saturated aqueous solution of safranin. The after treatment is the same as usual.

Method for Fixing and Staining Nervous Tissue.†—Mr. A. P. Ohlmacher has used the following modification of Carnoy's fluid for a long time on account of its great penetrating and hardening properties:—absolute alcohol, 85 parts; chloroform, 15 parts; acetic acid 5 parts; sublimate to saturation (about 20 grm.). Small pieces of tissue are hardened in a quarter to half an hour; large slices require 18 to 24 hours. After hardening, the pieces are washed, and may be kept in 80 per cent. alcohol. The fluid may be used several times. The staining procedure recommended by the author is to stain for a minute in Ehrlich's anilin-gentian violet, then drain off the superfluous fluid, and wash in water. Treat with picric acid-fuchsin solution (0·5 per cent. acid fuchsin to a saturated solution of picric acid which is diluted with an equal volume of water). Dehydrate with absolute alcohol. Clear up in clove oil, and mount in xylol-balsam.

Modification of Kronthal's Method of Staining Nervous Tissue.‡—Herr H. K. Corning states that he has obtained better results by fixing and hardening in 10 per cent. formalin previously to immersing in the lead formate mixture. Moreover, instead of the lead formate obtained by dropping formic acid into saturated solution of acetate of lead, he uses Merck's plumbum formicum. Though Kronthal's method § possesses some advantages over that of Golgi, the penetrating power of the fluids (the original and the modified) is not great, and does not reach deeper into the piece of tissue than 3–4 mm.

Method of Staining Medullated Nerve-fibres en bloc, and a Modification of Marchi's Method.‖—Dr. D. Orr states that he has

* Zeitschr. f. wiss. Mikr., xvi. (1900) pp. 425–6.

† Bull. Ohio Hosp. Epilept., 1898. See Zeitschr. f. wiss. Mikr., xvi. (1900) pp. 435–6.

‡ Anat. Anzeig., xvii. (1900) pp. 108–11.

§ Cf. this Journal, 1899, p. 548.

‖ Journ. Pathol. and Bacteriol., vi. (1900) pp. 387–93 (1 pl.).

obtained excellent results by the following method, which renders the fine medullated nerve-fibres coursing in the grey matter very distinct and conspicuous. A piece of fresh tissue from cortex or cord, not exceeding 1/8 in. in thickness, is placed in a mixture of 2 per cent. osmic acid 8 ccm. and 1 per cent. acetic acid 2 ccm. If the mixture be darkened within 24 hours, it should be renewed. After 48 hours the piece is immersed in 10 per cent. formalin for three days, and is then imbedded in paraffin or celloidin. The sections are passed through 1·5 per cent. permanganate of potash solution and 1 per cent. oxalic acid solution until differentiation is complete. They are then treated in the usual manner.

The modification of Marchi's method consists in immersing pieces of central nervous tissue which have been hardened in bichromate, in the aceto-osmic acid solution just described for ten days. This addition so increases the penetrating power of osmic acid, that the central portions of the block are found to give the Marchi reaction quite as well as the peripheral.

The author has found that the initial stages of fixation and hardening may be hastened by using a mixture of 2 per cent. bichromate and 5 per cent. formalin for 24 hours, and then removing to 2 per cent. bichromate.

Modification of Marchi's Method of Staining Degenerated Nerve-fibres.*—Mr. J. N. Langley and Mr. H. K. Anderson adopt the following procedure for preventing nervous tissue from becoming brittle, and for enabling adjoining sections to be stained by other methods. After hardening in 2 per cent. potassium bichromate or in Müller's fluid, the pieces are placed for a day in a solution of gum in 2 per cent. potassium bichromate. Sections made with a freezing microtome are removed to a 2 per cent. potassium bichromate solution to wash out the gum. Successive sections may then be placed in:—(1) a mixture of potassium bichromate and osmic acid to stain the medulla of the degenerated fibres, and may be left therein for 1–3 weeks; (2) in water, then in alcohols up to 70 per cent. to remove the fixative and to harden somewhat; then back through alcohols to picrocarmine or other stains; (3) chrome-alum mixture, and stained by the Weigert-Pal method as modified by Heller and by Ford Robertson.

The writers find that spinal cord may be kept for more than a year in potassium bichromate, and still give the Marchi reaction by the foregoing method.

Staining Gonococci in Living Leucocytes.† — Herr Plato mixed a droplet of pus with a loopful of neutral red solution (1 ccm. of cold saturated aqueous neutralised solution and 100 ccm. of physiological salt solution), and on examining as a hanging drop found that the intracellular gonococci were stained deep red. Warming the stage excited amœboid movements, and during this phase the cocci lost their colour, regaining it when the movements ceased and the granular condition of the leucocyte was resumed. It is stated that intracellular gonococci have a greater receptivity for the pigment than other organisms, while

* Proc. Physiol. Soc., p. xxxi. See Journ. of Physiol., xxiv. (1899).

† Berlin Klin. Wochenschr., 1899, No. 49. See Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 286–7.

those free in the plasma (extracellular) behave in a way similar to other organisms.

In fixed preparations a mixture of 20 ccm. of cold saturated aqueous neutralised solution and 100 ccm. of water stain the cocci deep red in a few seconds, while the nuclei of the cells are but faintly coloured, so that the nuclei do not obscure the cocci.

New Method of Staining Gonococcus.*—Dr. Dreyer gives the following method for staining gonococcus. The preparation is stained with Loeffler's methylen-blue in the usual way, and then, having been washed with water, is treated for 4 minutes with 1 per cent. protargol solution. After differentiation the preparation is washed repeatedly, and then contrast-stained by immersing it for half a minute in dilute carbol-fuchsin (10 drops Ziehl-Neelsen to a watch-glassful of water). The bacteria are blue, the tissue cells and nuclei red.

Differences in the Staining Reaction of Friedlaender's Bacillus.‡ —Dr. P. Clairmont found—from histological examination of the liver and kidney of a case wherein Friedlaender's bacillus had been discovered intra vitam in the pus of an abscess—that the bacteria were not decolorised in sections which had been stained by Gram's method and afterwards treated with alcohol and oil of cloves, while the colour was discharged from culture preparations of the same origin.

PETIT, L. C.—**Refraction versus Stain in Microscopy.**
New York Med. Record, LV. (1899), No. 16, p. 851.

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

Preparing Glycerin-Jelly.‡ — Glycerin-jelly for mounting microscopical objects and also for museum specimens is easily prepared by placing photographic gelatin in a washing apparatus and leaving under a gentle stream until clean. It is then melted by a gentle heat in an equal quantity of glycerin. After this it should be hot-filtered thrice. A thymol crystal will keep it from becoming mouldy.

(6) Miscellaneous.

Method for Demonstrating Actinomycotic Appearances in Tubercle.§ —Prof. P. L. Friedrich and Dr. H. Nösske describe actinomycosis-like appearances which they have found in tuberculosis produced experimentally by injecting into the arterial circulation suspensions of tubercle bacilli. The appearances depicted in the illustrations are strikingly like those of actinomycosis, and show a central mass of bacilli surrounded by a zone of club-shaped elements arranged radially. These typical appearances were demonstrated by special staining methods, and the sections exhibit a striking contrast to those stained by carbol-fuchsin and the ordinary method. One of these procedures was hæmatoxylin staining, followed by Gram and eosin. These sections show violet staining of the tissues, the bacilli being blue and the clubs red. A still

* Monatsber. üb. d. Gesammtleist. a. d. Gebiete d. Krankh. d. Harn., iii. (1898) No. 3. See Zeitschr. f. wiss. Mikr., xvi. (1899) p. 383.

† Wiener Klin. Wochenschr., 1899, p. 1068. See Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 272–3. ‡ Journ. App. Microscopy, ii. (1899), p. 641.

§ Beiträge z. Pathol. Anat. u. z. allgem. Pathol., xxvi. (1899) pp. 470–510 (1 pl. and 4 figs.).

better result is exhibited by a more complicated procedure. The sections were hot-stained with 1 per cent. bleu-de-Lyon, then washed, and differentiated with a solution made up of sp. vini 3, aceton 3, distilled water 3, and anilin 1. After washing with sp. vini, the sections were stained with carbol-fuchsin, and then differentiated with 1 per cent. HCl-alcohol. The sections, having been washed in water, were contrast-stained with an aqueous slightly acid solution of Bismarck-brown, then dehydrated in alcohol, cleared in xylol, and mounted in balsam.

Study of Central Nervous System.*—Dr. G. C. van Walsem gives a systematic and critical account of the technical methods employed in investigating the central nervous system, discussing at length macroscopic preparations and drawings, microtome sections, fixing, staining, and so on.

Demonstrating Hæmatozoa of Padda oryzivora.†—M. A. Laveran has been able to demonstrate by a special staining method a hitherto unobserved phase in the development of the endoglobular hæmatozoa of *Padda oryzivora*. Fresh rubbings of spleen pulp are fixed in a saturated aqueous solution of picric acid. After having been washed in water, the films are stained with a mixture of eosin and Borrel's blue.‡ After an immersion of 15–18 hours, the preparations are washed in distilled water, and then treated with 5 per cent. tannin solution for some minutes. They are then dehydrated, and mounted in balsam. The newly observed parasites are spherical or oval bodies, 2–3 μ in diameter, and are found free in the plasma or within cells. They appear to be present in great abundance, while the numbers of the pigmented parasites are not increased. They are not evident in fresh blood nor after ordinary staining methods.

Demonstrating Canaliculi of Bone.§—Dr. W. Colquhoun arranged glass tubing in lengths of about 12 feet up the wall of the laboratory. To the bottom of each of these tubes a bone (e.g. tibia of sheep) was fastened by means of rubber tubing and a rubber cork, after an end had been sawn off and the medullary cavity cleaned out. The periosteum was also stripped off, and any opening on the outside of the bone plugged with wooden pegs. The tubes were then filled with some staining solution containing a little antiseptic, and the bone left exposed to the warm air of the room, so that, as it lost moisture from the outside, the stain would be sucked in by the natural channels. After about a month the nuclei of the bone and the lining membrane of the canals were found stained. The sections were made by grinding after permeation with balsam.

By the foregoing procedure the canaliculi were but faintly stained, and this defect was remedied by using first a penetrating fixative (such as 3 per cent. bichromate of potassium with or without 0·25 per cent. osmic acid) and following this up with a fluid (such as 1 per cent. nitrate of silver), which would form a precipitate by chemical combination with the first. After the first fluid had been allowed to act for a

* Verh. K. Akad. Wetenschap. Amsterdam, vii. (1899) pp. 1–184 (8 pls. and 30 figs.).

† C.R. Soc. de Biol., lii. (1900) pp. 19–22.

‡ Cf. this Journal, *ante*, p. 264.

§ Journ. Anat. Physiol., xxxiv. (1899) pp. 84–9.

few days, the slice of bone was ground smooth on one side, and then treated with the silver solution for a week or two in the dark. After this it was permeated with balsam, and the other side ground down in the usual manner.

Dental Histology.*—Those interested in dental histology will find an excellent and useful account of the various processes necessary for demonstrating the structure and appearances of normal and diseased teeth in the article by Mr. L. Strangways, which, though covering a great deal of ground, is extremely concise.

New Liquid for Counting Blood-corpuscles.†—M. G. Hayem has found the following fluid very satisfactory as a menstruum for counting blood-corpuscles:—Distilled water 200 grm.; sodium chloride 1 grm.; sodium sulphate 5 grm.; solution of iodo-potassic iodide 3–4 ccm. The iodo-potassic iodide solution is composed of: distilled water 500 grm.; potassium iodide 25 grm.; iodine in excess. The amount of the iodine solution varies for different animals; for man it is 3·5 ccm.

Biological Test for Arsenic.‡—Herren R. Abel and P. Buttenberg, in an article on the action of mould fungi on arsenic and its compounds, deal with the demonstration of the metal by means of cultures. The results of Gosio and Abba § are confirmed, and the authors find that for the qualitative determination of arsenic this method is universally applicable, and is more sensitive than chemical tests. The mould used was *Penicillium brevicaule*, and the medium a sterilised mash of mouldy bread. At 37° and often within 24 hours, and always in from 48–72 hours, the growth was so luxuriant that the characteristic garlicky odour was perceptible. In this way 0·00001 grm. As_2O_3 and often 0·000001 grm. could be detected. Of metallic arsenic less than 0·0001 grm. could not be clearly demonstrated.

The method is applicable to any substance or compound or structure, such as chemical solutions, skins, hides, carpets, paper, woven fabrics, foodstuffs, and beverages of all descriptions. The presence of arsenic in minute quantities in human and animal bodies was easily demonstrated, and in the living subject a dose of 5 drops of liquor arsenicalis was detected.

Method for Sticking Celloidin Series with Water and Albumen.‖—Prof. P. Argutinsky communicates the following simple and satisfactory method for sticking celloidin sections on slides. The slide is carefully cleaned from grease by means of spirit and heat. A small drop of Mayer's glycerin-albumen is placed on each slide, and spread out into a very thin layer. The albumen is then coagulated by warming the slide. The sections, cut under 70 per cent. alcohol, are carefully straightened out and removed with a dipper to the slide, and then covered with alcohol. If the sections be not quite smooth, they must be replaced in alcohol to be straightened out. When the sections are satisfactorily arranged, the alcohol is removed by touching the long side of the slide

* Illust. Ann. Microscopy, 1900, pp. 61–70 (9 figs.).
† C.R. Soc. Biol., vi. (1899) p. 265.
‡ Zeitschr. f. Hygiene u. Infektionskr., xxxiii. pp. 449–90. See Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 137–9. § Cf. this Journal, 1899, p. 239.
‖ Arch. f. Mikr. Anat. u. Entwicklungs., lv. (1900) pp. 415–19.

with blotting-paper. Strips of filter-paper, 8–12 mm. thick, are now placed on the slide, and pressure applied with the finger. This removes the remains of the alcohol, and presses the section into the albumen. The filter-paper strips are then removed, and the slide is at once immersed in distilled water, where it remains until required for further treatment (staining, &c.). Slides thus treated may remain in the water for a whole day without detriment; but if not required for several days it is better to place them in 70 per cent. alcohol.

The albumen is best coagulated by placing the slides for some minutes in an incubator at about 100° C.

Encain Hydrochloride as a Narcotising Agent.*—Mr. G. T. Harris extols the virtues of encain hydrochloride (Beta-encain) as a narcotising agent. He has found it give far better results than cocain, and has tried it on Vorticellidæ, Rotatoria, and Vermes. Mr. Rousselet also reports favourably as to its action on Floscularиæ. A 1 per cent. solution is recommended. It is stated to be perfectly stable in aqueous media.

Method for obtaining Thin Laminæ of Minerals.†—M. F. Stöber recommends the following procedure for reducing granules of minerals and stones to thin laminæ. Upon a large cover-glass lying on a slide is placed some Canada balsam. This is liquefied by heat, and then some of the powder to be examined dropped in. The balsam is now covered with a piece of paper, and over this is placed a thin piece of rubber, and then another slide. Pressure is now made so that the grains may sink into the soft balsam and settle on the upper side of the cover-glass. When the balsam has become hard, the slides and paper are removed, and the grains ground down flat and even with fine emery. Some balsam is now placed on a slide, and the preparation with the ground surface downwards placed thereon. The balsam is now heated, and pressure applied as before. When the balsam has become hard, the cover-glass is sprung off, paper is placed on the smooth surface, and the preparation again heated and pressed so that the grains with their ground side may firmly adhere to the slide. The other surface is now ground until the granules are sufficiently thin, and then the preparation is provided with a cover-glass. In the same way thin sections may be transferred from one slide to another.

Peculiar Diffusion Movements of Microscopic Objects.‡—Dr. J. Katz calls attention to some peculiar movements observed in a recently mounted specimen of sputum containing tubercle bacilli. Some six hours after having been treated with xylol and then mounted in chloroform-balsam, the bacilli were observed to exhibit active movements. In character the movements were trembling and undulatory, and recalled the appearance of spirilla in motion. The origin of the movements is ascribed to diffusion currents arising out of the use of xylol as a clarifying agent and of chloroform-balsam as a mounting medium.

Slide Labelling.§—Prof. G. J. Peirce mentions a neat device for labelling slides. One end is painted with a very thin solution of balsam.

* Illust. Ann. Microscopy, 1900, pp. 28–9.

† Bull. Soc. Franç. de Minéral., xxii. (1899) pp. 61–6. See Zeitschr. f. wiss. Mikr., xvi. (1900) p. 516.

‡ Zeitschr. f. wiss. Mikr., xvi. (1900) pp. 431–3.

§ Journ. App. Microscopy, ii. (1899) p. 627 (1 fig.).

When dry this is easily written on with ink, and the record may be permanently preserved by means of another coat of balsam.

Writing on Glass.*—Herr F. Noll remarks that for a long time he has used the edge of ground-glass stoppers for writing notes relative to the contents of the bottle. The notices are easily made with a lead pencil, and readily removed with a damp cloth when required. Recently he has had laboratory vessels ground near the top so that notes can be written thereon. This has been found a great convenience, while the increased cost is quite trivial.

FRIEDLAENDER, C.—**Mikroskopische Technik zum Gebrauch bei medicinischen und pathologisch-anatomischen Untersuchungen.** (Microscopical Technique for use in Medical, Pathological, and Anatomical Investigations.) Sixth edition, by C. J. Eberth. Berlin (Fischer), 1900, 8vo, 359 pp. and 86 figs.

SZYMONOWICZ, L.—**Lehrbuch der Histologie und der mikroskopischen Anatomie, mit besonderer Berücksichtigung des menschlichen Körpers, einschliesslich der mikroskopischen Technik.** (Handbook of Histology and of Microscopical Anatomy, with especial reference to the human body, including Microscopical Technique.) Parts 1 and 2. Würzburg (Stuber), 1899.

* Flora, lxxxvi. (1899) p. 384.

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on the 18th of April, 1900, at 20 Hanover Square, W.
G. C. Karop, Esq., Vice-President, in the Chair.

The Minutes of the Meeting of March 21st, 1900, were read and confirmed, and were signed by the Chairman.

The Secretary said they had only received one donation since the last Meeting (in addition to exchanges and reprints)—the *Journal* of the Board of Agriculture for March.

The thanks of the Society were voted to the Donor.

The Chairman felt sure that the Fellows would regret to hear that the President was so indisposed as to be quite incapable of being with them that evening. He was to have given them a demonstration on the structure of some Palæozoic plants, with lantern illustrations. In his unavoidable absence, however, Mr. George Murray, F.R.S., at very short notice, had most kindly undertaken to give them an address on Coccospheres and Rhabdospheres.

Mr. Swift exhibited and described a new pattern Field Microscope, which he thought would be found very useful for travelling, as it folded up into a small compass and packed into a case about 9 × 3 × 3 in. The stage was rather larger than the one usually fitted to so small an instrument, but it was made so as to carry an Abbe condenser, and being jointed it took very little additional room when folded back. In addition to the Microscope the case would contain two objectives, bottles, a Rousselet live-box, pipette, and forceps (see p. 379).

The Chairman thought this was an extremely well made and finished Microscope, and very ingeniously contrived to pack up into the smallest possible space. It would no doubt be found very useful by travelling naturalists ; it only seemed to be too good to carry about and get damaged.

The thanks of the Meeting were voted to Mr. Swift for his exhibit.

Mr. George Murray's address dealt with a subject which must be of interest to all biologists, namely, the nature of those strange pelagic organisms, the Coccospheres and Rhabdospheres.

So long ago as 1857, Prof. Huxley described, in deep-sea soundings from the North Atlantic, curious structures which he called coccoliths. Dr. Wallich, about the same time, had the good fortune to observe the tiny coccoliths aggregated into definite structures which he called coccospheres; but for some time after the observations the real nature of the coccospheres and rhabdospheres remained extremely doubtful. It was definitely known that the coccoliths were of a calcareous nature, but whether they or the coccospheres were the individual living organisms, whether they should be considered as animals or plants, and what part they played in the economy of nature, were all such dubious questions that many people went so far as to deny altogether the organic origin of these structures.

The 'Challenger' expedition, however, carried the matter a step further by the discovery of coccospheres (and of somewhat similar organisms, rhabdospheres), living free upon the surface of the water. From observations made during this expedition, Sir John Murray held that both the coccospheres and rhabdospheres were minute pelagic calcareous algæ; doubt was, however, cast on his conclusions by the failure of the Hensen Plankton expedition to find any trace of these structures. The botanist of that expedition even cast doubt on their very existence as organisms, and in any case would have none of them in the vegetable kingdom.

Matters were in this condition when, by the aid of the Government Grant Fund, Mr. Murray, accompanied by Mr. Blackman, was able to make a voyage to the West Indies for the purpose of studying these organisms, and setting at rest, once for all, the conflicting views as to their nature. On this voyage the coccospheres and rhabdospheres were found floating free on the surface of the Atlantic. The former were obtained in an undoubted living condition, and were seen to contain a single green chromatophore, thus rendering extremely probable the view as to their algal nature. The coccosphere was shown to be made up of a number of calcareous plates, each perforated by a minute pore in the centre, and overlapping each other in a definite and regular way. The skeleton was shown to enclose a tiny mass of protoplasm in which the chromatophore lay imbedded, and the method of division was shown to be by simple fission. The rhabdospheres seemed to be similar organisms, but differed from the coccospheres in the projections borne on the outer side of each plate. In the paper dealing with these observations, the species of coccospheres and rhabdospheres, including a new and smaller species, were for the first time accurately described.

The address was illustrated by lantern slides.

The Chairman said he was reminded of the saying that the misfortunes of one man were often the advantages of others. The unfortunate absence of the President had in this case given them the privilege and pleasure of hearing this very excellent address from Mr. Murray, and at the same time they had the promised paper from the President to look forward to on his recovery.

Mr. W. H. Shrubsole said he was glad to have had the opportunity of listening to this very interesting address; indeed, he might say that he had never been more interested by anything he had heard in that room than he had been by what he had heard from Mr. Murray that evening. He had studied these things for some years, and should like to state that he had found rhabdoliths in the London Clay very much resembling those with the trumpet-shaped projections, the difference being that each projecting tube had similar but smaller tubes radiating from it at right angles. All were, however, in the peculiar mineralised condition which prevented them from being easily recognised. Diatoms were common in that formation, but rhabdoliths were more rare, for he had found the latter only in the clay from a well at Queenborough. One other point he should like to refer to, viz. the spines projecting from some kinds of diatoms. He had often noticed similar projections from *Pleurosigma* found in the estuary of the Thames.

Dr. D. H. Scott, F.R.S., said he should like to join with others present in expressing the great pleasure with which he had listened to this communication. He had come to hear Mr. Carruthers, but, however much they regretted his absence and the cause of it, they could not have had a more complete compensation for their disappointment. As regarded the position to be assigned to these organisms, he did not think they seemed to fit on exactly to any known group, but the way in which Mr. Murray had made out their structure was most interesting. The arrangement of the overlapping plates was to his mind a much more natural one than the old idea, which would appear to prevent growth. Nothing would be of more importance than to ascertain what was the mode of reproduction of these organisms. He should like to enquire if, after the study he had made of them, Mr. Murray could give them any idea as to the affinities of these bodies. So far as he was aware, the knowledge of pelagic organisms was still in a very infantile condition.

Mr. Shrubsole enquired whether Mr. Murray considered that any relation existed between the coccospheres and the gelatinous bodies which made their appearance every year in the month of May in the estuary of the Thames in such quantities as to produce the condition known to fishermen as "foul water?" As May was approaching, he would suggest to some gentlemen who had the means of so doing, that they should take the opportunity of examining these things.

Mr. Murray said, with regard to the contents of these bodies, not only did he have very little material to go upon, but it was an extremely difficult matter to make satisfactory observations upon such minute bodies upon the high seas. About eighteen months ago, about four miles off the North Foreland, he was towing in rather rough weather, and got rather a large haul, in which he found *Coccosphæra pelagica* in fine perfection in September. He hoped to be able to obtain some further quantities during next September. He had said nothing about the affinities of these things, because he knew nothing about them; he was just as much in the dark on this matter as Dr. Scott was. Mr. Blackman and he did their best to try and place them, and they thought they were justified in calling them plants. The "foul water" organism was known as *Tetraspora*, but he had not as yet had a good opportunity of examining it. Some time ago Dr. Murie brought him a quantity of the slime, but it had been in a bottle for some days. He thought it was most likely to be a primitive form in the group of Flagellata. It was certainly a great nuisance to fishermen in fouling their nets, and that not only on our own coasts, but it was complained of by fishermen so far south as the Falkland Islands.

The Chairman was sure all who were present would join in giving a very hearty vote of thanks to Mr. Murray. It was a long time since they had had so interesting a subject brought before a Meeting, and their thanks were due to Mr. Murray, not only for giving them this very excellent address, but for coming down with it at such short notice.

The thanks of the Society were cordially voted to Mr. George Murray for his communication.

The following Instrument was exhibited:—

Messrs. J. Swift and Son:—A new pattern Field Microscope.

New Fellows.—The following were elected *Ordinary* Fellows:—Messrs. Ernest E. Barker, A. J. Murphy, Harry St. John, and Matthew Henry Stiles.

MEETING

HELD ON THE 16TH OF MAY, 1900, AT 20 HANOVER SQUARE, W.
THE PRESIDENT (W. CARRUTHERS, ESQ., F.R.S.) IN THE CHAIR.

The Minutes of the Meeting of the 18th April, 1900, 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 Society were voted to the Donors.

	From
A Collection of some of Mr. Gosse's Water-colour Sketches of the Rotifera	*Dr. C. T. Hudson.*
B. D. Jackson, Glossary of Botanic Terms. (8vo, London, 1900)	*The Publishers.*
C. F. O. Nordstedt, Index Desmidiacearum	*University of Lund*

The President called special attention to the very beautiful drawings of Rotifera by Mr. P. H. Gosse, which had been presented to the Society by Dr. Hudson. The illustrations in Mr. Gosse's work were themselves very beautiful, but it would be seen that the original drawings were still more beautiful. They would make a very valuable addition to the Society's collection. When a student in Edinburgh he was greatly interested by some lectures delivered there by Mr. Gosse, and greatly admired the drawings he made upon the board in illustration of the subjects of his lectures.

He also called attention to the Index of Desmids by Prof. Nordstedt, which would be found a most valuable book of reference by those who were studying these organisms. It was certainly a most useful addition to the library.

A special vote of thanks to the Donors of these presents was, on the motion of the President, unanimously carried.

Dr. Hebb said that in the possession of the Society were numerous samples of diatomaceous earths, deep sea dredgings, sponges, and some shells. It had been decided to dispose of these to Fellows of the Society and to Members of the Quekett Club, and any Member of either Society who would like to have any of the material was invited to apply as early as possible to the Assistant Secretary at the Society's rooms.

Mr. C. Baker exhibited two Microscopes, one being specially made for critical work, having pull and rack draw-tubes, mechanical stage, and substage with fine adjustment. It was also interesting in being fitted with the Society's new size eye-piece, gauge No. 3 of 1·27 in. The other instrument, called the Plantation Microscope, was designed for use in the tropics for the purpose of discovering the ova of internal parasites; being made in the simplest possible manner, it could be used by any person not acquainted with microscopical technique, and having a magnifying power of × 150, would be found efficient for the diagnosis of over half-a-dozen kinds of ova.

The President said he was pleased to hear of the adoption of the new 1·27 eye-piece by Messrs. Baker, and a vote of thanks to them for sending these exhibits was unanimously passed.

Dr. Hebb said another paper had been received from Mr. F. W. Millett, being Part VIII. of his series of papers on the Foraminifera of the Malay Archipelago. He stated that, as on former occasions, this paper would be taken as read, and that it would be published in due course in the Society's Journal.

The thanks of the Society were voted to Mr. Millett for his communication.

Mr. E. M. Nelson read a paper "On the Lag in Microscopic Vision," which he illustrated by drawings and by a series of tables showing the proportionate values of the performance of various objectives under eye-pieces of different powers. In the case of an apochromatic objective of fine quality the degree of merit was shown to range from 14·7 with a low eye-piece to 7·7 with a deep one, but the difference was more marked in the case of dry lenses of ordinary achromatic construction. Mr. Nelson said that his experiments had shown that in respect to the lag, short-tube Microscopes had some advantage over those with long tubes; contrary to what he had previously thought, it appeared that lengthening the tube increased the lag.

The President said they would be very glad to read this paper *in extenso*, as from the simple results arrived at by a path of mathematical deduction which Mr. Nelson had put before them, it was one likely to prove of great practical value.

The thanks of the Society were voted to Mr. Nelson for his paper.

Mr. E. M. Nelson also read a paper for Mr. E. B. Stringer "On a New Form of Fine Adjustment," a Microscope by Messrs. Watson and Sons fitted with the arrangement being exhibited in illustration.

Mr. Nelson said, that having had the pleasure of examining this Microscope, he could only say that its working seemed to be exceedingly perfect. As the fine adjustment was placed just behind the body, the limb could be made of any length without causing any additional strain upon the screw—a matter which would be of very great advantage in the case of Microscopes which were made for examining sections of very large size.

The thanks of the Society were voted to Mr. Nelson and to the author of the paper.

The President said most of those present in the room had no doubt seen something of the very excellent show of objects illustrating pond life exhibited that evening. In securing so large a number of exhibits of this class they were greatly indebted to many Members of the Quekett Microscopical Club who had brought their Microscopes and objects for the purpose. He was sure the service thus rendered would be much appreciated, and he had therefore great pleasure in moving that the best thanks of the Society be given to these gentlemen for so kindly exhibiting on that occasion.

The motion having been put from the Chair, was carried unanimously.

The President, in announcing the adjournment of the Meeting until Wednesday, June 20th, said he hoped then to be able to submit and explain a series of lantern slides representing minute structure of some Palæozoic plants. He feared, however, that in his present state of health he was somewhat bold in undertaking to do this, but hoped that by the time named he would be more equal to the undertaking than was unfortunately the case at the time of speaking.

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

Mr. Chas. Baker:—A Microscope for critical work; the "Plantation" Microscope.

Messrs. Watson and Sons:—Microscope fitted with Mr. E. B. Stringer's new Fine Adjustment.

Mr. A. W. Bird:—*Spongilla lacustris.*

Mr. A. Earland:—Movement of protoplasm in tip of *Closterium lunula.*

Mr. T. D. Ersser:—Hydra, budding.

Mr. G. P. Dineen:—Daphnia.

Mr. H. E. Freeman:—*Plumularia similis*; old Pocket Aquatic Microscope by Gilbertson.

Mr. Alfred E. Hilton:—*Spongilla lacustris.*

Mr. E. Hinton:—*Spirogyra communis* in conjugation.

Mr. J. T. Holder:—*Hydra viridis* showing testes.

Mr. John Hood:—*Alcyonella fungosa*, *Hydatina senta*, *Stephanoceros Eichhorni*, *Volvox globator*.

Mr. R. Macer:—*Alcyonella fungosa*, *Lophopus crystallinus.*

Mr. J. W. Measures:—Statoblasts of *Cristatella mucedo.*

Mr. C. Muiron:—Sundry Rotifers.

Mr. C. F. Rousselet:—*Anuræa aculeata*, *A. cochlearis*, *Asplanchna*

Brightwelli, *Brachionus pala*, *Floscularia ornata*, *Melicerta ringens*, *Notholca labis*, *N. spinifera*, *Polyarthra platyptera*, *Synchæta cecilia*, *Spongilla fluviatilis*.

Mr. D. J. Scourfield :—*Bosmina longirostris*, hatched from winter eggs taken last autumn; *B. longirostris* showing special sense-organ on antennule (flagellum in cup), brain, &c.

Mr. Chas. B. Soar :—*Curvipes fuscatus*, larval form.

Mr. A. Verinder :—*Stephanoceros Eichhorni*.

New Fellows :—The following were elected *Ordinary Fellows* :—Mr. Oscar H. Elbrecht, Mrs. G. C. Frankland, Mrs. Leo Grindon, and Mrs. Muff.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

AUGUST 1900.

TRANSACTIONS OF THE SOCIETY.

V.—*On the "Lag" in Microscopic Vision.*

By Edward M. Nelson.

(*Read 16th May*, 1900.)

The method employed by the "man in the street" to determine the efficiency of a clock is to test its capability of keeping time; but a scientific horologist would not be satisfied with this mere time-keeping test; he would want to know the difference between the amount of energy put into the clock and that given out by the clock—in other words, the amount of energy wasted in the clock itself by friction, etc.

Example:—The work given out by a common grandfather's clock is the wagging of a 4 lb. pendulum, 40 in. long (roughly), and the energy put into the clock is a 10 lb. weight falling 4 in. per diem. The ratio between these quantities is therefore $\frac{10 \times 4}{4 \times 40} = \frac{1}{4}$. Compare this with a good regulator which wags a 30 lb. pendulum 40 in. long, by means of a 5 lb. weight falling 3 in. per diem; thus $\frac{5 \times 3}{30 \times 40} = \frac{1}{80}$; the regulator therefore has twenty times the efficiency of the grandfather's clock.

Now, we microscopists have hitherto, like "men in the street," been content to test a Microscope objective by measuring its numerical aperture, and indicating the nature of its performance by some qualifying adjective; thus, a microscopist may be heard to say that a certain 1/4 is a beautifully corrected lens of 0·8 N.A., whereas, with regard to another lens of precisely the same power and aperture, he will not commit himself further than to describe the lens as fair, or tolerably good. The question therefore that must present itself to every one's mind is:—Cannot we microscopists, following the example of scientific horologists, substitute, by means of a formula, definite figures for the indefinite terms applied to objectives, such as excellent, fair, tolerably good, etc.? The scope of this paper then is to show how this may be easily accomplished. The method is as follows:—First, find out the tangent of the visual angle for a minimum visible with the unaided eye; this tangent, when multiplied by a million to get rid of the decimal point, will be distinguished by the letter v. Secondly find out the tangent of the similar angle with a Microscope, care being taken that the minimum visible is not the minimum resolvable with the given objective; in other words, the power must be so adjusted that the minimum visible is within the grip of the aperture of the objective; this tangent, when multiplied by a million, will be known by m. Thirdly, the "lag" is the difference between the quantities represented by m and v.

Of course it is necessary that the observer measuring the various objectives should determine the value of v for his own sight. Let us suppose that an observer can divide the one-hundredth of an inch at 10 in.; then by a Microscope with a power of 100 he ought, if there is no "lag," to be able to divide the one ten-thousandth of an inch at a 10 in. projection distance. In this case v is 1000, and m also 1000, the "lag" or the difference between these values being 0. If, on the other hand, the Microscope is capable of resolving only 8000 lines to the inch with the same power, m will be 1250; and as v will be 1000, as before, the "lag" will be 250. In 1875, while experimenting with some telescopes, I found that if a certain grating could just be resolved by the unaided eye at a distance of say 20 yards, the same grating could always be seen with a telescope of a power, say, 10 at a distance greater than 200 yards. Similar experiments were performed with many telescopes of various powers, the powers and distances being all very accurately measured, and in every case the telescope resolved the grating at a distance greater than the naked eye distance multiplied by the telescope's power. This shows that, so far as the telescope is concerned, the "lag" becomes a negative quantity; if then we meet with a similar experience with respect to a Microscope, we need not be surprised.

We have seen above that the "lag" in microscopic vision may be expressed by the formula tan M − tan V; it will now only be necessary to explain the practical method of using this formula for non-mathematical readers, and to give a table of values obtained from objectives tested in this manner. To find tan V, set up any suitable grating, for example an ivory scale divided into fiftieths of an inch would answer the purpose, and measure the greatest distance at which the lines can just be separated; a bright day must be chosen for performing this experiment. Suppose that one-fiftieth of an inch can just be divided at 45 in., then tan V is 1/50 or 0·02; divided by 45, this equals 0·000444. Multiplying this by one million, we obtain the value of v as 444. To find tan M, divide the magnifying power by ten times the number of lines to the inch on the test-plate resolved by the Microscope. Example:—with a power of 280 the number of lines to the inch resolved is 45,000, then tan M will be 280 divided by 450,000. This is equal to 0·000622, which multiplied by a million $= m = 622$. In this case the "lag" $m - v = 622 - 444 = + 178$.

Take another objective, which with a power of 140 just resolves 35,000 lines to the inch; then 140 divided by 350,000 = 0·0004, which multiplied by a million = m = 400. The "lag" is now 400 − 444 or − 44, the negative sign indicating that the Microscope is doing relatively more than the unassisted eye. The objectives in the following table were tested with a wide-angled solid cone of axial illumination, the condenser was kept accurately centred, and the edge of the lamp flame strictly focussed upon the object. This is an important point, because if the condenser is racked so that the flame image is a little out of focus, a hollow annular cone would be substituted for a solid axial one, and the character of the illumination would be changed into one which would partake somewhat of the nature of oblique light with a slot; and the resolving power of the objective would consequently be increased. The column marked O.I. shows the optical index of the lens; it is found by dividing one thousand times the N.A. of the objective by its initial magnifying power. Example:—a 4/10 of N.A. 0·62 has an initial power of 33, its O.I. is therefore $\frac{620}{33} = 18 \cdot 8$. The eye-pieces distinguished by numerals are compensating; those by letters Huyghenian; that by XII is a twelve-power of my own construction. The column P contains the combined magnifying power of the objective and eye-piece. This, together with the N.A. and initial powers of the objectives, was measured in every instance, and was not derived from the values given in catalogues. The column t shows the number of thousands of lines per inch resolved. With regard to m, a simpler way of finding this quantity is to multiply P by 100 and divide by t. Example in the seventh line:—$\frac{12900}{25} = 516$.

The column marked "Lag" is, as we have seen above, $m - v$, and as $v = 437$ throughout this table, it therefore is $m - 437$.

A number obtained empirically is placed in the last column, which shows the order of merit of each objective's performance in resolving a certain number of thousands of lines to the inch with a certain magnifying power, and on account of its general utility may be preferred by some to the column marked "Lag." The number is obtained by dividing 10 v by $m - t -$ O.I. It will be conceded that if two objectives having precisely the same initial powers but different apertures resolve the same band with a low-power eye-piece, the preference ought to lie with the wider angled lens; by subtracting the O.I. from the denominator compensation is to a certain extent effected. Again, if two objectives of different powers have the same optical index, some allowance will have to be made for the objective which resolves the higher band; thus a 1 inch of 0·26 N.A. and a 1/4 of 0·95 N.A. have both an O.I. of 23·5; it would be very much more difficult for the 1/4 to resolve 60,000 lines to the inch than it would be for the 1 inch to resolve 15,000; compensation for this is effected by subtracting the number of thousand lines to the inch resolved from the denominator.

A column of the denominators $m - t -$ O.I. is given; $10\,v$ is of course 4370 throughout the table.

Objective.	Focus.	O.I.	Eye-piece.	P.	*t.*	*m.*	*m*−*t* −O.I.	"Lag."	Order of Merit.
Apochromatic	1½	26·3	6	35	10	350	314	−87	13·9
"	"	"	12	67	15	447	406	+10	10·8
Achromatic..	1½	23·0	A	37	10	370	337	−67	13·0
Apochromatic	1	28·0	4	51	15	340	297	−97	14·7
"	"	"	6	70	20	350	302	−87	14·5
"	"	"	8	90	20	450	402	+13	10·9
"	"	"	12	129	25	516	463	+79	9·4
"	"	"	XII	120	25	480	427	+43	10·2
Achromatic..	1	21·8	A	57	15	380	343	−57	12·7
"	"	"	B	87	20	435	393	−2	11·1
Apochromatic	1/2	32·0	4	70	20	350	298	−87	14·7
"	"	"	6	130	35	371	304	−66	14·4
"	"	"	8	180	40	450	378	+13	11·6
"	"	"	XII	250	50	500	418	+63	10·4
"	"	"	12	270	50	540	458	+103	9·5
" without screen	"	"	"	"	45	600	523	+163	8·4
"	"	"	18	360	55	654	567	+217	7·7
Achromatic..	1/2	24·4	XII	290	50	580	506	+143	8·6
"	1/2	15·3	A	105	25	420	380	−17	11·5
Apochromatic	1/4	22·7	4	167	45	371	303	−66	14·4
"	"	"	6	250	55	455	377	+18	11·6
"	"	"	8	350	60	583	500	+146	8·7
Achromatic..	1/4	17·0	A	250	50	500	433	+63	10·1
"	"	"	B	350	55	636	564	+199	7·8
Semi-apochromatic *	1/4	19·0	A	150	40	375	316	−62	13·8
"	"	"	B	200	50	400	331	−37	13·2
"	"	"	C	260	55	473	399	+36	11·0
Achromatic..	1/5	15·8	A	283	55	515	444	+78	9·8
"	"	"	C	510	60	850	774	+413	5·6
Semi-apochromatic *	1/6	12·8	A	250	55	454	386	+17	11·3
"	"	"	B	333	60	555	482	+118	9·1
"	1/6	14·5	B	286	55	520	451	+83	9·7
"	"	"	XII	470	60	783	709	+346	6·2
Achromatic *	1/6	14;5	B	350	45	778	719	+341	6·1

* Short-tube objectives.

Looking at the figures in the Table, which deals with 14 objectives, we see that the "lag" is increased in every instance by deeper eye-pieces. In the first lens, an apochromatic of $1\frac{1}{2}$ in. focus, the "lag" is increased from − 87 to + 10 by changing the eye-piece from 6 to 12. The achromatic $1\frac{1}{2}$ with an A or 5 eye-piece does not perform so well as the apochromatic, its order of merit being 13·0 against 13·9 of the apochromatic with a 6 eye-piece. The fall in the merit of an apochromatic 1 in. with eye-pieces ranging from 4 to 12 is as much as from 14·7 to 9·4. The apochromatic 1/2 shows a similar result, viz. from 14·7 to 9·5. The XII eye-piece has an advantage of about 1·0 over the compensating. The Gifford screen also raises the order of merit about 1·0. The difference in the performance between an apochromatic 1/2 and an achromatic of nearly the same aperture in resolving the same band with the XII eye-piece, is about 2·0. An achromatic 1/2 with a very low optical index can only score 11·5 points with an A eye-piece—in other words, it is about 3 behind the apochromatic.

The apochromatic 1/4 falls off more rapidly than the 1/2, its merit with the 8 eye-piece being only 8·7; but the achromatic on the other hand is only 7·8, and that too upon a lower band. The position maintained by the semi-apochromatics in the table is most interesting. Take for example the 1/4; it begins with an order of merit only a little behind that of the apochromatic, and holds its own remarkably well under the deeper eye-pieces; it resolves 55,000 with 11·0 marks as against 11·6 for the apochromatic, and 7·8 for the achromatic. An achromatic 1/5 with some uncorrected spherical aberration falls as low as 5·6 for 60,000 lines. Two semi-apochromatic 1/6ths come next, the one which has the lower optical index being the better corrected lens of the two. The above 13 objectives may all be described as picked lenses in their respective classes, but a bad achromatic 1/6 is put last by way of comparison; it can obtain only 6·1 marks in resolving 45,000 lines per inch.

The last point shown by this method of testing lenses is an important one, for it demonstrates that the advantage lies with short-tube objectives. It is to be regretted that the table is not as complete as it might have been, but a sufficient number of short-tube lenses were not at hand for comparison.

We see then that lenses which hitherto were thought capable of bearing the deepest eye-pieces without showing the least sign of breaking down are proved incapable of standing even medium power eye-pieces without loss; and we also learn that all super-amplification of the objective image, whether by eye-piece or tube-length, will be accompanied by a fall in the number of marks; and lastly we note the very high place taken by cheap semi-apochromatic objectives.

Assuming that there is no "lag," the power sufficient to resolve any given number of lines to the inch may be found by multiplying v by t and dividing the product by 100. Example:—What is the power necessary, when there is no "lag," to resolve 50,000 lines per inch? Here 437 multiplied by 50 = 21,850, dividing by 100 the answer 218 is obtained

The N.A. necessary to resolve any given number of lines to the inch with a large solid axial cone and Gifford's screen, may be found by dividing t or the number of thousands of lines to the inch by 80. Example:—What is the N.A. necessary to resolve 50,000 lines per inch? Here $t = 50$, and $\frac{50}{80} = 0 \cdot 625$, the N.A. required.*

The test-plate was a 12-band plate, ruled to 60,000 lines per inch, by Mr. H. J. Grayson, of Melbourne, mounted in realgar of refractive index 2·5.

* See this Journal, 1893, p. 17.

VI.—*A New Form of Fine Adjustment.*

By E. B. Stringer, B.A.

(*Read 16th May*, 1900.)

In the accompanying fine adjustment I have endeavoured to overcome those imperfections which proved troublesome in photomicrographic and also in visual work. The main points of its construction will be seen in fig. 103, and are as follows.

The limb, which is of the Jackson type, is prolonged into a vertical pillar P, of triangular section, placed close behind the coarse adjustment and body, so that any shake, should it exist, is not magnified by an intervening arm. The lever is of the second order, having its fulcrum F at the bottom and just in front of the pillar, and bearing on the moving part at a point exactly underneath it; this point being so near the fulcrum as to render the movement extremely slow.

The moving part, which carries the coarse adjustment and body in front of it, has a back plate attached to it by eight screws, with which, if necessary, its fit may be adjusted. It has two prolongations which pass downwards on each side of the limb, and receive a transverse steel pin in their extremities. This pin carries a small roller R, of hard steel, upon which the lever bears, downwards.

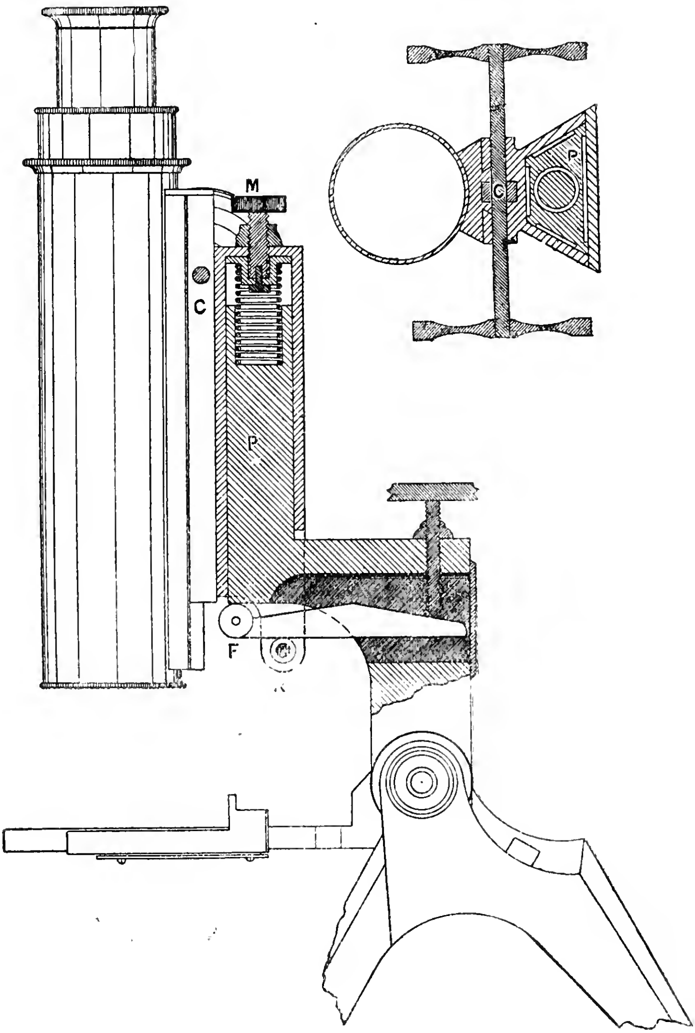
The opposing spring is in a recess at the top of the pillar, and draws the roller upwards against the lever. The action of the roller is to abolish friction at this point, and to convert the movement of the lever, which is of course the arc of a circle, into the straight movement of the sliding part, without the least tendency to the production of a shake in a backward or forward direction.

It will be noticed that in virtue of the position of the spring the weight of the body is supported by it; so that, though this weight is, as it must be, considerable, it is in practice reduced to a small minus quantity; and the pressure of the lever on the micrometer screw is thus very slight, being in fact only just enough to take up its backlash. The finest screw may in consequence be used without danger of its suffering from wear.

Further it will be seen that the weight of the body bears most upon the spring when the Microscope is in a vertical position, whilst in the horizontal position it is quite inoperative; so that for the latter position the same spring is much too strong, and by exerting an undue strain might cause lateral movement. It is in consequence of this that much of the trouble occurs in photomicrography; fine adjustments which are perfectly satisfactory in the vertical or inclined positions, sometimes working badly when set horizontally.

To meet this difficulty I have added a means by which the tension of the spring may within considerable limits be controlled. A milled

Fig. 103.



P, Pillar. F, Fulcrum of lever. R, Steel roller on which the lever bears. M, Milled head controlling tension of the spring. C, Coarse adjustment pinion.

screw M, seen just behind the coarse adjustment, passes into the hollow pillar and terminates in a plug which bears upon the spring. When the Microscope is set horizontally this screw is run out to its full limit, leaving just sufficient tension in the spring to work the movement in this position. Also should a binocular body or unusually heavy nose-piece be in use in ordinary work, the tension of the spring may with advantage be increased in proportion, by slightly screwing it up.

It would seem that only by such means can a high degree of sensitiveness be maintained under all conditions, in movements which actuate the entire body.

Another point of importance is that the body, as will be seen, is drawn downwards by the lever, and drawn upwards by the spring; the force in each case being applied exactly in the line of motion; so that, even should the pillar fit loosely and side shake be possible, it does not for the most part occur. Arrangements (and there are several) in which the body is *pushed* against an opposing spring, tend much to increase the liability to every kind of side shake and jamming.

Also, seeing that the moving part is firmly held between the lever below and the spring above, any alteration of focus when the milled head is at rest is quite impossible; a point of great importance in photomicrography.

The movement is well protected from dust, and is of sufficient strength to withstand the roughest treatment. It may be taken apart with great ease, it being only necessary to unscrew the transverse steel pin, and remove it and the roller, when the whole may at once be lifted off the pillar.

I should add that Mr. Nelson, who saw my drawings before Messrs. Watson made the instrument, suggested that the pillar should be slightly hollowed out at the sides, so as to bear only at its edges, thus guarding against the possibility of any lateral rocking movement. He subsequently suggested that the back plate should be slightly sprung by cutting away the underlying metal in four places; also that the pillar should be made wider and considerably truncated in front, so as to form a bar similar to that in the coarse adjustment of Powell's large stand. All these three improvements have been carried out in the present instrument.

Careful trials since made have shown that with this form of pillar the strongest spring works perfectly well, without the least tendency to the production of side shake, either in the vertical, inclined, or horizontal position. The adjustment controlling the tension of the spring, therefore, loses much of its importance. Very critical workers might still, however, find it advantageous.

VII.—*Some New Microscopic Fungi.*

By Miss A. Lorrain Smith.

(*Read 20th June*, 1900.)

Plate III.

Entomophthora Pooreana sp. n., plate III. fig. 1.

Hyphæ abundant, interwoven, breaking up into short lengths, varying in width from 5 μ upwards, septate; resting-spores formed in an intercalary manner on anastomosing hyphæ, globose, varying from 25 μ to 40 μ in diameter, with a thick yellowish epispore and granular contents.

Found in the tissue of a rabbit that had been buried in a garden at Isleworth, about 3 in. beneath the surface of the soil, until almost disintegrated.

The hyphæ of this species formed a large part of a waxy-looking white mass of "adipocere" *; with here and there little clumps of yellow resting-spores. I did not succeed in germinating these spores; but from the hyphæ I got a culture of anastomosing filaments and intercalary resting-spores, which were equal in size to the smallest spores, and otherwise exactly similar to those in the "adipocere"; the spores produced by culture do not measure above 25 μ in diameter.

EXPLANATION OF PLATE III.

Fig. 1.—*Entomophthora Pooreana* sp. n. *a*, Hyphæ found in adipocere, × 500; *b*, anastomosing hyphæ, × 500; *c*, resting-spores from adipocere, × 140; *d*, hyphæ and spores from culture in a hanging drop, × 140; *e*, hyphæ and spores developing, × 500; *f*, spore fully formed, × 500.

Fig. 2.—*Gymnoascus verticillatus* sp. n. *a*, Fruit, enlarged; *b*, peridial hyphæ. × 160; *c*, verticil of branchlets, × 500; *c*, ascus-group of spores; *d*, spore, × 500.

Fig. 3.—*Coniothyrium Boydeanum* sp. n. *a*, Section through perithecium, enlarged; *b*, spores, × 500.

Fig. 4.—*Libertella blepharis* sp. n. *a*, Pustules, natural size; *b*, section, enlarged; *c*, part of hymenium, enlarged; *d*, sporophores with spores attached × 500; *e*, spores, × 500.

Fig. 5.—*Libertella corticola* sp. n. *a*, Pustule, natural size; *b*, section, enlarged; *c*, sporophores with spores attached, × 500; *d*, spores, × 500.

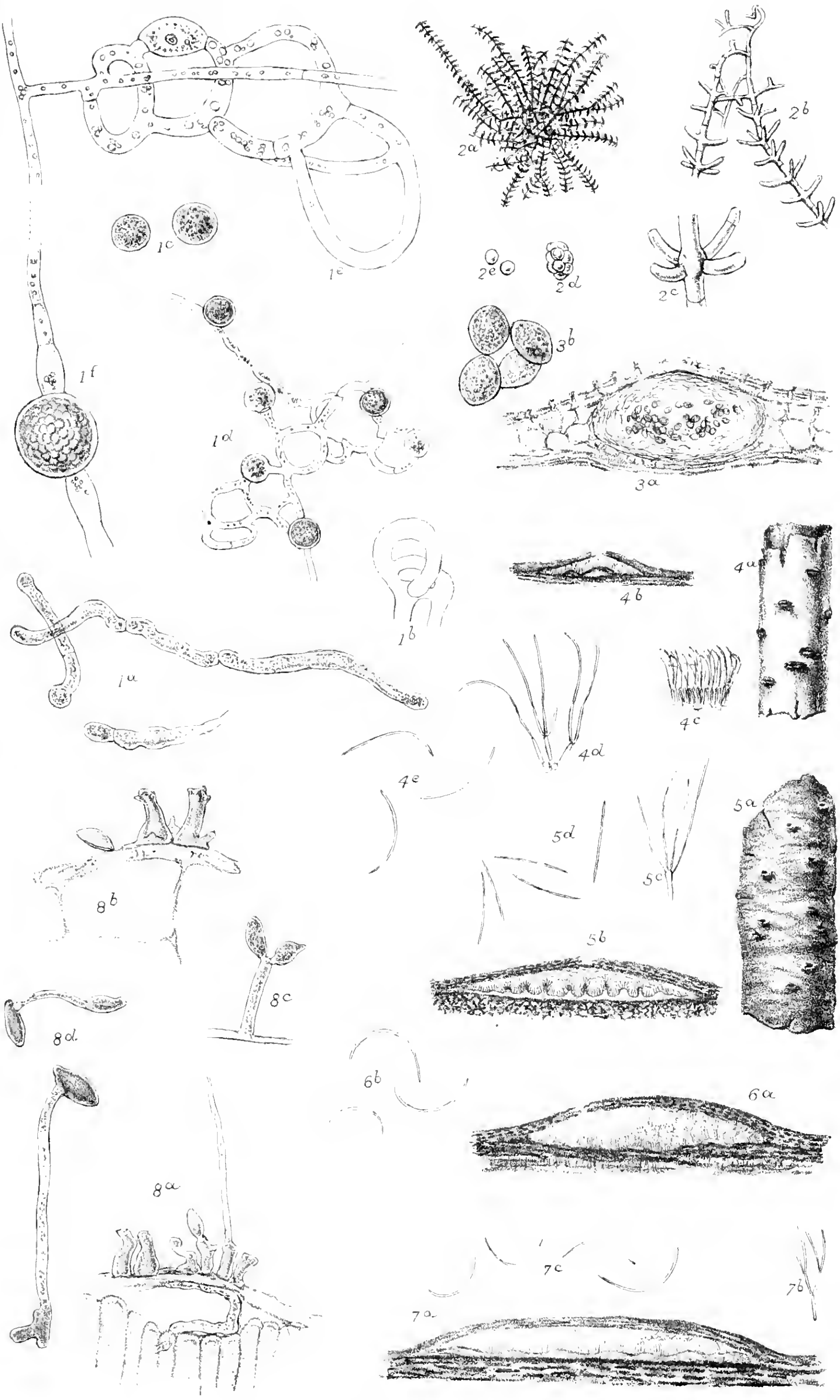
Fig. 6.—*Libertella Ribis* sp. n. *a*, Section of pustule, enlarged; *b*, spores, × 500.

Fig. 7.—*Libertella Salicis* sp. n. *a*, Section of pustule, enlarged; *b*, sporophore, × 500; *c*, spores, × 500.

Fig. 8.—*Fusicladium pyrinum* Lib. *a*, Section of pear-leaf, with conidiophores and hyphæ, × 360; *b*, denticulate conidiophores, × 360; *c*, conidiophores, with two apical conidia, × 360; *d*, conidia germinating in water, × 360.

---

* This term is used by zoologists for "a fatty body found in corpses buried in damp places."



A.L.S. del. Highley lith Hanhart imp

SOME NEW MICROSCOPIC FUNGI.

Entomophthora has been known hitherto as a parasite of insects and larvæ; it is here wholly confined to dead tissue.

Gymnoascus verticillatus sp. n., plate III. fig. 2.

Fruit composed of loose deep-brown hyphæ, the outer ends free, thick-walled, and beset with regular verticils of 4 curved blunt branchlets up to 15 μ in length and about 5 μ in width, the inner ends narrower, irregularly branched, the branches more angular, the whole forming tangled clumps; spores scattered among the filaments, separate or in ascus-like groups, globose, minute, about 2·5 μ in diameter, ascus-like groups somewhat oblong, 10 μ by 7 μ, dark-coloured. The specimens were all too old to determine the connection of the ascus-groups with the interior branches.

On the bones of a dead rabbit that had been buried under a tree, in a garden at Isleworth, for about a year.

I am indebted for the above two species of fungi to Dr. G. V. Poore, F.R.S., who has made a prolonged study of the "earth in relation to the preservation and destruction of contagia," and of the agents that are active in the disintegration of dead animal matter. In connection with his research, he buried some rabbits in wire cages, that the bodies might be in close contact with the soil. At the Natural History Museum, South Kensington, I had the opportunity of examining for fungi the fragments of exhumed remains after the softer parts had almost entirely disappeared. I found the fungi described above, and several other species more or less well known. There was still another which I was unable to determine, and which I consider also new to science, but the specimens were too old to pronounce definitely on them. They had evidently formed little balls the size of a small pea, with rather thin walls of loosely interwoven delicate brownish hyphæ, and filled with a mass of powdery reddish-brown echinulate spores, some of which were in groups that strongly suggested an ascus. But the specimens were all too old for determination.

Coniothyrium Boydeanum sp. n., plate III. fig. 3.

Perithecia in small groups or scattered, developed on the inner bark and bursting the cuticle, somewhat lentiform, 300 μ by 200 μ, parenchymatous, surrounded by a few loose hyphæ, yellow-brown; spores globose-ovate, usually about 12 μ in diameter, but varying to 15 μ by 10 μ, colourless, then dark smoky-brown, smooth, with granular contents.

On dead branches of *Fuchsia*, collected at Seamill, Ayrshire, by Mr. D. A. Boyd, October 1899.

Libertella blepharis sp. n., plate III. fig. 4.

Pustules of one or several cavities beneath the outer bark, the spores escaping by a wide opening and forming a milk-white layer on the surrounding bark; sporophores erect, slender, branched, slightly stouter and of denser contents than the spores; spores filiform, curved, sometimes strongly falcate, 25–40 μ by 1·5 μ.

On dead branches of *Prunus Cerasus* and *Pyrus Malus*, Seamill, Ayrshire, October 1899. Mr. D. A. Boyd.

Libertella corticola sp. n., plate III. fig. 5.

Pustules forming effused whitish spots under the outer bark, the spores escaping and forming a milk-white layer; spores straight or slightly bent, colourless, 20–25 μ by 1·5 μ, borne on closely packed sporophores that line the irregular infolding tissue of the pustule.

On dead branches of *Pyrus communis*, Seamill, Ayrshire, September 1899. Mr. D. A. Boyd.

Libertella Ribis sp. n., plate III. fig. 6.

Forming lentiform effused pustules under the outer bark, bursting the cuticle and the spores oozing out in a gelatinous pinkish mass; spores much curved, sometimes forming a complete semicircle, 30–40 μ by 1 μ, colourless.

On branches of *Ribes rubrum*, Seamill, Ayrshire, October 1899. Mr. D. A. Boyd.

Libertella Salicis sp. n., plate III. fig. 7.

Pustules formed in the cortex, convex or triangular in section, causing slightly elevated reddish-coloured spots on the bark; spores curved, 25–35 μ by 1·5 μ, colourless.

On dead bark of *Salix cinerea*, West Kilbride, Ayrshire, autumn 1896. Mr. D. A. Boyd.

Fusicladium pyrinum Lib., plate III. fig. 8.

Effused, velvety, rusty-brown; mycelium spreading just under the cuticle, finally penetrating and blackening the tissue; conidiophores upright, short, nodulose, irregular in form, denticulate at the tips, usually about 20 μ in height; conidia ovate-fusiform, 15–30 μ by about 7 μ, one-celled, brownish-yellow, smooth, usually solitary, but often two or more on the same conidiophore.

Parasitic on the leaves and fruit of *Pyrus communis* and, according to Goethe, other fruit-trees.

This fungus is, according to Dr. Goethe, *Garten Flora*, 1887, the conidial stage of a Pyrenomycete, and differs specifically, though only slightly, from *F. dendriticum*, both in this conidial stage and in the ascomycetous form.

It has been noted on the Continent for many years as a most harmful parasite. This year it has appeared in Britain, doubtless favoured by the late cold spring. I have seen specimens on pear-trees from Worcester and Hereford.

Specimens and slides of these fungi are in the Herbarium of the British Museum, Cromwell Road, South Kensington.

NOTES.

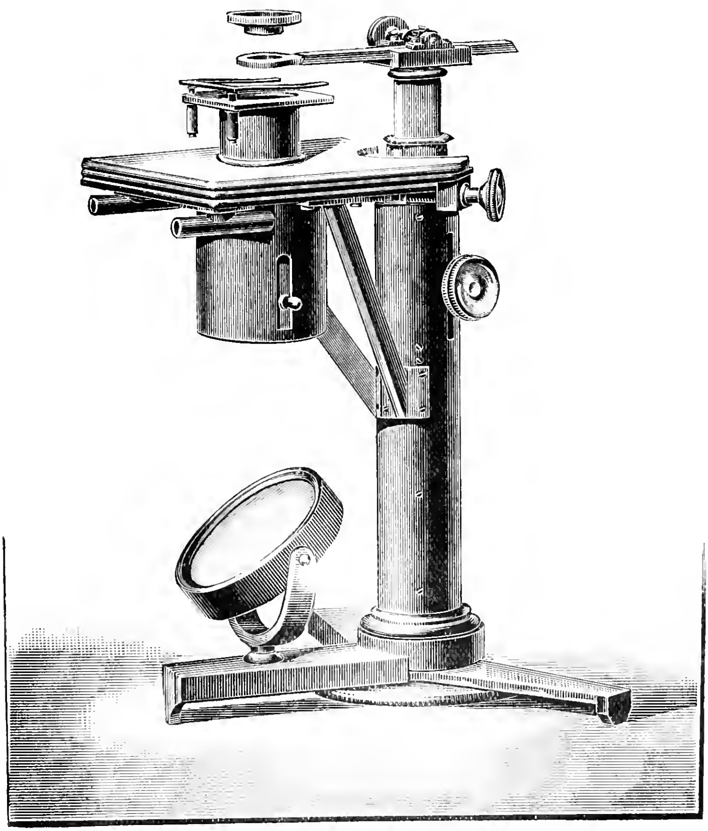
The Microscopes of Powell, Ross, and Smith.

By Edward M. Nelson.

II.—Andrew Ross's Microscopes.

The name of Andrew Ross first appears in the *Transactions* of the Society of Arts,* in connection with a Microscope he made in March 1831, for Mr. W. Valentine of Nottingham. At this time Mr. Ross's address was 5 Albemarle Street, St. John's Square, Clerkenwell; and it is probable that he was a philosophical instrument maker to the

Fig. 104.



* Vol. xlviii. p. 413 (1832).

trade, and that Mr. Valentine, in getting him to carry out his ideas, preferred to deal direct with the actual maker rather than through any of the retail opticians, who merely engraved their names on the instruments made by Messrs. Ross, Powell, and others.

Mr. Valentine's Microscope was a very good one in its day. It has been repeatedly figured, but important details in its construction, which have had much influence on the evolution of the Microscope, have been passed over without notice.

Description of this Microscope.—The foot was a flat folding tripod, fig. 104—a common form at that time; it was subsequently altered to a solid flat tripod. Stage—mechanical with slow rectangular movements, actuated by direct-acting screws.

This movement was a sort of fine adjustment stage movement, the coarse adjustment being the movement of the lens over the object; it should be remembered that for about three-quarters of a century it had been the custom to fix the object and move the lens over it.

FIG. 105.

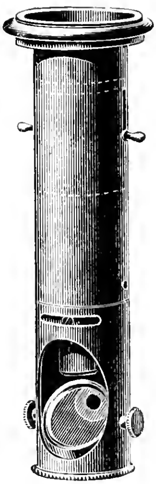
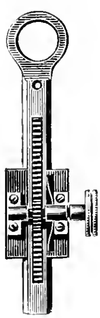


FIG. 106.



Illumination.—Wollaston's illuminating apparatus, fig. 105, or a modification of it, as shown attached to the Microscope in fig. 104.

Focussing.—These movements were three in number:—1st, by drawing out the inner triangular bar; 2nd, by rack-and-pinion work, which moved the middle triangular bar; 3rd, by fine adjustment screw, which moved the outer triangular bar. So in principle the movement is not unlike that of the modern Continental Microscope, where the body and coarse adjustment are carried by the fine adjustment screw.

This Microscope was, like many of that date, both single and compound. The lens-holder, for either a single lens or a Wollaston doublet, is shown in fig. 106. These lenses, although non-achromatic, were excellent; their fields and apertures were small; nevertheless they gave very good images. I have in my cabinet a Wollaston doublet which shows tubercle bacilli. The lens-holder was attached to the top of the inner triangular bar by means of a conical pin; the lens was therefore capable of a motion in arc over the preparation as well as that given to it by means of the extension rackwork. This movement—a very convenient one for a simple dissecting Microscope—owes its origin to Ellis's Aquatic Microscope, made by J. Cuff in 1755; afterwards Benj. Martin was the first to add rack-and-pinion to the extension and a worm-wheel to the tangential movement.

The compound body was attached to the inner triangular bar by a conical pin, in the same manner as the lens-holder (fig. 107).* The important part of the Microscope lies in its fine adjustment; the screw with 50 threads to the inch had its head divided into 100 parts, and placed below the foot. This Microscope resembled, in three points, Adams's Universal Microscope of 1746, for both had upright pillars, both flat folding tripod feet, and both had the heads of their fine

FIG. 107.

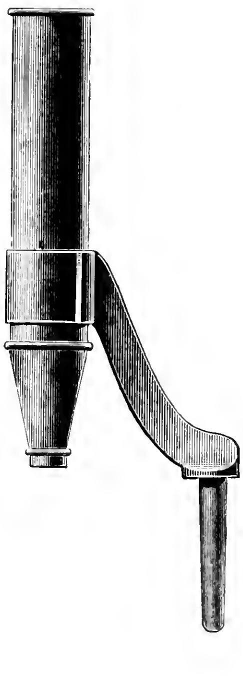
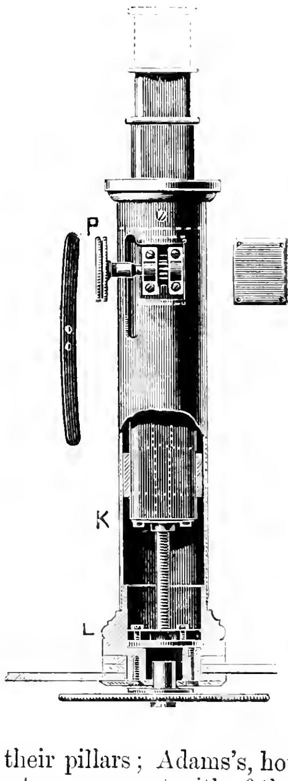


FIG. 108.

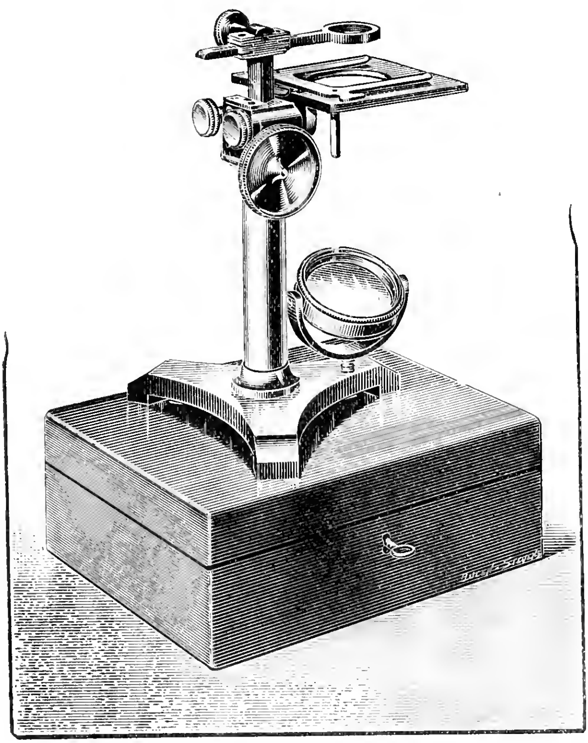


adjustment screws below the bases of their pillars; Adams's, however, was a stage focusser. This is the first instance we meet with of the head of a fine adjustment screw divided for micrometrical purposes; and it was the suggestion of Mr. R. H. Solly, whose liberality in defraying the cost of the plates illustrating these early Microscopes enables us to

* Mr. J. Mayall, junr., figures this Microscope, with the compound body and Wollaston condenser attached, in the Cantor Lectures of the Society of Arts for 1888, p. 14, fig. 20, but he has failed to note its identity with Valentine's Microscope. Had he known that an important feature in this Microscope was copied from a Microscope designed by C. Varley, he would probably have modified his adverse criticism on the latter's work.

ascertain many important facts with regard to their construction. But to return to the fine adjustment:—it had a sprung nut K, fig. 108, and also a sprung bearing for its lower portion at L, to prevent loss of time in its action. The spring in the rack-slide of the lens-holder, fig. 106, and also the spring P, fig. 108, which fits inside the round pillar, and presses the triangular bar into one of the angles of its slide, will be noticed. From the text we learn that this springing of the fine adjustment was copied from a Microscope designed by C. Varley,

Fig. 109.



which is figured and described in the same volume of the *Transactions* of the Society of Arts.* From the above account it will be seen that this first Microscope of Andrew Ross, or at least the first issued under his own name, was an excellent and thoroughly practical construction.

In 1832 we find Andrew Ross at 15 St. John's Square, Clerkenwell, and achromatic objectives bearing his name with this address upon them are still extant. In 1838 his address is 33 Regent Street.

* See figs. 72, 73, *ante*, p. 284.

Piccadilly, and in 1839 the article "Microscope" in the *Penny Cyclopædia,* written by him, was published. In this article is figured a simplified form of Valentine's Dissecting Microscope, fig. 109. It has no fine adjustment, but as there is a thoroughly well sprung rackwork coarse adjustment acting upon a triangular bar, its focussing

Fig. 110.

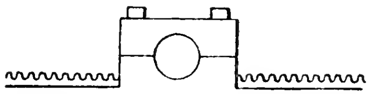
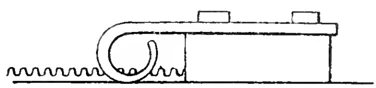
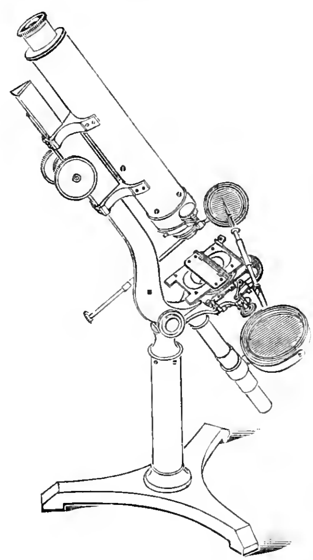


Fig. 111.



capabilities are quite equal to the work it is intended to perform. The springing of the coarse adjustment pinion of this Microscope was an advance upon that of Valentine; for while Valentine's was like fig. 110, this Microscope had one like fig. 111. This kind of sprung coarse adjustment was first used in C. Varley's Vial Microscope, made by Hugh Powell in 1833, and it is even now by far the best method of mounting the pinion; but it has been given up by all manufacturers except Powell. This instrument is very portable, for the pillar unscrews from the foot, the mirror unships, and the two screws seen at the back liberate the stage, which can be packed flat in the case. This Microscope is also figured in vol. iii. p. 220 of the *Quarterly Journal of Microscopical Science* (1855).

Fig. 112.



The next Microscope, a compound, fig. 112, is also figured in the *Penny Cyclopædia.* The foot and pillar are similar to those of the dissecting stand, but the feature that at once attracts attention is the Lister limb supporting a cradle which carries the body. It has been thought that this form of mount was suggested by Mr. G. Jackson; but we learn, from a note in the *Quarterly Journal of Microscopical Science,** that the editors have Mr. Jackson's authority for saying that it was originally made by Mr. Ross. The fine adjustment is of the short lever nose-piece type. Although the name of the inventor of this kind of fine adjustment is not stated, it is pretty certain that it was Andrew Ross. James Smith fitted a somewhat similar arrangement to one of his early Microscopes in 1839. The stage is mecha-

* Vol. i. p. 219 (1853).

nical, with rectangular motions performed by two racks and two pinions, both pinions being at right angles to the stage, in which respect Smith's Microscope was also similar. An achromatic condenser could be fitted beneath the stage instead of the rotating diaphragm. The compass joint was supplied with a screw clamp to fix the instrument at any inclination.

Fig. 113.

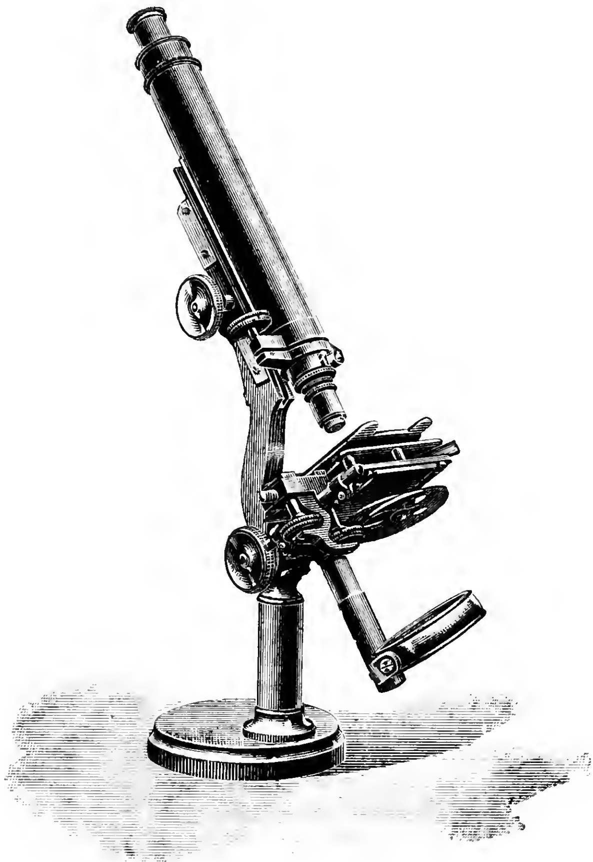
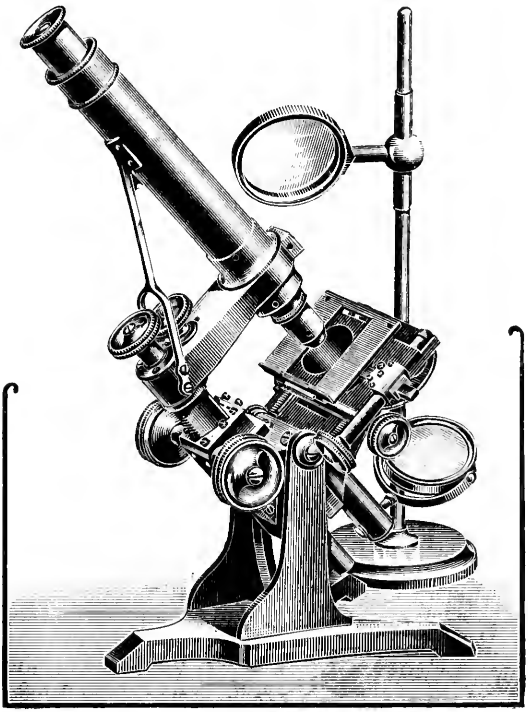


Fig. 113 shows the next stage in the evolution of Ross's Microscopes. Here the Lister limb is retained, but the cradle is dispensed with, the limb itself being grooved and the rack attached to the body. This capital form of mount was designed by Mr. Jackson, but it is impossible to say who was the first manufacturer to carry it out practically. We know that both Powell and Smith adopted this plan in 1841, and probably Ross made this Microscope in that year. The fine adjustment and the stage remain as before; the lower part of the stage is better seen in this figure; the rotating diaphragm is attached to a plate, which slides in grooves below the stage; it is removable. and an achromatic condenser can be inserted in its place. The large lower milled head is the clamp of the compass joint. The foot is circular and capable of rotation, so that the greatest amount of stability can be secured when the instrument is used in either an inclined or a vertical position. This excellent idea, which was first introduced by Cuff in 1765, is still carried out.

Fig. 114.

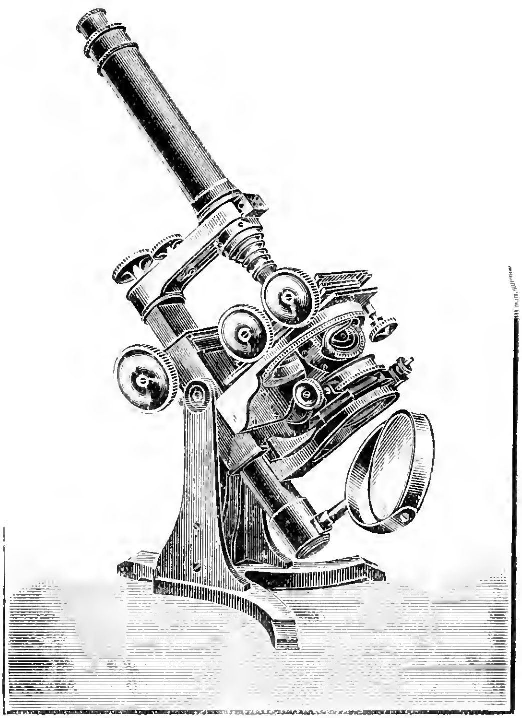


Andrew Ross's next model was constructed upon a totally different plan, as we can see from fig. 114, which is copied from a very rare book, the *London Physiological Journal* for Dec. 1843. This figure is so clear, and the model so well known, that a description is superfluous; the following improvements may however be pointed out. The hanging of the instrument between two supports is far preferable to the former method of fixing it upon the top of a compass joint; this, as we have seen, was the invention of George Jackson; its centre of gravity is lowered, and its poise is in every way better.

2 G 2

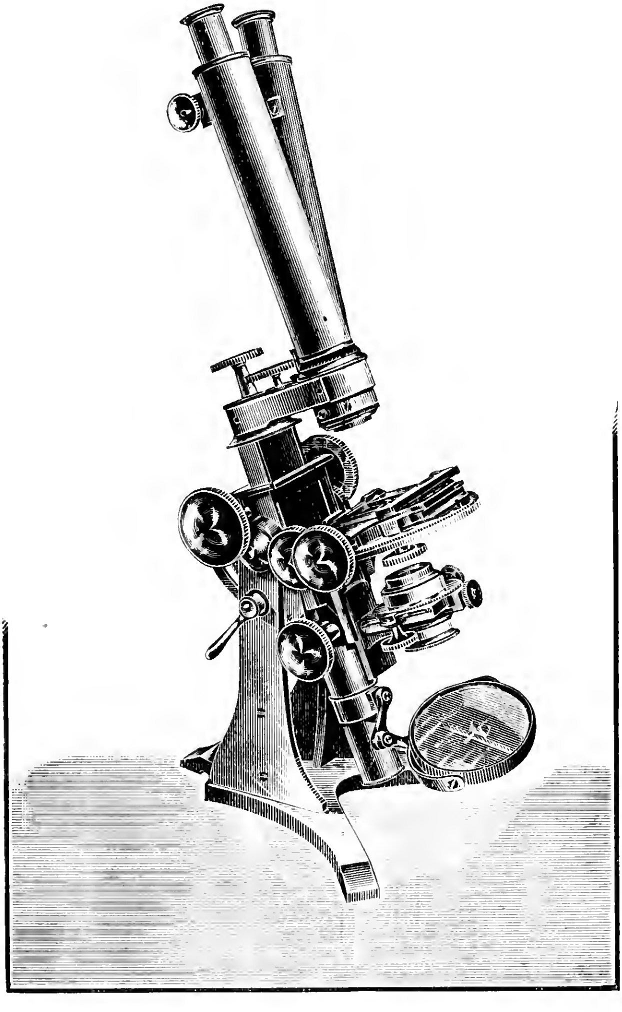
The pinions of the rectangular movements of the stage, though placed at right angles to one another, are both in the same plane as the stage. By placing the fine adjustment lever inside the transverse arm, a far steadier movement is secured. The coarse adjustment, obtained by racking a well sprung and stout triangular bar out of the limb, is a very sound construction, which yields a smooth and steady movement, and which also possesses the advantage that the milled heads of the pinion are brought down closer to the table. Compare this with figs. 112, 113. The substage arrangements are

Fig. 115.



the same as in the previous model. There is one feature this Microscope possesses which has been generally overlooked, viz. that the body, together with its transverse arm, can be removed, a plain arm can be substituted for the purpose of carrying a single lens or a Wollaston doublet, so this instrument can be used either as a simple or compound Microscope. About 1847 Andrew Ross moved to 2 Featherstone Buildings, Holborn, and about 1850 a new model was brought out; but fig. 115, taken from the 2nd edition of Quekett (1852), plate 11, dated 1851, shows that the general form of the instrument remained much the same as it was before. The following alterations may be enumerated :—1st, a rectangular bar was substituted for the triangular bar in fig. 114, and the back-stay to the body was omitted; 2nd, the pinions controlling the rectangular stage movements were

Fig. 116.



placed parallel instead of at right angles to one another; 3rd, concentric rotation was added to the stage; 4th, a complete substage with rectangular and rotary movements was supplied.

It is highly probable that this model was prepared for the Exhibition of 1851; but we are unable to obtain any information on the subject from the Report of the Jurors of the Microscopical section. This was the last Microscope Andrew Ross designed. He died in 1859, and was succeeded by his son, Thomas Ross.

Thomas Ross prepared for the Exhibition of 1862 a new model very similar to the previous one, the chief difference being the addition of a binocular body, fig. 116. This form of binocular, which was invented by Wenham in Dec. 1860, is by far the best of all the contrivances that have as yet been introduced. The stage was made a little thinner, and the diameter of the substage tube was altered from 2 in. to 1·527 in.

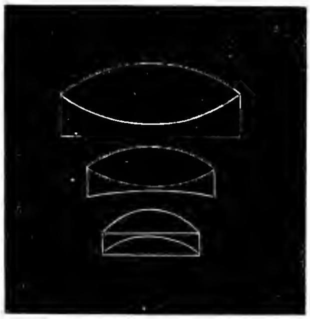
On March 15th, 1843, Ross delivered the Microscope which had been ordered by the Microscopical Society of London on May 26th, 1841; but unfortunately we are now unable to determine what that Microscope was like, because it was exchanged in 1863 for the binocular Microscope in our cabinet, which was made by Thomas Ross, fig. 116. The original Andrew Ross model must have been like either fig. 113 or fig. 114. If we assume that it was like the latter figure, which was then an entirely new pattern, some time must have been taken with alterations and adjustments, and so the delay in its delivery would be accounted for.

THE OBJECT-GLASSES OF ANDREW ROSS.

The first achromatic Microscope object-glass constructed in this country was made to the order of Dr. Goring by W. Tulley, the telescope maker, of Islington, in 1824; it was an uncemented triplet, and cost 90*l*. Mr J. J. Lister, in 1824, began experimenting with achromatic object-glasses; on seeing a 4/10 and a 2/10 which Tulley had made for Dr. Goring, he suggested some improvements, the result of which was the production of the celebrated 9/10 by that firm. Subsequently Mr. Lister ground and polished lenses himself. On January 21st, 1830, he read his paper on the two aplanatic foci before the Royal Society. In 1837 he designed an 1/8 object-glass for Andrew Ross. This had a triple front (Mr. Lister's invention) and two doublets (fig. 117); for the lower powers he suggested a double combination, which was formed by combining a front (one of Andrew Ross's failures) with one of Lister's backs (this is Lister's own account; but, according to Ross, it was a Lister front that was combined with a Ross back). I am rather inclined to think that there is a clerical error in Lister's account, and that Ross is correct. If this is so, then the lens will have a back similar to the middle combination of the lens in fig. 117 and a front of the form shown in fig. 121. In 1840 Lister obtained Ross's consent to instruct James Smith in the construction of object-glasses; he says, "even in 1843 it was with the understanding that he should not go to deeper powers than 1/4 in., and 'Smith's quarters' were long in repute. Some variations too have been since made in the construction in which I have had no part; but for all, the principle of the two aplanatic foci has furnished the clue."

Andrew Ross began making Microscope object-glasses in 1832; the following list gives a tabulated history of his work. One of his

FIG. 117.



most important discoveries was that of the aberration caused by the cover-glass (1837), and its method of correction by lens distancing was suggested to him by Mr. Lister's paper on the two aplanatic foci. In 1849 Ross added a correctional collar to the Gillett's condenser; he was also the inventor of the silver side reflector in 1836.

In 1855 Mr. Wenham made the correcting collar of objectives in such a manner that it moved the back lenses of the combination

FIG. 118.

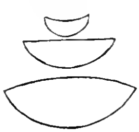
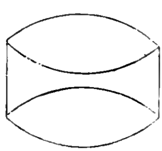


FIG. 119.



instead of the front; this constituted a real advance, and this plan has now become general; it is mentioned here because Ross made lenses from formulæ supplied by Mr. Wenham. In 1850 Ross made a chromatic condenser consisting of three lenses; the front was a hemispherical meniscus, the middle a plano, and the back a crossed lens; this lens was designed by the Rev. W. Kingsley, professor of mathematics at Cambridge (fig. 118). It was a very good condenser for a non-achromatic one, and its performance was not unlike Abbe's three-lens condenser; it however did not become popular here, as the achromatised condenser was preferred.

Date.	Focus.	Angular Aperture.	N.A.	Character.	Remarks.
1832	1	14°	·12	Two achromatic doublets	Made for Mr. R. H. Solly.
1833	1	18°	·16	Uncemented triple	Tulley's form.
1834	1/4	55°	·46	.. ..	Belonged to Prof. Quekett.
1836	1	15°	·13	Cemented triple	Fig. 119.
1837	1	22°	·19	Designed by Mr. J. J. Lister	Fig. 117.
,,	1/8	64°	·53		
1842	1/2	44°	·37		
,,	1/4	63°	·52		
,,	1/8	74°	·60		
1843	2	10°	·09		*London Physiological Journal.*
,,	1/6	66°	·55		
,,	1/12	90°	·71		
1844	1/8	85°	·68	Copied from objectives constructed by Prof. Amici	
,,	1/12	135°	·92		
1848	2	12½°	·11		From 1st edition of Quekett.
,,	1/12	120°	·87		
1851	1	27°	·23		Report of Jurors, Exhibition 1851.
,,	1/2	60°	·50		
,,	1/5	113°	·83		
,,	1/8	107°	·80		
,,	1/12	135°	·92		
1852	1/4	75°	·61		2nd edition of Quekett.
,,	1/4	105°	·79		
,,	1/12	150°	·97		
1855	1/2	65°	·54		3rd edition of Quekett.
,,	1/4	120°	·87		
,,	1/6	135°	·92		
,,	1/8	150°	·97		
,,	1/12	170°	·99		

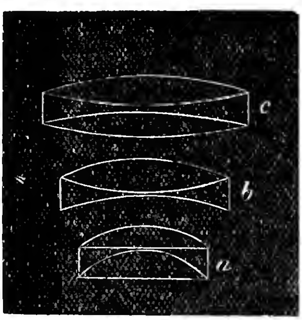
The following (see next page) are in the possession of the author. The numerical apertures and the optical indices are from actual measurement.

It is very difficult at this date to ascertain who was the inventor of the various improvements in objectives; nothing was published about any improvement at the time of its introduction, and much secrecy was observed. I should be disposed to regard Ross's 1832

Date.	Focus.	N.A.	O.I.	Character.	Remarks.
1836	1	·14	12·7	Cemented triple, fig. 119	Address, 15 St. John's Sq., Clerkenwell.
,,	1/2	·19	7·9	,, ,,	
Post 1837	1	·21	16·7	Two doublets and triple fronts, fig. 117	A fine lens.
Ante 1837	1/2	·28	12·7	Three doublets	Well corrected. Address, 33 Regent St., Piccadilly.
,,	1/4	·40	9·5	Ditto, ditto. No correction collar	Well corrected.
Ante 1847	1/4	·54	9·8	Correction marked, covered and uncovered. Two doublets and triple front, fig. 117	Well corrected.
1854	1/6	·93	12·9	Three doublets and single front. An early example of single front lens. The mount, which is dated, is very massive, and weighs 4 oz. A fair lens. Correction collar graduated	
Circa 1840	1/12	·81	6·2	Correction marked covered. Triple front, triple back, double middle, fig. 120	Well corrected.
1856	1	·21	19·1	Two doublets, front fig. 121, back same as middle, fig. 117	Not so good as 1-in. above; lens is dated.

objective as a copy of a Continental one, and his 1833 objective as a copy of Tulley's. The triple front, fig. 117, was undoubtedly due to Mr. J. J. Lister.

FIG. 120.

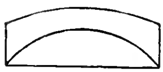


Mr. Wenham, writing * in 1869, claims to have been the inventor, about the year 1850, of the single front; but in an article written by him for the third edition of Quekett in 1855, he does not even mention

* Mon. Micr. Journ., i. (1869) pp. 111, 170.

the single front. The lens figured by Mr. Wenham in his 1869 paper has a single front, a double middle, and a triple back (fig. 122); he states that the triple back was the invention of Mr. Lister in 1850. He alters * this form of lens in 1873 to a single front, a triple middle, and a single back, the whole of the corrections being performed by the single flint in the centre of the triplet. I have an example of this kind of lens, and have seen many others, but cannot say that they are better than the (1854) 1/6 with the single front and the three doublets.

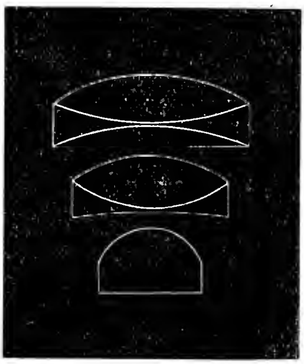
FIG. 121.



Personally I am inclined to believe that the triple back is older than 1850, and it is doubtful if it was the invention of Mr. Lister, as he makes no mention of it. A good many improvements in objectives were undoubtedly due to Prof. Amici.

The optical index which equals $\frac{\text{N.A.} \times 1000}{\text{Initial power}}$ reveals the true character of a lens, and shows the real advance made in object-glass construction. Example :—The 1/4 (before 1837) has an O.I. of 9·5,

FIG. 122.



and that of 1847 one of 9·8, only a slight difference; this is accounted for by the fact that the older lens is a true 1/4, while the later is between a 1/5 and a 1/6 in power, so that the ratio of aperture to focus is about the same in both. In the 1 in. lenses we have an advance from 12·7 to 16·7, and then to 19·1. We may compare these old lenses with the modern apochromatics, 1 in. O.I. 28, 1/2 O.I. 32, 1/4 O.I. 22, 1/6 O.I. 15, this last lens being not so greatly different from the 1/6 of 1854.

Andrew Ross died in 1859.

* Mon. Micr. Journ., ix. (1873) p. 157.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, Etc.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Cell-Cleavage and Phylogeny.‡—Prof. E. B. Wilson has reprinted his lecture on this subject delivered at Wood's Holl Marine Laboratory in 1898. Its object is to prove that the different stages of cell-cleavage display definite homologies in different forms, and illustrate what he aptly calls "ancestral reminiscences." It has long been known that the cleavage in Polyclades strongly resembles that in Annelids and Molluscs; but a great difficulty has been that, in spite of the similarities in the cleavage, the resulting quartets give rise to different structures in the different groups, this being especially the case with regard to the mesoblast. Some part of the difficulty is, however, obviated by the recent discoveries of Lillie, Conklin, the author, and others, which tend to show that the mesoblast-bands of the annelid or gasteropod are not represented in the polyclade, but are neomorphs which have more or less completely replaced the ancestral mesoblast. The evidence for this is discussed in some detail, and the author's general conclusion is that during the process of cleavage there is illustration of "ancestral reminiscence" similar to that clearly manifested by such structures as the primitive streak in the egg of a bird, and the yolk-sac in the mammalian egg.

Centrosome and Chromosomes.§—The late Mr. B. B. Griffin conducted an elaborate series of researches on maturation and fertilisation phenomena, with special reference to the centrosome and the process of reduction, and his MS. has been published by Prof. E. B. Wilson, under whose direction the work was carried out. The material consisted of the

* 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, Reproduction, and allied subjects.

‡ 'Cell-Lineage and Ancestral Reminiscence,' Boston, U.S.A., 1899, 42 pp., 5 figs.

§ Journ. Morphol., xv. (1899) pp. 583–634 (4 pls. and 2 figs.).

Echinroid *Thalassema mellita* Conn, and of the "boring clam," *Zirphæa crispata*. In both cases the astral systems agree closely with Boveri's descriptions for *Ascaris*. There is a central focal granule (centriole) surrounded by a cloudy area (the centrosome), which is again enclosed by the clear centrosphere with its dense crown of astral rays. But of these parts it is the focal granule which alone meets Boveri's definition of the centrosome—"the single permanent cell-organ which forms the dynamic centre of the cell, and multiplies by division to form the centres of the daughter-cells"; it is the focal granule alone which persists throughout all stages, divides, and apparently initiates mitotic activity. Rays, centrosphere, and cloudy area, are formed only during prophases and metaphases; when the anaphase begins they break down and disappear, while the centrosome migrates to the periphery of the sphere, and sets up a new system.

In both *Thalassema* and *Zirphæa* a reducing division occurs. In the former case the first polar division is a longitudinal (equation) division, the second a transverse (reducing) division. In the latter the same process seems to occur, but it is not possible to say which division is the reducing division. In the occurrence of a reducing division the two forms resemble Insects and Copepods.

Mitotic Figures in Ovarian Ova of Mammals.*—Herr J. Sobotta comments upon an observation of A. Spuler's † that he saw a spindle figure in an ovum in the ovary of a pregnant guinea-pig—an observation from which he drew the conclusion that ovarian ova in mammals may divide by mitosis. Sobotta has also seen central spindles in the ovarian ova of the mouse, but he is convinced that these represent the first directive spindles. In the mouse, according to Sobotta, the first polar division is usually suppressed and only one polar body liberated.

Structure of Ovary of Rabbit.‡—M. Charles Honoré has investigated those structures in the follicular epithelium of the rabbit, which were first described by Call and Exner, and later named "epithelial vacuoles" by Flemming. The author finds that they have an intercellular origin, and are to be regarded as a special product of the activity of certain cells of the granular membrane of the Graafian follicle. They are primitively compact and homogeneous, but become vacuolised by imbibition of liquid. This vacuolisation occurs at the time when the follicular liquid is secreted by the granular layer, and the bodies appear to exercise an influence on the rupture of the cellular partitions which extend from the *discus proligerus* to the parietal granulosa. The bodies pass out of the follicle at its dehiscence, and take no part in the formation of the corpora lutea.

In a further communication the author discusses the formation of the corpora lutea. He finds that the follicular epithelium persists intact until the rupture of the follicle, and shows no trace of degeneration. The yellow cells of the corpora lutea are the epithelial cells of the follicle which have become hypertrophied. This hypertrophy, together with the interpenetration of connective-tissue, accounts for the increase in volume of the corpus luteum as compared with a freshly ruptured

* Festschr. Phys. Med. Ges. Würzburg, 1899, pp. 186–292 (1 pl.) See Zool. Centralbl., vii. (1900) p. 380. † Verhandl. Anat. Ges., 1899, p. 22.
‡ Arch. Biol., xvi. (1900) pp. 537–99 (3 pls.).

follicle. There is no increase in number of epithelial cells. The connective-tissue which penetrates into the follicle arises chiefly from the theca interna, and to a less extent from the theca externa. Of the cells arising from the former, some but not all are transformed into little fusiform cells which penetrate between the epithelial cells. The vessels of the corpus luteum arise from the vessels of the theca.

Ovarian Ova in Mammals.*—Herr J. A. Amann describes the ovary of a woman of sixty-three, in which there appeared to be a formation of primitive ova and structures like primary follicles.

Prof. W. Flemming † describes the ovarian ova of the rabbit, the reticular junctions of the coiled threads of the cytoplasm, the formation of yolk-granules in the threads and their passage out of them as they grow larger, the membrane of the germinal vesicle, and, in short, the general structural features.

Transplantation of the Ovary.‡—Sig. C. Foa has experimented with rabbits. An adult ovary if transplanted degenerates rapidly; the embryonic ovary, on the other hand, may flourish and develop if transplanted to appropriate new surroundings. An embryonic ovary transplanted into an adult female develops and gains the state of sexual maturity much sooner than one transplanted into a young immature female. Thus it abbreviates the normal period of development. If an embryonic ovary is transplanted into a female at the period of the menopause, it is rapidly absorbed and disappears. The author refers to the interest of these experiments in connection with the "autonomy of the germ-plasm in respect to the somatoplasm;" but it will surely be difficult to find any one, certainly not Weismann, who believes in what this phrase suggests.

Spermatogenesis in Mammals.§—Prof. V. von Ebner confirms his previous conclusion that the spermatocytes of mammals (the rat) show two divisions in rapid succession, with a short resting stage between. The first division is heterotypic, the second homöotypic. In the first there are in the prophases 8 annular chromosomes and in the anaphases 16; in the second the number of chromosomes increases from 8 to 16, and becomes 8 in the anaphases. Neither can be interpreted as a reducing-division in Weismann's sense. The author proceeds to discuss the volumetric relations of the chromatin at different stages.

Spermatogenesis in Sparrow.‖—Gustave Loisel begins with an account of the prespermatogenetic period in *Passer domesticus*, a period in which there is enormous increase of size. Spermatogonia of the first order began to multiply rapidly about the end of February or the beginning of March, and the multiplication is exclusively by direct division. The history is continued from spermatogonia of the first order to those of the second order, and from these to spermatocytes. Then follows the period of retrogressive change or metaspermatogenesis. The spermatozoa almost always degenerate in the course of a kinesis, but the previous multiplication is amitotic.

* Festschrift C. v. Kuppfer, Jena, 1899, 14 pp. and 1 pl.
† Tom. cit., pp. 320–4 (1 pl.). See Zool. Centralbl., vii. (1900) pp. 413–4.
‡ Atti R. Accad. Lincei (Rend.). ix. (1900) pp. 230–2.
§ SB. K. Akad. Wiss. Wien, cviii. (1899) pp. 429–47 (1 pl. and 21 figs.).
‖ Journ. Anat. Physiol., xxxvi. (1900) pp. 160–85 (7 figs. and 4 pls.).

Spermatogenesis in Batrachoseps.*—Dr. G. Eisen publishes a preliminary account of the spermatogenesis in *B. attenuatus*. The testes contain four distinct kinds of cell—polymorphous spermatogonia, auxocytes, spermatocytes, and spermatids, which originate from one another in the order mentioned. There are, after the polymorphous spermatogonia, four generations of round cell spermatogonia, then auxocytes, &c. He describes the various constituents of the cells and uses a somewhat complex nomenclature. Even if we restrict attention to the fibres, we are confronted with mantle fibres, polar fibres, central spindle fibres, contractile fibres, retractile fibres, and fibre cones. In the mitoses, a radiosomic and a chromosomic process are sharply distinguished. The cytosome proper contains no permanent structures of any kind. The plasmosphere, hyalosphere, granosphere, the various kinds of fibres, as well as the central spindle, are all ephemeral structures which are developed by re-arrangement of pre-existing granula, and which again disperse when their function is over. The granula are of at least four different kinds, and one kind is never converted into any other.

Dental Ridges in Birds.†—Dr. H. D. Tjeenk Willink finds that in *Gallinula chloropus*, *Sterna hirundo*, *St. cantiaca*, *Hæmatopus ostralegus*, *Œdicnemus crepitans*, and *Numenius*, there are, in the mouth-cavity, besides many other ridges and thickenings, two lateral ridges, the so-called dental ridges. In *Numenius* they are seen only for a short period of embryonic life; in *Limosa ægocephala* they are altogether absent. The ridges do not appear to have any embryonic function. In *Numenius*, especially, they are vestigial structures. They occur in the position of dental ridges, and each arises as a thickening of the epidermis, which first projects from the epidermis, and later on sinks deeply into the mesoderm. They are certainly vestigial dental ridges. The author also discusses the other ridges, e.g. the lip-ridges and the egg-tooth.

Experimental Embryology.‡—E. Bataillon has experimented with the eggs of the lamprey (*Petromyzon planeri*), subjecting them to isotonic saline and sugar solutions. The segmentation is much changed in response to the altered conditions of osmotic pressure. The results seem independent of the chemical nature of the solutions.

The third plane of cleavage, which is normally horizontal, is always vertical in the solutions. The early segmentations tend to be unequal, recalling those in *Nassa* and some other Molluscs. The altered rate of development (delayed), the irregularities of cleavage, the point of arrest, seem all to depend on the osmotic pressure. Some experiments on compression between vertical plates are also reported.

Experimental Polyembryony. § — E. Bataillon has observed the results of transferring fertilised ova of *Petromyzon planeri* to solutions of sugar (10 per cent) or of salt (1 per cent,) for eighteen hours, and then returning them to ordinary water. The changes in the egg's osmotic pressure thus induced bring about a separation of blastomeres; the first two or three proceed to develop in isolation. Thus he observed in

* Biol. Bulletin, i., No. 2, 1900, pp. 99–113 (16 figs.).
† Tydschr. Nederland Dierk. Ver., vi. (1899) pp. 243–54 (1 pl.).
‡ Comptes Rendus, cxxx. (1900) pp. 1413–5. § Tom. cit., pp. 1480–2.

one case three gastrula-rudiments, each with its blastopore. He believes that most double or multiple monstrosities may be attributed to an early mechanical separation of the first blastomeres under the influence of an excess of osmotic pressure.

Experiments in Grafting Tadpoles' Tails.* — Mr. R. G. Harrison has followed Born in his grafting experiments, and has obtained a number of interesting results.

The embryos of *Rana virescens* and *Rana palustris* are markedly different in colour. The specific coloration, which is due to pigment and yolk granules, is common to all cells. In heteroplastic combinations of embryos of these species, made according to Born's method, it is, therefore, possible to follow in the living specimen, as development proceeds, the movement of any group or layer of cells with respect to the original dividing line between the two constituents.

The combination of body and head of one species with the embryonic tail-bud of the other, gives the following information concerning the mode of growth of the tail :—(*a*) The epidermis passes steadily from the body to the tail, shifting over the underlying structures, so that one week after grafting the original epidermis of the tail-bud covers only about one-third (the tip) of the tail. (*b*) The musculature, spinal cord, and notochord, increase in length, largely by apical growth, and also, to a much less extent, by the pushing of segments (about three) out from the trunk to the base of the tail.

In the trunk region, the shifting of the epidermis over the underlying organs becomes less in amount as the head is approached. The movement of the epidermis is due to the tension brought about by the rapid apical growth of the tail, and the absence of a corresponding proliferating centre in the epidermis at the tip. The oblique course taken by the cutaneous nerves of the trunk and tail of the full-grown larva and frog, in passing from the vertebral column to their ending in the skin, is due to the ontogenetic shifting of the latter from its original position.

After amputation of the tail, the peripheral nervous system is regenerated from the spinal cord. First, a single nerve pair arises from cells lying within the cord. Some of these cells pass out upon the nerve-root and form a large ganglion. Later, a few of the nerve-cells wander further peripherally along the nerve-trunk, forming several (at most three) ganglionic cell-groups. These represent the more distally situated ganglia, lost in amputation, which are never entirely replaced.

The oral end of an amputated tail-bud has a considerable regenerative capacity when the bud is transplanted by its distal end to the body of another individual. The structure then regenerated is tail-like in form, no matter to what part of the body it is attached. When transplanted so as to replace a normal tail, the resemblance to the latter may become striking. The perfection of the part as a swimming organ is in such cases dependent upon the exactness with which the corresponding tissues of the respective components are united. If the union is imperfect, forked tails result. The cases in question are not regarded as

* Bull. Johns Hopkins Hospital, x. (1899) pp. 173–94 (2 pls. and 21 figs.). See Arch. Entwickmech., vii.

heteromorphoses (tail in place of head and trunk), for the tail-like appendage is to be considered as an imperfectly regenerated trunk.

The position of the reversed tail-stump with respect to the rest of the organism is of importance during regeneration only in so far as it influences the degree of efficiency of the structure regenerated. Neither the present nor other experiments indicate that the influence of the organism as a whole upon the regenerating part is able to bring forth a heteromorphic structure, functionally adapted out of material which would produce something else.

In combinations between embryos of two species, each component maintains its specific individuality. The modifications which may arise in either of the components are not of the nature of a blending of specific characters. In combinations where the tail alone is replaced by a tail of the other species, the latter forms at first a perfect substitute for the original tail. But later on it atrophies and disappears almost entirely, long before metamorphosis. When a small portion of the trunk is transplanted along with the tail, atrophy of the latter is considerably delayed. Also when the two components are united in the region of the pronephros, the composite larva grows normally, and may remain healthy and vigorous for many weeks. Only in one case, however, did such a specimen complete its metamorphosis. The frog had perfectly normal instincts and power of co-ordination. The portions derived from each of the two species could nevertheless be distinguished clearly by their colour-markings and other specific characters.

Variations in the Position of the Chick Embryo.*—Dr. Ch. Féré remarks on the frequency with which the embryo of the chick may vary in orientation. This may occur without known reason, and it tends to increase the likelihood of other abnormalities. In many cases, however, the anomaly of orientation is apparently unassociated with any other abnormalities.

Development of Bdellostoma Stouti.†—Dr. Bashford Dean gives a general account of the development of this Myxinoid from the egg to the time of hatching. After describing the spawning in *Bdellostoma*, he discusses the question of protandrous hermaphroditism in *Myxine*, which he holds to be unproved. The ovum of *Bdellostoma* is then described, and the mode of development outlined. Then follow descriptions of fertilisation, segmentation, the blastula, the gastrula, the early and later embryos, and the newly hatched young. There are special notes on integument, teeth, skeleton, nervous system, and viscera, &c. Then follow general conclusions.

The striking dissimilarity in the plan of development of Hyperotretes and Hyperoartes points to a division of the Cyclostome phylum. The few and yolk-filled eggs of Myxinoids contrast strongly with the many and holoblastic eggs of the lampreys.

The plan of gastrulation in *Bdellostoma* is highly specialised; the great bulk of yolk has played the usual part in modifying the mode of appearance and the physiological relations of the embryo; the origin of the periblast-like nutritive layer parallels in an interesting way the con-

* Journ. Anat. Physiol., xxxvi. (1900) pp. 210–6.

† Festschrift C. von Kuppfer, Jena, 1899, pp. 221–76 (12 pls. and 25 figs.).

ditions in Selachians, or even in Teleosts, although, unlike what occurs in the latter, specialisation has not proceeded so far as to cause the development of a definite germ-ring. In no developmental characters, perhaps, do the two types of Cyclostomes stand more widely apart than in the processes connected with gastrulation.

The origin of the lumen in the central nervous system of the Myxinoid by infolding medullary folds is a feature of the greatest significance. For evidently, if this character has here been retained, in spite of the unfavourable conditions of yolk and of restricting membranes, it is clearly of great palingenetic value. The great length of the brain in the embryos of *Bdellostoma* is also important. As to auditory and optic organs, there is no tangible evidence of degeneration; the Myxinoid gives little ground for the belief that the pineal eye was a primitive character of the Craniota; nor is there any obvious evidence that an embryonic series of end-organs is present comparable to a distinct lateral line.

The head-structures in *Bdellostoma* are strikingly different from those in the lamprey. The noteworthy flattening of the head at early stages has borne with it the modification of the stomodæal region, and, for the present at least, it is impossible to say to what point in the mouth-region of a young hag the primitive ectoderm extends. The actual mouth is clearly a neomorph, and the "velum" is in a far more superficial position than the velum of the lamprey. As to the hypophysis, the evidence is clearly favourable to the view of von Kuppfer as to its palæostomal nature. The fact that its posterior part is distinctly paired recalls the early work of Dohrn in homologising the structure with gill-slits. The embryonic nasal sacs arise from the early *Nasenrachengang* as paired structures.

The resemblance of the embryonic mouth to that of a Gnathostome is very striking. Every step of transition occurs between the narrow transversely directed mouth-cavity of the embryo and the constricted and barbel-filled oral lobe of the adult.

No structures directly comparable to visceral arches occur at any stage. The various skeletal elements which occur in late embryos in the hinder region of the head have probably arisen as neomorphs in especial relation to the muscles of the barbels and tongue. These elements certainly do not appear until after the gill-slits have passed entirely out of their neighbourhood. Nor is there any hint of paired fins. As regards gill-pouches, there is a closer correspondence between Myxinoid and lamprey than one would at first expect, but in general the gill-pouches of hags have retained the simpler conditions. The excretory system of Myxinoids is generally admitted to be more primitive than that of the lamprey, and this conclusion is now greatly strengthened by the discovery that a series of segmental tubules, in all probability pronephric, is found to occur throughout practically the entire body-length of the embryo.

It seems fair to conclude that the Myxinoids are not to be looked upon as forms which have become greatly degenerate. As to general morphological conclusions, the author lays emphasis on the fact that in Myxinoids branchiomery does not correspond with myomery. The suggestion is also made that the vertebrate brain is not a collection of definite neuromeres, whose number is constant throughout the series, and whose enlargement and fusions have directly accompanied regional differentiation, but that it represents a complex of colonies of nerve-cells whose elements having similar functions are gradually drawn from various body-regions to centres whose ultimate position is a matter of physiological convenience. It is the physiological convenience, accordingly, which might be looked upon as the determinant in matters of position, and it is this which becomes the criterion of the homology of parts.

It should be noted, in conclusion, that the above citations and summary cannot suggest the detailed descriptions which form the bulk of this sumptuously illustrated memoir.

Development of Amphioxus.* — Prof. E. W. MacBride returns to the much disputed question of the origin of the atrial chamber in *Amphioxus*. He finds himself in agreement with Kowalevsky as to the existence of atrial ridges, which appear at an early stage of development, and contain each a cavity which is an extension of that of the first myotome (collar-cavity). The ectoderm on the outer side of these ridges becomes thickened, and ultimately hollowed out to form the lymph canals, which the author no longer regards as of cœlomic origin. The thickenings and the contained canals are metapleural. The (cœlomic) cavities of the atrial ridges become later separated from the collar-cavities, and constitute the metapleural cœlom at each side; later this becomes filled up by cells. The atrial ridges unite beneath the ventral surface of the body, and enclose the atrium. The upward growth of the atrial chamber described by Lankester and Willey does not occur, the appearances noted by these authors being due to the disproportionate growth of the ventral part of the pharynx of the larva.

The paper, which is controversial in tone, includes a discussion of various criticisms passed on the author's previous paper.

Development of Nasal Groove.†—Dr. Karl Peter has tried to discover whether the invagination is due to a simple folding without localised growth, or is the result of local proliferation. His method involved much careful enumeration and observation of mitosis. There seems no doubt that the development is due to the proliferation of a localised growth of cells, and not to the folding of a uniformly growing plate. The mesoderm does not seem to have any influence; it is a wholly ectodermic affair; nor does the brain affect the growth. Besides mechanical conditions, there are favourable nutritive conditions to be considered, which enable the cells on the lumen side of epithelial organs to increase with special rapidity.

l. Histology.

Structure of the Cell.‡—Dr. Nils Sjöbring argues in support of the idea that the cell includes two sets of structural complexities:—(*a*) the trophoplasm, having to do with nutritive metabolism, and (*b*) the kinoplasm, concerned with motor processes. The two are apposed, not topographically separated. Like the nucleus, both are under the control of the archiplasm. The fundamental structure consists of threads and rows

* Quart. Journ. Micr. Sci., xliii. (1900) pp. 351–66 (1 pl.).
† Arch. Mikr. Anat., lv. pp. 585–617 (1 pl. and 5 figs.).
‡ Anat. Anzeig., xvii. (1900) pp. 273–304 (3 figs.).

of granules or rods, and the precise form alters with the phase of functional activity.

The Granula Theory.* — Prof. Arnold thinks that the solution of the "riddle of protoplasm" would be greatly assisted by a knowledge of the origin and importance of the "granula." During experiments on exogenous and endogenous siderosis, he came to the conclusion that the iron is contained in the cells in the form of granules. According to the current doctrine, such granules are taken up by the cells by a phagocytic process; but various facts made him doubt this interpretation, and he has made a series of further experiments by injection of soluble and insoluble iron salts into the lymph-sacs of the frog. The result of these and other observations is to lead him to the conclusion that the granules of sideroferous leucocytes are not grains of iron which have been taken up, nor precipitates which have originated within the cell, but are unaltered cell-plasmosomes, which have taken up the iron, modified it, and combined it with their own substance. Further, the arrangement of the sideroferous granules in other cells (such as connective-tissue-cells, epithelial cells, liver-cells), whether in the case of exogenous or endogenous siderosis, is the same as in leucocytes, and the granulated appearances obtained in such cells by means of methylen-blue and neutral red, are similar to those obtained in sideroferous cells—two facts which tend to confirm the view just expressed as to the origin of the "granula." As yet it is not possible to decide whether or not the plasmosomes can give up their iron without undergoing degeneration, but the research shows clearly that they are cell-organs of functional importance.

Cell Studies.†—S. Prowazek briefly summarises a series of observations which he has made on the eggs of *Echinus microtuberculatus*, and other cells and simple organisms. Immature eggs of *Echinus* show distinct "spinning activities" after fertilisation. Spermatozoa penetrate into non-nucleated fragments of immature eggs, and produce the ordinary radiating figures, but these are not followed by segmentation phenomena. In the case of non-nucleated fragments of mature eggs, segmentation may follow normally; it may become irregular at the two-cell stage: or the furrows may appear after some delay and then disappear again; or the male pronucleus may divide without the division being followed by segmentation. Non-nucleated fragments are frequently penetrated by many sperms which, within the egg, seem to be strongly attracted towards one another. By shaking segmenting eggs, various different types of segmentation, such as discoidal, superficial, unequal, can be produced. The attraction of eggs on sperms appears to be due to a substance produced in living protoplasm; for non-nucleated fragments and eggs from which the reserve substance has been removed attract sperms like uninjured eggs. The spermatozoa are to a certain extent aerotropic, but Engelmann's bacteria method gave a negative result in the case of eggs. The tails of spermatozoa when torn off are non-motile unless the middle piece is present; but if this be present, they will continue to move even if the distal end is also injured. Cilia, flagella, and the ciliated plates of *Cydippe*, on the other hand, continue to move only when the whole organ is intact.

* Anat. Anzeig., xvii. (1900) pp. 346–54.
† Zool. Anzeig., xxiii. (1900) pp. 305–9 (3 figs.).

Cytology of Rabbit.*— Dr. Hans von Winiwarter has used the epiploon of fœtal and newly-born rabbits, and the amnion in the same animal, in the study of the intermediary body (*corps intermédiaire*, *Zwischenkörper*) and of the chromosomes. He finds that at the diaster stage no trace of the structure known as the cellular plate appears, but a little later swellings appear on certain of the achromatic threads. As the daughter-cells separate, these swellings fuse together and form the intermediary body. In the amnion the intermediary body forms a spherical body in a clear space, instead of being fusiform as in the epiploon. In both cases, however, it clearly arises from the union of fusiform thickenings (the cellular plate) formed on the threads connecting the daughter-cells. These thickenings the author believes to originate by the confluence of microsomata, which, during the process, undergo chemical changes, manifested by changes in their staining reactions. As the swellings on the spindle threads fuse to form the intermediary body, this should be regarded as a rudiment of a cell-membrane, rather than (as Flemming supposes) as the homologue of the cellular plate of the plant-cell.

In regard to the number of the chromosomes, the author finds that the number 42 is most common, and is probably the typical number for somatic cells, as also for young sexual cells. Mature ova, however, appear to contain 20–24 chromosomes, or 10–12 after the formation of the first polar body. A similar condition has been described for *Ascaris* by Boveri, and possibly also occurs in man.

Giant Nuclei.†— Prof. E. Ballowitz finds that the membrane of Descemet in the cornea is an excellent object for fine histological work. Pending the publication of a paper on the subject, he notes as of special interest the occurrence there of giant nuclei. The cells of the membrane contain very large spheres, with a microcentrum containing 2–4 central corpuscles. Under the influence of the sphere the nuclei in post-embryonic life undergo a series of changes, losing their original rounded shape, and becoming kidney-shaped, semi-lunar, horseshoe-shaped, and ultimately S-shaped. Scattered among the ordinary nuclei others occur which are 1½–3 times as large, but undergo similar changes. They occupy giant-cells which occur sporadically among the other cells, and do not apparently differ from those, except as regards size. The phenomenon may be regarded as analogous to the sporadic appearance of giant spermatids or spermatozoa among those of ordinary size; this has been described for various animals by different observers. It may be a nutrition phenomenon, and is possibly associated with pluripolar mitosis.

c. General.

Thalamencephalon of Reptiles.‡— Prof. L. Edinger continues his study of the Reptilian brain, and describes the region of the thalamencephalon. The thalamus proper is distinguished from the dorsal epithalamus, and both from the ventral hypothalamus, and these parts are described in detail. The brains of about 17 species have been studied.

* Arch. Biol., xvi. (1900) pp. 685–707 (1 pl.).
† Anat. Anzeig., xvii. (1900) pp. 340–6.
‡ Abhandl. Senckenberg. Nat. Ges., xx. (1899) pp. 161–96 (3 pls.).

Fauna of Salt Lakes.* — R. Florentin has studied in detail the fauna of the salt lakes of Lorraine, with special reference to such questions as the origin of the fauna, the nature and cause of the variations known to occur in the forms inhabiting these lakes, the question of acclimatisation, and so on. He believes that too much stress has been laid on the chemical nature of the surrounding medium, in discussions on the faunas of fresh and salt water, for there is reason to believe that differences in temperature, food supply, &c., are of great importance in determining the nature of the different faunas. He also finds, in regard to forms which inhabit equally fresh-water and saline lakes, that only a small number show notable variation as a result of change of medium; most of them manifest no marked external modification. Again, a comparison of members of a species taken respectively from fresh water, the sea, and saline lakes, shows that it is not the salinity in itself which produces variation, but rather the diet and other factors, such as temperature. Thus the marine variety of *Actinophrys sol* does not occur in the lakes of Lorraine, but only the fresh-water one. On the other hand, forms like the sticklebacks, which have had marine ancestors, show in saline lakes a closer approximation to what must have been the original marine form than do the typical fresh-water forms. The complex nature of the problems involved is also shown by such facts as that varieties from saline lakes exhibit at times progressive variation as compared with the typical form, and sometimes retrogressive. On the whole, the resemblance between the peculiar species or varieties inhabiting saline lakes and those inhabiting the sea is to be regarded as a reversion to ancestral type, due to the influence of the environment rather than to passive transference of such forms from the sea to the lakes. The research, therefore, emphasises anew the plasticity of the species in a changing environment.

Colour-Change.†—Mr. F. W. Gamble gives an account of the power of colour-change in animals. He discusses the changes of colour in chameleon, tree-frog, fishes, cuttle-fish, and Crustaceans. The common striped prawn (*Leander serratus*) assumes a dark brown striping when placed in the dark or on a blackened surface, while, if transferred to a white dish, the markings first pass through a blue phase, and then become pale and almost colourless. In the case of *Hippolyte varians*, the protective coloration is well known, but there is also change of colour. In a week a green form becomes brown if transferred to brown weeds; and a rapid change from brown to green is induced by increasing the light intensity. This prawn also shows the periodic assumption of a peculiar nocturnal colour. Mr. Gamble also discusses the chromatophores and their control.

Physiological Effect of Common Salt.‡—Prof. Jacques Loeb concontinues his observations upon the effect of sodium ions. He finds that a pure solution of sodium chloride of the same concentration as sea-water acts as a strong poison to many (if not all) marine animals, the poisonous effect being due to the Na ions. This is also true for pure equimolecular solutions of calcium or potassium chloride. But in

* Ann. Sci. Nat. (Zool.), x. (1899) pp. 209–349 (3 pls. and 4 figs.).

† Trans. Manchester Micr. Soc., 1899, pp. 92–106.

‡ Amer. Journ. Physiol., iii. (1900) pp. 327–38.

ordinary sea-water, the poisonous effects of the Na ions are antagonised by the presence of Ca ions and K ions, by means of which the Na ions lose their poisonous nature. The reason is that these or other metal ions form combinations with the proteids of protoplasm, the combinations having different physical qualities. Muscles are contractile only so long as they contain the different kinds of ions in a certain proportion, and in a pure solution of sodium chloride, for example, the Ca ions and K ions will gradually be replaced by Na ions, or a loss of contractility supervenes. Dr. Warren's results in regard to *Daphnia* and the effect of sodium chloride (p. 461) should be compared with these conclusions.

In another communication,* the author shows how this method may be employed in the solution of various obscure physiological problems. From the previous results it appears that irritability depends upon the various ions existing in a definite proportion in the tissues. But each tissue has its own specific irritability, therefore each tissue must possess the various ions in different proportions—must be differently affected by variation in the ions. The method can therefore be applied to the solution of such problems as: whether the contractions of the heart are myogenic or neurogenic, for muscle or nerve-tissues contain different proportions of ions, and are differently affected by added ions; whether the phenomena of cell-division are similar to those of muscular contractility; what is the nature of ciliary motion; and so on. Among the results, one of extreme interest is the fact that the eggs of a marine fish (*Fundulus*) can be made to develop and hatch in *distilled* water.

Increase in the Size of the Cerebrum in Mammals.†—Prof. E. Ray Lankester, starting from the fact that recent forms have a greatly increased bulk of cerebrum as compared with their early tertiary or mesozoic fore-bears, makes the suggestion that the advantage of a larger cerebral mass consists in greater "educability." "A mere spoonful of cerebral tissue is sufficient to carry abundant and highly efficient *instinctive* mechanisms from generation to generation; but for the more valuable capacity of elaborating *new* brain-mechanism in the individual as the result of the individual's experience of surrounding conditions, a very much larger volume of cerebral tissue is needed." It is also pointed out that the capacity of learning by experience must (as it were) defeat and turn from its route the otherwise triumphant transformation of bodily structure. Furthermore, educability can be transmitted, being a congenital character, while the results of education cannot be transmitted. The latter have to be acquired afresh in each generation, and with increased "educability" they are more readily acquired, and a larger variety of them. On the other hand, the nerve-mechanisms of instincts are transmitted, and owe their inferiority, as compared with the results of education, to the very fact that they are not acquired by the individual in relation to his particular needs, but have arisen by selection of congenital variation in a long series of preceding generations. Instinctive and individually acquired brain-mechanisms are in opposition to one another. "The loss of instinct is what permits and necessitates the education of the receptive brain." That instincts are due to "lapsed" intelligence is a theory far removed from the truth.

* Tom. cit., pp. 383–96.

† Nature, lxi. (1900) pp. 624–5. Reprint from Jubilee Vol. of Soc. Biol. Paris, 1899.

Effect of Sterilised Air on Mammals.* — Dr. Kijanizin finds that rabbits, dogs, and guinea-pigs, when supplied with sterilised air, die in from 1½–5 days after introduction into the apparatus. Though the absence of bacteria in food greatly lowers the power of assimilation, yet death is evidently not due to this cause. Nor is it due to any toxic substance added to the air during the process of sterilisation, nor to insufficient ventilation or similar cause. The exact cause of death was for long a great puzzle, but an elaborate series of analyses showed the presence of a large amount of leucomaines in the urine, and led to the conclusion that death is due to auto-intoxication with these. This result leads the author to the following conclusion, which, as he notes, is of great importance in biological chemistry:—"In addition to the oxygen of the air, certain micro-organisms of the air are also absolutely necessary to life and to the normal (respiratory) exchange; these micro-organisms are introduced into the blood at the moment of the gaseous exchange, and are there devoured by the leucocytes. Digested by these, they constitute the source of the oxidising ferment without which the normal processes of oxidation in the organism diminish greatly, and give place to the accumulation of a large amount of leucomaines, which are intermediate products of incomplete oxidation, and lead to the death of the animal."

Æsthetic Judgments on Mammals.†—Prof. K. Möbius has entered upon a field which the zoologist usually leaves alone. After a proposal to substitute the objective word *erhaltungsmässig* for the transcendental concept *zweckmässig*, he points out that *erhaltungsmässig* is not equivalent to beautiful. He then passes the Mammals in review, and judges them æsthetically. The proportions of the different parts of the body, the real or apparent subordination of mere bulk, the attitudes, the eyes, the coloration, and so on, are discussed, and the learned author is free with the condemnation *hässlich*. His judgments are in some cases very surprising to us, but *de gustibus non disputandum est.*

Monotremes and Reptiles.‡ — Prof. V. Sixta has worked out in detail the homologies between the skulls of *Psammosaurus griseus*, *Ornithorhynchus*, and *Echidna*, and sums up his conclusions as follows. The Monotremes possess an *arcus*, a *cavitas temporalis*, an *os quadratum*, as do Reptiles. Their *os squamosale* is the homologue of that of Reptiles, and the bony labyrinth in them is almost identical with that of Reptiles, while Jacobson's organ is similar in both. In *Ornithorhynchus* the upper and under jaw have the same structure as in Reptiles. Generally the skulls of *Echidna* and *Ornithorhynchus* are built on the Reptilian plan, though in some respects they approach the Marsupial skull more nearly. The Reptilian characters are most distinct in *Ornithorhynchus*; the skull of *Echidna* has diverged from the Reptilian type, and can only be understood through that of *Ornithorhynchus.*

Aglossal Toads.§—Dr. W. G. Ridewood notes that, until the recent discovery of *Hymenochirus boettgeri*, the new aglossal toad, the genera *Xenopus* and *Pipa* occupied a very isolated position, their relations being

* Arch. Biol., xvi. (1900) pp. 663–84 (1 pl.).
† SB. Preuss. Akad., 1900, pp. 164–82.
‡ Zool. Anzeig., xxiii. (1900) pp. 213–29 (3 figs.).
§ Journ. Linn. Soc., xxvii. (1900) pp. 454–62 (1 pl.).

very doubtful. He has studied the hyobranchial skeleton and larynx of the new form, and finds that, though the former presents some unique peculiarities, it also possesses those which characterise *Pipa* and *Xenopus* as contrasted with all Phaneroglossal Anura. The larynx of both sexes is of simpler structure than that of the two sexes of *Pipa* and *Xenopus*, but presents resemblances to those of both genera. On the whole the structure of hyobranchial skeleton and larynx in *Hymenochirus* tends to confirm the view that the Aglossa constitute a natural group, and that the three genera now composing it have had a common ancestry.

In a note the author mentions the interesting fact that the carpus in the new genus has the same structure as in *Pipa*; that is, a single bone only intervenes between the ulna and the fifth metacarpal, instead of two as in *Xenopus* and all other anurous Amphibia.

Nasal Secretory Sacs in Teleostei.*—Mr. H. M. Kyle has found in *Cynoglossus semilaevis* that the nasal organs which are placed symmetrically on each side of the head communicate with a single large sac occupying an area over the median portion of the roof of the mouth. In one specimen examined, and termed by him "divergent," which may be the type of a separate species or even genus, the roof of the mouth is perforated by a large oval opening passing into a chamber corresponding in position to the median sac in the ordinary forms, from which two tolerably large canals pass to the nasal cavities, forming an effective means of communication between the exterior and the mouth.

The presence of nasal "sacs" is an adaptation to semi-sedentary as opposed to migratory habits of life. In *Labrus*, *Scorpæna*, *Gastrosteus*, and *Anarrhichas*, forms leading a tolerably quiet life, simple water-retaining "reservoirs" are present. These are absent in the Gadidæ, as far as examined, and also in the herring—free-swimming migratory forms. In the halibut, plaice, and turbot, which are ground feeders, searching for their food almost entirely by the sense of smell, definite *secretory* sacs are present.

In the Sole group, the tactile sense, as shown by the development of papillæ and filamentous outgrowths of the integument, aids and replaces the olfactory organ to a certain extent, and here the secretory has given place to the water-retaining function.

In the normal *Cynoglossus* the sacs, and in the "divergent" specimen the nasal cavity, have the water-retaining function, and are not secretory.

The homology of the naso-pharyngeal communication in *Cynoglossus* with the internal nares in other Vertebrates, and with the condition in Cyclostomes, is discussed.

Air-bladder in Notopterus borneensis.†—Prof. T. W. Bridge figures and describes the air-bladder of this species, with special reference to its connection with the auditory organ. He finds that there is no direct contact between the walls of the auditory cæca and those of the utriculi, the two being separated by the membrane of the auditory fontanelles; nor is there any open tubular communication between the utricular and the saccular portions of the auditory organs of the opposite sides of the

* Journn. Linn. Soc., xxvii. (1900) pp. 541–56 (1 pl.).
† Tom. cit., pp. 503–40 (2 pls. and 1 fig.).

head. During a part of their course the auditory cæca are enclosed in bony grooves, and for the terminal portion of their extent occupy the interior of bony culs-de-sac. In this respect they recall the condition seen in the Clupeidæ, as also in the fact that they originate from an anterior tubular portion of the air-bladder. In a discussion on the significance of the connection between auditory organs and air-bladder in Teleosts, the author comes to the conclusion that, though there can be no doubt that the connection has physiological importance, yet at present the exact significance cannot be definitely determined.

Copulatory Organ in Cottus gobio.*—Dr. Georg Surbeck notes that the fact that the male of this species has—at least during the breeding season—a distinct penis has hitherto been apparently overlooked. The structure is apparently produced by a papillary elevation of the skin, and bears the urinogenital pore at the tip; it reaches a length of about 3 mm. The presence of this structure would suggest that fertilisation is internal.

Urogenital Organs of Polypterus and Amia.†—Prof. H. F. E. Jungersen notes, *inter alia*, that in *Polypterus bichir* the *vasa deferentia* are essentially like those of Teleosts, but quite different from those in *Lepidosteus* and *Acipenser*. In the two last the extra-testicular network communicates directly with the malpighian corpuscles of the kidney; in *Amia* the chief connection is with the ureter; in *Polypterus* the extra-testicular network is separate even from the ureter, as in Teleosts. A general description of the urogenital system is given.

Tunicata.

New Composite Clavelinid.‡—Maurice Caullery points out that among social Ascidians there is a tendency to become composite. He illustrates this by the series (a) *Clavelina lepadiformis*, (b) *Podoclavella*, (c) *Stereoclavella*, (d) *Pycnoclavella*.

In the Paris Museum collection he has found two forms—species of what must be made a new genus (*Synclavella*)—in which the various individuals are *completely imbedded in a common tunic*. Individually and developmentally they are true Clavelinids, but their mode of cormogenesis shows that the distinction between social and composite has not much meaning.

Structure of Tail in Appendicularidæ.§—Prof. Oswald Seeliger has studied this organ with special reference to the question of the existence of segmentation. He finds in the first place that, in regard to the structure of muscles and nervous system, the species of *Fritillaria*, of *Oikopleura*, and of the other known genera, show similar conditions. The muscular system consists of a one-layered cell-plate, lying free in the primary body-cavity (segmentation cavity), and composed of segments which may (*Fritillaria*) consist of the ten muscle cells, each cell constituting a segment, or (*Oikopleura*) of ten rows of cells, each row constituting a segment. There is no constant relation between the segmentation of nerve cord and that of muscles, and though at times it may

* Zool. Anzeig., xxiii. (1900) pp. 229–30. † Tom. cit., pp. 328–34.
‡ Comptes Rendus, cxxx. (1900) pp. 1418–20.
§ Zeitschr. wiss. Zool., lxvii. (1900) pp. 361–400 (3 pls. and 1 fig.).

appear as though ganglion and muscle segment corresponded, yet the correspondence is never complete. Further, the mesoblast of the tail is represented only by the one-layered muscle band; there is no splitting of mesoblast, and therefore no space corresponding to the vertebrate enterocoel. This the author regards as decisive evidence against the hypothesis that the muscle blocks in the tail of the Appendicularidæ represent the primitive segments of *Amphioxus*. Indeed, he considers that the muscle bands are essentially unsegmented structures, the appearance of segmentation being the result of the action of reagents which render the cell-boundaries conspicuous. Further, he is of opinion that the evidence is decidedly against the view that the structure of the tail can be explained by the hypothesis of descent from distinctly segmented forms. If therefore the Appendicularidæ are to be regarded as the most primitive of the Tunicates, then the relation of Tunicates to Vertebrates must be much less intimate than is generally supposed; for while the ancestral Tunicate had neither distinct segmentation nor an enterocoelic body-cavity, the ancestral Vertebrate must have had both, and divergence must therefore have occurred at a very distant period.

INVERTEBRATA.

Mollusca.

γ. Gastropoda.

Maturation and Fertilisation in Pulmonata.*—Mr. H. R. Linville has studied these processes in two species of *Limax* and two species of *Limnæa*. He finds that the centrosome and the centrosphere are extremely variable structures, both in size and in their reaction to stains. In the processes leading to the formation of the first polar cell in *Limax maximus*, no centrosome is visible; the astral rays apparently begin in the thickened wall of a pale centrosphere. After the formation of the first polar cell, and also after the formation of the second, the centrosphere is greatly enlarged in *Limax maximus* and *Limnæa elodes*. In the latter there is great variation in the condition of the centrosome and centrosphere. Two facts suggest that the centrosphere is not a permanent organ of the cell:—First, the centrosphere is sometimes invisible, on account of the increased area at the centre of the aster which reacts to the stain, and, secondly, astral rays beginning in the centrosome continue through the centrosphere, which thus appears to be no more than a region of thickening in the astral fibres. The centrosome in the first maturation spindle of *Limnæa* varies from a very minute granule to a diameter at least as great as the transverse dimension of the spindle itself; in the second maturation spindle it was never large. In both *Limax* and *Limnæa*, after the formation of the second polar cell, the disappearance of the egg-centrosome and the egg-aster, though long delayed, is complete.

A reduction division of the chromosomes in the Roux-Weismann sense is seen in the second maturation division of *Limnæa elodes*, when there is a transverse division of the dyads resulting from the longitudinal splitting of the masked tetrads of the first maturation division.

In fertilisation the tail follows the sperm-head into the egg, but is

* Bull. Mus. Harvard., xxxv. (1900) pp. 213–48 (4 pls.).

absorbed. The sperm-head, breaking away, moves with its base in advance towards the egg-aster. The centrosome, at first invisible, becomes distinct and often large. Sometimes the sperm-centrosome of *Limnæa* divides into two while on its way toward the egg-nucleus, a process prophetic of the existence of the centrosomes at either pole of the first cleavage-spindle.

Reasonably satisfactory proof that the first cleavage-spindle is wholly of spermatic origin is found in the fact that the incipient cleavage-spindle involves the sperm-nucleus first, and that the egg-nucleus is never involved in the spindle before the sperm-nucleus is entirely drawn upon it.

Abbreviated Development in Nudibranchs.* — Prof. A. Vayssière notes that Prof. Paul Pelseneer has found that in *Cenia cocksi* the larval stage is suppressed, and the young form leaves the egg as a miniature adult. It is of interest to note that Vayssière observed the same phenomenon in *Pelta coronata* (*Runcina hancocki*) in 1887. The adults laid eggs in captivity, and the nidamental ribbon was found to contain relatively few (20–30) eggs, which were of considerable size (1–1·4 mm. in diameter), and contained a large amount of yolk. Segmentation is partial, and there is no trace in the subsequent development of veliger or nautiliform shell, though at one period the embryo is covered with cilia and rotates in its membranes. On emergence the young form displays the characters of the adult, and the intestine still contains a large quantity of nutritive yolk. Details of the development are promised shortly, but it is noted that the velum is probably represented by a tuft of cilia above the blastopore.

Distribution of Opisthobranchs.† — Prof. A. Vayssière notes that the Opisthobranchs on the oceanic coasts of France (Atlantic and the Channel) are for the most part northern forms, while those on the Mediterranean coasts are predominantly southern. Some lists of genera are given to illustrate this. In the Bay of Biscay the northern and southern forms occur side by side.

Arthropoda.

α. Insecta.

Basal Segments of Insect's Leg.‡—Mr. L. B. Walton discusses the series of segments and sclerites which enter into the composition of the base of the leg. These are the (1) trochanter, (2) articulating with it the *coxa genuina*, (3) the *meron trochantin* or posterior lateral part articulating with the *epimeron*, and (4) the antecoxal piece. His conclusions are the following:—In Hexapoda and Chilopoda the *coxa* is composed of two more or less fused segments, *coxa genuina* and *meron*; the antecoxal piece results from the chitinisation of the membrane connecting the *coxa* with the sternum. The *trochantin* probably originated from a lateral portion of the same membrane. Audouin erroneously homologised the lateral margin of the posterior *coxa* in *Dytiscus circumflexus* with the *trochantin* of the prothorax and mesothorax; the trochanter represents a distinct segment of the legs. The *meron* and *coxa genuina*, together with their corresponding basal segments, *epimeron* and *epi-*

* Zool. Anzeig., xxiii. (1900) pp. 286–8.
† Comptes Rendus, cxxx. (1900) pp. 926–7.
‡ Amer. Nat., xxxiv. (1900) pp. 267–74 (6 figs.).

sternum, give evidence of a fusion between two primary metameres in the Hexapoda and Chilopoda. In Hexapoda and Chilopoda, the anterior metamere bears the functional, and the posterior the rudimentary leg. Neuroptera are most generalised in the development of the *coxæ*; in Thysanura and Orthoptera there is high specialisation.

Influence of Light on Coloration and Development.* — Herr D. Neniikow has experimented with the eggs and larvæ of *Pieris rapæ*, which he reared under light passing through solutions of various colours. The development was most rapid, both as a whole, and in its component periods, under the influence of ordinary white light. After white light, the order of advantageousness is red, violet, green. But under the green rays the development was markedly retarded, and there was great mortality. Neither with *Pieris rapæ* nor with *Vanessa urticæ* was any change in the coloration of larvæ, pupæ, or adults observed as the result of development under red, violet, and green rays.

Rôle of Insects in Spread of Disease.† — Dr. G. H. F. Nuttall has published a critical and historical study on the rôle of insects, arachnids, and myriopods in the spread of bacterial and parasitic diseases of man and animals. Beginning with an account of experiments made to determine the rôle of flies in the spread of anthrax, he goes on to cholera, tuberculosis, malaria, &c. Ixodidæ, *Argas*, *Sarcopsylla penetrans*, and Trombididæ are also discussed; and what we may call a chapter (in a long paper whose arrangement is not very clear), is devoted to the diseases of insects, &c., due to animal parasites. There is a long bibliography.

Clinical Entomology.‡—Dr. J. Ch. Huber has done a useful piece of work, a reference to which may be of service, in making a bibliography of the Pediculidæ, Diptera, and Acarina parasitic in or on man. The work will form a valuable supplement to the author's bibliography of clinical helminthology.§

"Cilia" in Intestine of Insects.‖—Dr. L. Bordas points out, in reference to a paper by M. Lécaillon ¶ on "cilia" in the mid-gut of the gnat, that he has described these curious non-motile protoplasmic prolongations of the epithelial cells in several of his papers, both in the mid-gut itself and in the pyloric cæca. He believes that they occur in the mid-gut of all insects.

Structure of Nucleolus in Insect Hypodermic Cells.**—Mr. T. H. Montgomery describes the nucleoli of the resting hypodermic cells of the larva of *Carpocapsa pomonella* as displaying what he has already described as "chromatin nucleoli." In undifferentiated hypodermic cells the nuclei contain true nucleoli (plasmosomes), but in the modified cells which cover the feet, "chromatin nucleoli" appear in close approximation to the true nucleoli, and, except in their greater affinity for stains, resemble ordinary chromatin granules. They are apparently produced by the modification of chromatin granules. Similar "chro-

* Physiol. Russe, i. (1899) pp. 244–50.
† Johns Hopkins Hosp. Rep., viii. (1899) pp. 1–154 (3 pls.).
‡ Jena, 1899–1900, 4 Hefte. § München, 1890–1894, 8 Hefte.
‖ Bull. Soc. Ent. France, 1900, pp. 25–7. ¶ Tom. cit., 1899.
** Zool. Jahrb. (Abt. Anat.), xiii. (1900) pp. 385–92 (1 pl.).

matin nucleoli" occur in spine-producing hypodermic cells, in giant free-cells in the hæmolymph, in stomodæum and proctodæum cells.

Copulatory Apparatus in Drone.* — Dr. G. Michaelis points out that the structure and development of this remarkable organ is inadequately treated in the literature. He has followed its development from its first appearance until the time when it becomes completely chitinised. In other Hymenoptera the copulatory organs are constituted by external structures which form a penis, but in the hive-bee pairing is effected by means of the copulatory tube, which is the expanded end of the ejaculatory duct. In larvæ of 1·8 mm. in length the first rudiment of the ectodermal genital-pocket can be observed. This gives off two short tubes from which the *vasa deferentia* and accessory glands arise; later its upper portion becomes the *ductus ejaculatorius* and the lower the copulatory tube. During pairing the whole of the copulatory tube is forced out of the body-cavity, but this is not a simple process of extrusion, but is accompanied by a complete inversion of the tube, and is comparable to the doubling outwards of an inturned glove finger. This process of inversion occurs slowly during the nuptial flight, and results in such an intimate connection between queen and drone, that when the drone frees itself it leaves behind in the vagina of the queen the copulatory tube, which is torn off at its point of attachment. This tube is ejected by the queen after the return to the hive, as soon as the spermatheca is filled with sperms.

Male Genital Appendages in Hymenoptera.†—Dr. E. Zander finds that in *Vespa germanica* the male genital appendages (in contrast to the sting) have no morphological relations to the integumentary skeleton. All the parts arise from a differentiation of a single pair of processes (*Primitivzapfen*), which grow out from the oral wall of a genital pouch situated near the post-segmental margin of the twelfth ventral piece. The same is true in *Apis* and *Bombus*. In whole and in detail the male appendages are of a different morphological nature from the sting.

Thorax of Ants.‡—Prof. C. Emery, who has been engaged in preparing the fasciculus on ants for the German *Tierreich*, has been led to a study of the structure of the thorax and to a revision of the nomenclature.

Mites and Insects. § — Dr. G. Leonardi discusses the mites whose life is more or less bound up with that of insects. He divides them into three sets:—(*a*) passengers (*viaggiatrici*) which use insects as means of transport, e. g. many Tyroglyphidæ, Gamasidæ, &c.; (*b*) commensals, forming the family Canestrinidæ; and (*c*) parasites. These are then discussed in systematic order.

Genealogical Tree of Butterflies.|| — Mr. A. Radcliffe Grote reiterates his conclusion as to the diphyletism of diurnal butterflies. He has separated the Papilionides as a distinct phyletic line from the rest of the butterflies, keeping these together under the title Hesperiades. It is the Hesperiades alone whose ancestry can be sought for in the Noctuid

* Zeitschr. wiss. Zool., lxvii. (1900) pp. 439–60 (1 pl.).
† Tom. cit., pp. 461–89 (1 pl. and 9 figs.).
‡ Bull. Ent. Ital., xxxii. (1900) pp. 103–19 (14 figs.).
§ Tom. cit., pp. 1–76.
|| Proc. Amer. Phil. Soc., xxxviii. (1899) pp. 147–54.

branch of Dyar's Bombycides (Agrotides), since to this presumptive lineage the Papilionides are apparently alien. For the general pattern of the veining of the Lycæni-Hesperiadæ is repeated in the Agaristid branch of the Bombycides, equally without any indication of affinity with the Papilionid type. He compares his diphyletic tree with the monophyletic schemes of Packard and Hampson.

Egg-formation in Rhizotrogus solstitialis.* — Otto Rabes recalls the fact that it was in this beetle that Korschelt described the curious ingrowth of folds of the follicular epithelium into the vitellus of the egg. He has had an opportunity of repeating those observations, and making a further investigation of the ovarian tubes. The ovary belongs to the type with terminal chamber filled with numerous nuclei. The young eggs have a massive vitellus and a clear nucleus; they are surrounded by numerous small cells. These follicular cells form folds which penetrate the egg, and apparently serve to feed the rapidly growing egg. The folds occur only in young eggs, and are not seen in the later stages when the chorion becomes cuticularised. The author also noticed certain peculiarities in regard to the germinal vesicle, which, apparently as a nutrition phenomenon, approaches the follicle wall and becomes flattened against it.

Male Genitalia in Coleoptera.†—Dr. L. Bordas has studied the male organs of various members of the Cerambycidæ. In regard to histology, he finds that the testes consist of a number of conical ampullæ converging towards a central reservoir. In the nymph the ampullæ are largely filled by spermatozoa, but towards the periphery spermatogonia in various stages of development occur.

Continuing his investigation of this subject,‡ the author describes the male genital organs in beetles with compound and fasciculated testes, viz. Aphodiinæ, Coprinæ, Geotrupinæ, Melolonthinæ, Rutelinæ, Lucanidæ, Cetoninæ, Chrysomelidæ (except in some genera), Cerambycidæ, &c. In all these the organs are almost uniform, and include:—(1) two testes composed of spermatic ampullæ; (2) a pair of cylindrical *vasa deferentia*, swollen on their course to form seminal vesicles; (3) two accessory glands (except in Cetoninæ); and (4) an ejaculatory duct, unpaired throughout (except in some Longicorns), and generally dilated at its origin.

Mouth-Parts of Nematocera.§ — Mr. Vernon L. Kellogg has examined the mouth parts in a large number of Nematocerous Diptera, and finds that they consist of a labrum-epipharynx; a pair of mandibles, which are always absent in the males, and in some cases in the female also; a pair of maxillæ, with never more than a single maxillary lobe, which may occasionally be absent; and a labrum without palps, with the terminal lobes showing various degrees of coalescence. The tendency of specialisation is to the reduction and loss of mandibles and maxillæ, and the development of the labrum as a "rasping, lapping organ."

* Zeitschr. wiss. Zool., lxvii. (1900) pp. 340-8 (1 pl. and 1 fig.).
† Ann. Soc. Ent. France, lxviii. (1899) pp. 508-13 (1 pl.).
‡ Comptes Rendus, cxxx. (1900) pp. 738-40.
§ Psyche, viii. (1899) pp. 303-306, 327-30, 346-8, 355-9, 363-5 (11 figs.).

β. Myriopoda.

Seychelles Myriopods.* — Dr. C. G. Attems has been entrusted with Dr. Brauer's large collection of Myriopods from the Seychelles. Hitherto the Myriopods of the islands have been known chiefly from Broelemann's description of Alluaud's collection, which contained 13–14 species. Of the 23 species in Brauer's collection 13 are new to science, and only 7–8 are also present in Broelemann's collection, which suggests that the Myriopod fauna of the islands is still inadequately known. Four of the new species are types of new genera.

Diplopoda of Greece.† — Dr. Carl Verhoeff, in the course of his monograph on the Palæarctic Myriopoda, has reached the Diplopoda of Greece, and finds that the fauna of this area shows many peculiarities. For example, it has not a single species in common with Germany or France; even certain regions of Austria have no species in common with Greece. Among the notable peculiarities in regard to the genera and families the following are worth notice:—The Lysiopetalidæ are very abundant, the Chordeumidæ few, and the Glomeridæ virtually absent; Colobognatha occur which are South Mediterranean in type; among the Julidæ the genera *Brachyjulus* and *Pachyjulus* occur, *Blanjulus*, *Isobates*, and *Cylindrojulus* are absent, and *Julus* is only feebly represented; the endemic genera are *Cyphobrachyjulus* and *Himatiopetalum*; true sub-tropical forms are absent, but an affinity with the fauna of Italy is suggested by *Dolistenus* and the sub-genus *Acanthopetalum*, with that of Austria-Hungary by *Callipodella*, with that of Asia Minor by *Symphyojulus*.

γ. Prototracheata.

Genera of Prototracheata.‡ — Prof. E. L. Bouvier discusses the British Museum collection, and distinguishes the five genera composing the class, namely *Peripatus* (Guild.) Pocock, *Peripatoides* Pocock, *Opisthopatus* Purcell, *Peripatopsis* Pocock, and *Paraperipatus* Willey. He suggests that the most important structural modifications are the result of processes of atrophy several times repeated, which have reduced and fixed the number of appendages.

Phylogeny of Onychophora.§ — Prof. E. L. Bouvier accepts the view that the Onychophora have arisen from aquatic Annelids. He then discusses the different forms, and concludes that the *Peripatus* type is the most primitive. Their small eggs without yolk suggest an ancestry among Polychæte Annelids.

In *Peripatus* the placentar mode of nutrition predominates; in *Peripatoides* the egg accumulates a considerable quantity of nutritive material within itself; in *Paraperipatus* and *Peripatopsis* the utilisation of the uterine fluid becomes gradually predominant.

From a common ancestral trunk arise these three divergent branches, marked also by their male sexual organs. In this respect *Paraperipatus* and *Peripatopsis* are nearest the ancestral types, and *Peripatoides* is much more remote.

* Zool. Jahrb. (Abth. Syst.), xiii. (1900) pp. 133-71 (3 pls.).
† Tom. cit., pp. 172-204 (1 pl.).
‡ Quart. Journ. Micr. Sci., xliii. (1900) pp. 367-73 (4 figs.).
§ Comptes Rendus, cxxx. (1900) pp. 735-8.

δ. Arachnida.

Species in Hydrachnida.—F. Koenike * describes in detail a new species of *Eylais*, obtained by Schauinsland's Expedition in New Zealand. The new form is allied to *E. infundibulifera* Koen., which the author believes to be a synonym of *E. bifurca* Piersig; this species he states was founded by that author on a female specimen of *E infundibulifera*. In a note upon species and synonyms in Hydrachnids, Rich. Piersig † denies this, and asserts that the two species are both valid, and are distinctly marked off from one another.

North American Arachnoids.‡—Mr. N. Banks gives a synopsis of North American Arthrogastra—Arachnoids "with plainly segmented abdomen, palpi of male not modified for a genital organ, rarely of small size, without jointed abdominal spinnerets." He discusses the Scorpionida, Solpugida, and Pedipalpi, giving keys to their genera and species.

ε. Crustacea.

Macrura from Madagascar.§—H. Coutière has been able to study various collections of fresh-water Macrura from Madagascar, and finds that, apart from the Astacidæ which have already been studied, there are nineteen species or varieties belonging to the genera *Palæmon*, *Caridina*, and *Atya* represented in the gatherings. Of the nineteen, five appear to be peculiar, but some of these may be shown to have only varietal value. Of the remaining fourteen, two have a much restricted distribution (East Africa to Ceylon), and the remainder a wide distribution extending through the Pacific to New Zealand and Samoa. The distribution of the fresh-water members of the genus *Palæmon* is of much interest, both on account of the occurrence in the fresh-water basins of the same region of identical species (although there is no evidence that such basins have ever been connected), and the occurrence of the same species in widely separated regions. These peculiarities are in part explained by the hypothesis that the fresh-water forms have arisen comparatively recently from marine forms; but the occurrence in Madagascar of species found also in East Africa, the Malay Archipelago, and Australia; of a species *P. superbus*, found also in Shanghai, and possibly identical with *P. moorei* from Tanganyika and *P. trompii* from Borneo; finally of the (sub-)genus *Bithynis* in Madagascar and in Chili, cannot as yet be fully explained.

New Genus of Fresh-water Isopods.‖—Mr. O. A. Sayce describes *Phreatoicoides gracilis* g. et sp. n., found on logs of wood in a Gippsland river. Fundamental differences in the pleon necessitate a new genus, but this is near *Phreatoicus* Chilton and *Phreatoicopsis* Spencer and Hall. Though inhabiting surface-water it is blind, which perhaps points to a near ancestry in caves or subterranean waters. Another noteworthy characteristic of this form is the apparent dimorphism in the males.

* Zool. Jahrb. (Abth. Syst.), xiii. (1900) pp. 125–32 (7 figs.).
† Zool. Anzeig., xxiii. (1900) pp. 209–13.
‡ Amer. Nat., xxxiv. (1900) pp. 421–7 (4 figs.).
§ Comptes Rendus, cxxx. (1900) pp. 1266–8.
‖ Proc. R. Soc. Victoria, xii. (1900) pp. 122–38 (3 pls.).

North American Isopods.* — Miss H. Richardson gives a synopsis of the Chelifera, Flabellifera, and Valvifera, followed by one of the Asellota, Oniscoidea, and Epicaridea.

New Victorian Blind Amphipod.† — Mr. O. A. Sayce describes *Niphargus pulchellus* sp. n., a snow-white blind form from a fresh-water pool in Thorpdale, Gippsland. It is well characterised, and differs from *N. montanus* in the more slender body, narrower side-plates, the want of eyes, the elongated last pereiopods, and the greatly extended unibranched jointed terminal uropods.

New Subterranean Isopod.‡ — MM. Adrien Dollfus and Armand Viré note the discovery of what is apparently a new species of *Cæcosphæroma*, found in an underground stream near the village of Sauve. The new form is described as *C. faucheri*, and, like the four other known species of Sphæromedæ from subterranean waters, is totally blind, bears tactile bristles on antennæ and legs, and has four olfactory lamellæ on the upper antennæ, the lamellæ being longer and reaching a higher degree of development than in any Isopod hitherto described.

Sacculina on Pilumnopseus serratifrons.§ — Mr. D. G. Stead describes a species of *Sacculina* parasitic on the above-mentioned littoral crab, which is very abundant in Port Jackson. The parasite affects both sexes, and is occasionally as large as the body of its host. It is very noticeable, however, that all the specimens infected were of small size. Neither the pleons nor the abdominal appendages of either sex are modified in any way; but growth is retarded and reproduction is stopped. The crabs do not seem to interfere with their parasites, but in one instance, after repeatedly wounding the parasite, the author saw the crab completely dislodge the *Sacculina*, which proves the possibility.

Entomostraca and the Surface-film.‖—Mr. D. J. Scourfield notes that only a few species of Entomostraca are capable of utilising the surface-film for support, and of these all belong to the genera *Scapholeberis* and *Notodromas*. In *Scapholeberis mucronata* the supporting mechanism is as follows:—On the ventral margin of each valve there is a series of setæ. The animal habitually swims in the reversed position, and these setæ pierce the surface-film and produce capillary depressions. The coloration of the animal seems adapted to this habit; for the characteristic dark tint of the ventral surface must render it inconspicuous when looked at from above against a muddy bottom.

Organism and Environment.¶— Dr. Ernest Warren has conducted a suggestive series of experiments on *Daphnia magna*, and its reaction to changes in the environment. The special objects of the experiments were to determine the effect of the addition of sodium chloride to the water, and of a confined volume of water. The author finds that the times of killing with varying strength of solution of sodium chloride are, within certain limits, well represented by a rectangular hyperbola.

* Amer. Nat., xxxiv. (1900) pp. 207–30, 295–309 (16 figs.).
† Proc. R. Soc. Victoria, xii. (1900) pp. 152–9 (1 pl.).
‡ Comptes Rendus, cxxx. (1900) pp. 1564–6.
§ Proc. Linn. Soc. N. S. Wales, xxiv. (1900) pp. 687–90.
‖ Journ. Quekett Micr. Club, vii. (1900) pp. 309–12 (1 fig.).
¶ Quart. Journ. Micr. Sci., xliii. (1900) pp. 199–224 (4 figs.).

The physiological condition of the animal at the time of immersion in the salt solution was found to have an enormous effect on the resisting power. The power of becoming acclimatised to saline solutions is very low in *Daphnia*.

The effect of living in a confined volume of water is to diminish the length of the spine and to greatly decrease the power of reproduction. Ultimately the *Daphniæ* die out, and the water can be shown to be injurious to fresh *Daphniæ* introduced into it. After a prolonged period the injurious effect passes off, and fresh *Daphniæ* will thrive when introduced into the water. The organisms are very sensitive to differences in the mineral constituents of the water in which they are living, a sudden change from New River water to Canterbury water producing a premature weakening of the stock. The interest of these facts is their bearing on the life of the species in natural conditions.

Fresh-water Entomostraca.* — Mr. D. J. Scourfield, in a general lecture on fresh-water Entomostraca, comments upon the value of Entomostraca from the point of view of experimental biology. "Their commonness in all parts of the country, their transparency, the ease with which they can be isolated and reared under all sorts of conditions, . . . mark out the Entomostraca as particularly well fitted for observation in connection with even the most fundamental biological problems of the day." And in other connections there is much that requires to be done:—"We badly want detailed studies on local faunas, on the seasonal distribution and variation of the different species, on the faunas of various types of ponds, on the food of the most abundant forms, and many similar subjects."

Annulata.

British Annelids.†—Prof. W. C. M'Intosh has published, as Part II. of his 'Monograph of the British Annelids,' the first instalment of the Polychæta, comprising the families Amphinomiidæ to Sigalionidæ. The work has been looked forward to for a such a long period, that some disappointment will be felt in regard to the small number of families treated; while the scale on which these are described is so magnificent that it is to be feared that the remaining volumes can hardly follow rapidly. The volume is lavishly and beautifully illustrated, the external form, larval stages, anatomical details, and the specific characters all being represented in the plates. As might be expected, a great part of the volume is taken up by the Polynoidæ, which the author separates as a family from the Aphroditidæ. The British forms are arranged in fourteen genera, but the British area is taken in the extended sense, as stretching from the Faröe Channel to the Channel Islands, and beyond the 100 fathoms line on the west, which greatly increases our toll of species. The volume obviously represents so long and arduous a period of preparation, that it is perhaps ungracious to note that the absence of even a list of genera and species makes it somewhat difficult to use. This, however, only accentuates the eagerness with which the following volumes with tables and indices will be looked for.

* Proc. South London Entomol. and Nat. Hist. Soc., 1899, pp. 28–30.

† 'A Monograph of the British Annelids,' Part II., Ray Society, 1900, pp. 215–442 (10 pls. and 33 figs.).

Life-History of Autolytus cornutus.*—Mr. P. Calvin Mensch discusses whether it is useful to speak of alternation of generations in the life-history of this worm. The life-history includes:—(1) the development from the egg of the parent stock; (2) the development of sexual products in segments posterior to the thirteenth setigerous segment, the development of a head on the fourteenth, and the separation of these segments for the formation of the free-swimming stolons, Polybostricus ♂ and Sacconereis ♀; (3) regeneration of the lost segments and the formation in this way of a second and possibly a third or fourth stolon; (4) finally the development in the parent stock of sexual products and the conversion of it into a sexual individual. While the sexual products are forming, the regeneration of lost segments is still taking place; but in none of the specimens found had this new growth gone further than the formation of a small bud, consisting of no more than eight or ten distinct segments.

The above shows, not a sexual generation alternating with an asexual, but at most no more than a sexual dimorphism—a sexual individual budding off sexual stolons, and, as its own sexual products mature, partaking more or less of the epitokous form of other Syllids, and itself becoming sexual. In short, instead of true alternation the author sees simply a dimorphism resulting from an asexual multiplication of the parent stock.

Calciferous Glands in the Earthworm.†—The late Mr. N. R. Harrington made a research on this subject. The calciferous glands have two openings—(*a*) through the epithelial lining of the first pair of glands into the œsophageal pouch; (*b*) through the epithelium in the middle of the fourteenth somite directly into the œsophagus. The latter opening transmits only the milky fluid with its suspended crystals. These probably neutralise acid food, while the pebbles excreted from the anterior pouches pass through the digestive tract unchanged. An excess of calcareous matter in the intestine does not increase the amount of lime produced by the glands, although acid food does. Carbonate of lime is formed, and appears as crystals inside the secretory cells. The nucleus and the entire distal part of the cytoplasm disintegrate during active secretion. The nuclei are replaced by smaller nuclei situated near the blood-sinus wall, and around these the general cytoplasm of the syncytium is built up into club-shaped cells. The smaller nuclei are derived in turn from migratory elements which lie closely appressed to the limiting membrane of the secretory lamellæ, either in the blood or in the glandular tissue. These migratory nuclei, or blood-corpuscles, are derived in development from the amœboid cells of the endoderm. The plasma of the blood is also derived from these same cells of the endoderm. The anterior pair of pouch-like glands are the only ones lined with true epithelium, and are developed as diverticula of the œsophagus; while the two posterior pairs are formed by migration of the amœboid endodermic nuclei, which arrange themselves about cavities formed *de novo* near the splanchnopleure, and give rise to the secretory elements. In an appendix the complex circulation is fully discussed.

* Amer. Nat., xxxiv. (1900) pp. 165–72.
† Journ. Morph., xv. (1899) Supplement, pp. 105–68 (4 pls. and 10 figs.).

Nais with bifurcated Prostomium.* — Prof. C. M. Child describes a case of *Nais lacustris* in which the proboscis-like prostomium is bifurcated, probably as the result of an injury. One point is of special interest;—the branch is about as long as the main prostomium; i.e. a new prostomium of full length has arisen from a point near the tip of the original prostomium, just as it would arise if the latter were cut off at its base. If this be the result of regenerative processes, the lateral region of the prostomium, as well as its base, is capable under certain conditions of giving rise to a prostomium of full length.

Reproductive System of Digaster.† — Sarah O. Brennan describes the reproductive organs of the earthworm, *Digaster* (*Didymogaster*) *sylvaticus*, supplementing the account given by J. J. Fletcher in his diagnosis of the genus in 1886. She describes a pair of ovaries, two oviducts, three pairs of spermathecæ, two pairs of testes, two pairs of funnels leading into a pair of *vasa deferentia*, two pairs of lateral seminal vesicles, two median sperm reservoirs, occupying a segment each, and a pair of bilobed spermiducal (prostate) glands.

Oligochæta from Illinois.‡—Mr. Frank Smith gives a list of the Oligochætes found near the Biological Station at Havana, Illinois, with descriptions of the Tubificidæ. Among the latter the most interesting form is a new one described as *Rhizodrilus lacteus* g. et sp. n., which occurs in the "bottom-lands" of the Illinois River. It is distinguished from all known Tubificidæ by the "presence of two distinct kinds of highly modified genital setæ, and the presence of such setæ in the ninth somite." It is possibly related to *Vermiculus*, and in regard to its circulatory system is perhaps the extreme form of the series constituted by *Vermiculus* sp. and *Ilyodrilus coccineus*. Another interesting form described in some detail is *Embolocephalus multisetosus* sp. n.

Development of Nephridia.§—F. Vejdovsky discusses the points at variance between himself and Bergh as to this question. In part the differences in statement of the two authors would appear to be a difference in terminology. According to Vejdovsky the contractile bladder (*Endblase*) is of ectodermic origin, while Bergh says that the terminal region (*Endabschnitt*) is of mesoblastic origin; but according to Vejdovsky the exact significance of the last term is not adequately defined. Vejdovsky figures and redescribes his sections in order to make his own position perfectly clear. The sections show, as he believes, without a possibility of error, that in Lumbricidæ, as in *Tubifex* and in *Rhynchelmis*, the terminal bladder arises as an ectodermic invagination without any primitive connection with the nephridium primordium.

Metamerism of Hirudinea.‖—Mr. W. E. Castle has re-investigated this subject. He finds that the number of somites in the body of the leech has been determined correctly by Whitman (1892) for the Rhynchobdellidæ, and by Bristol (1899) for the Gnathobdellidæ. In both cases the number is thirty-four. The limits of the leech somite have

* Anat. Anzeig., xvii. (1900) pp. 311–2 (1 fig.).
† Proc. Linn. Soc. N. S. Wales, xxiv. (1900) pp. 691–6 (2 pls.).
‡ Bull. Illinois State Lab., v. (1900) pp. 441–58 (2 pls.).
§ Zeitschr. wiss. Zool., lxvii. (1900) pp. 247–54 (1 pl.).
‖ Proc. Amer. Acad. Sci., xxxv. (1900) pp. 285–303 (8 figs.).

been placed incorrectly by all students of leech metamerism, with the possible exception of Vaillant (1870) in the case of a single genus (*Pontobdella*), from the time of Gratiolet (1862) to the present.

The natural and true limits of the somite coincide with the limits of the neuromere; that is, a somite includes those annuli which typically are innervated from the same nerve-ganglion. This is confirmed by an examination of metamerically repeated structures other than ganglia, namely, septa, testes, and crop diverticula. Neuromeric groups of rings, that is, somites as above defined, behave as structural units—(*a*) in somite abbreviation (reduction in the number of rings in a somite), and (*b*) in somite elongation (increase in the number of rings in a somite). Both reduction and increase in the number of rings take place chiefly at the ends of the somite. The sensory ring occupies the middle of the somite, and is least often and least extensively affected in the two processes just named. It represents the *stable* component of the somite.

The five-ringed type of somite found in the Gnathobdellidæ has been derived from the three-ringed type found in the Rhynchobdellidæ, as suggested by Whitman and demonstrated by Bristol. This has been brought about by division of the non-sensory ring at either end of the somite.

The wide prevalence of ring multiplication among the Hirudinea suggests the derivation of the three-ringed type of somite from a still simpler type, consisting, as in Chætopoda, of a single ring. A phylogenetically intermediate stage between the one-ringed and three-ringed types of somite is probably represented in a typical body somite of *Branchiobdella*. The same type of somite structure appears also in the abbreviated somites of *Glossiphonia*, as a stage intermediate between the three-ringed and one-ringed conditions of the somite. The phenomena of ring multiplication in the Hirudinea is correlated with the restricted number of somites found in the body. Increase in the number of somites does not take place in the body of the adult leech. Without this, elongation of the body is possible only through lengthening of individual somites. Lengthening of the individual somite has probably been the cause, phylogenetically, of increase in the number of rings in a somite.

Nematohelminthes.

Phagocytosis in Nematodes.* — Prof. N. Nassonow describes, in *Ascaris osculata*, *A. ferox*, *Strongylus paradoxus*, and *Sclerostomum armatum*, unicellular phagocytic organs like those described in *A. megalocephala* and *A. lumbricoides*. They occur attached to the body wall, and often, though not always, bear an extraordinary array of amœboid processes.

Platyhelminthes.

Regeneration in Planarians.†—Mr. F. R. Lillie discusses, in particular, the source of material of new parts and the limits of size. He studied the well-known tendency of Planarians kept without food to diminish in size. The smallest specimen obtained (after 43 days) was less than one-hundredth the bulk of the original animal. When it had been reduced to less than one-half of its original length, it was cut in

* Arch. Mikr. Anat., lv. (1900) pp. 488–513 (3 pls.).
† Amer. Nat., xxxiv. (1900) pp. 173–7.

two parts, and both regenerated completely, although with constant diminution in bulk. Increase by fission was entirely stopped, but the power of regeneration remained.

"In regeneration, under the circumstances of these experiments, two processes are taking place side by side; not only is new tissue being formed at the cut end, but the old tissues are undergoing a translocation and partial re-differentiation, to accommodate themselves to the new proportion that must be assumed. The new tissue at the cut end must be formed entirely from the old tissue, and the final result involves, therefore, an extensive working over of the old material. The original tissues, with constant losses, owing to destructive metabolism, are moulded into the form of a new individual. . . Not less remarkable is the maintenance of form in individuals that gradually waste away to one-hundredth part or less of their original bulk, but remain active and normal, without hint of sickness."

New Planarian.*—Mr. W. C. Curtis has obtained in a stream near Williamstown, Mass., a Planarian which is apparently new, and which is of interest on account of the extreme simplicity of the reproductive system. The follicles of the testes are unusually few in number (average about 9), and are not paired except in the head region. Testicular canals, seminal vesicles, and penis, all show great simplicity of structure. The ovaries are not compact, but consist of straggling lobes, and show little differentiation from the yolk-glands and oviducts. The uterus is a slightly curved tube of uniform diameter without terminal enlargement; there are no accessory glands other than the shell gland of the vagina. The new species has been named *Planaria simplicissima*.

Cestode Nervous System.†—Mr. W. L. Tower has applied Golgi's method, the methylen-blue method, and Von Rath's method, to the study of the nervous system of *Moniezia expansa*. The best results were obtained with Von Rath's fluid followed by crude pyroligneous acid, and the want of success with the other methods, notably the methylen-blue, was due in part to the difficulty of finding a suitable medium in which to keep the worms during transport to the laboratory. Later it was found that any fluid containing sodium chloride is injurious, but the worms can be kept alive without injury for several days in a nutrient fluid if this salt be absent, thus affording opportunity for the use of methylen-blue. The material was obtained from the small intestine of *Ovis aries*, and no difficulty was experienced in obtaining an abundant supply.

The nervous system was found to be devoid of any continuous protective investment, but the more important nerve-trunks display scattered cells with branching processes, the "binding-cells" of the author, doubtfully homologous with the *Hüllzellen* described by Zernecke for *Ligula*. In the scolex the nerve apparatus has the following parts:—(1) an anterior nerve-ring with four ganglia; (2) a pair of large cephalic ganglia; (3) connecting nerves between the preceding; (4) dorsal or ventral commissures connecting the outer ends of the cephalic ganglia. These structures are described in some detail. In the neck region there are six distinct longitudinal trunks, a large lateral one at either side, two

* Zool. Jahrb. (Abt. Anat.), xiii. (1900) pp. 447–66 (2 pls.).
† Tom. cit., pp. 359–84 (5 pls.).

dorsal and two ventral, but ganglia are not differentiated. In the posterior neck region where the proglottides begin to appear, ganglionic swellings appear on the lateral nerves. In a mature proglottis accessory longitudinal nerves appear in addition to the six described; the lateral trunks show an anterior and a posterior ganglion at each side, and the dorsal and ventral nerves also display ganglionic swellings. The paper is illustrated by some very clear figures.

Development of Cestodes.* — G. Saint Remy briefly describes the development of *Anoplocephala plicata* Zeder and *A. mamillana* Mehlis, parasites of the horse. The spherical ovum has a very delicate envelope and a large mass of almost homogeneous yolk. What looked like two polar bodies were seen. Some of the early blastomeres increase greatly in size, as if at the expense of the yolk. Two of them penetrate into the yolk, which then fragments. The two cells end by surrounding the other elements of the ovum and forming an external envelope. Meanwhile, three large cells form an internal envelope surrounding numerous small elements without distinct boundaries. In short, the development is very like that in *Bothriocephalus* and *Tænia serrata*. No diploblastic arrangement, however, was observed.

Cestodes of Birds.† —Dr. L. Cohn publishes the first of a series of papers on the anatomy and systematic position of the Cestodes of birds. The present paper discusses the structure of the following species:— *Amabilia lamelligera* Owen, *Schistotænia scolopendra* Diesing, *Sch. macrorhyncha* Rud., *Tænia polymorpha* Rud. ex parte.

Development of Echinococcus Scolices.‡ — Herr R. Goldschmidt notes the discrepancies which exist in the literature in regard to this subject. His own observations seem to him not only to reconcile the apparently discordant statements of other authors, but also to shed light on the development and significance of the rostellum. The first trace of the scolex is a disc-like thickening of the wall of the brood capsule. This gradually rises up to form a button, while a circular furrow appears at the same time around its base. The furrow deepens into a pit, within which lies the dome-shaped projection, the two constituting the hollow bud (*Hohlknospe*) of Leuckart. The central projection is the rudiment of the rostellum, and projection and pit together are the homologue of the *Kopfzapfen* of a Cysticercus, the only notable difference being the early appearance of the rostellar region in the former case. Later there begins that process of differential growth which was interpreted by Leuckart as invagination. Details of the development are given; but the chief point of general interest is in regard to homology. The fully formed scolex of an Echinococcus exhibits a strong resemblance to the Cysticercoid of *Tænia cucumerina*; but this resemblance must nevertheless be looked on as secondary and adaptive only, for development shows that the Echinococcus scolex is the homologue of the *Kopfzapfen* of Cysticercus.

In regard to the phylogenetic significance of the rostellum, the author considers that his observations lend no support to the theory

* Comptes Rendus, cxxx. (1900) pp. 930–2.
† Zeitschr. wiss. Zool., lxvii. (1900) pp. 255–90 (2 pls.).
‡ Zool. Jahrb. (Abt. Anat.), xiii. (1900) pp. 467–94 (1 pl. and 1 fig.).

that it is to be regarded as the remnant of the pharynx of Trematoda. They seem to him rather to support the older suggestion that the rostellum is to be homologised with the proboscis of Turbellaria. He points especially to developmental resemblances between it and the proboscis of the Turbellarian *Macrorhynchus.*

Incertæ Sedis.

Development of Phoronis buskii.*—Dr. A. T. Masterman finds that in this species the mesoblast appears to arise from five separate parts of the archenteric hypoblast, one of these being unpaired and pre-oral, the other four paired and post-oral. The first arises as a hollow outgrowth of the archenteron, its cavity being shut off from the archenteron in the course of development. Of the post-oral somites, the first (collar somites) arise as solid masses of cells, which at first have no cavity; the second (trunk somites) appear to arise in the same way at the anal extremity, though it is possible that they are originally hollow outgrowths with the walls in contact. In origin and in details of development, there is close correspondence with *Balanoglossus*, thus confirming the author's view of the existence of relationship between *Phoronis* and *Balanoglossus.*

Affinities of Phoronidea.†—Prof. L. Roule has already argued that there are important resemblances between the development of Phoronidea and that of Chordata. He goes on to indicate the resemblances between the early stages of Phoronidea and Nemertea. The pilidium is certainly not homologous with the actinotrocha, but there are some striking resemblances in developmental procedure. So the young Phoronid, before it has assumed the actinotrocha disguise, resembles the Annelid trochophore in the origin of the germinal layers, e.g. origin of the primary mesenchyme. For the stage succeeding the gastrula, Roule proposes the term *vermula*; it may, in a sense, be called the common form from which the more specialised trochophore, pilidium, and actinotrocha are derived.

Budding in Ectoproctous Bryozoa.‡—Dr. Fr. Ladewig has studied this especially in *Bugula avicularia*, and with the following results. The rudiment of the polypid is always an invagination of the ectoderm. From a slight incurving, to start with, the process is traced to the appearance of a distinct lumen of invagination. The avicularia rudiment is an ectodermic evagination, formed about the same time as the first differentiation of tentacles in the associated polypid. In the evagination a distal club-shaped portion is differentiated, into the lumen of which there wander mesenchyme cells from the body-cavity of the mother-zoœcium; this part becomes constricted off from the head of the avicularia. On the distal side of the evagination there is formed an invagination of the outer germinal layer, similar to that in the rudiment of the polypid bud. The musculature of the avicularia arises from the mesoderm, which is established by the multiplication of the mesenchyme cells to form a connected endothelium. The invagination itself forms the

* Quart. Journ. Micr. Sci., xliii. (1900) pp. 375–418 (4 pls.).
† Comptes Rendus, cxxx. (1900) pp. 927–30.
‡ Zeitschr. wiss. Zool., lxvii. (1900) pp. 323-39 (1 pl.).

nervous organ; the anterior part of the ectoderm becomes the membrane of the fully formed avicularia.

Genus Steganoporella.*—Mr. Sidney F. Harmer publishes a revision of this genus, giving the characters of twelve species, with keys for ready identification, and careful descriptions and figures.

New Histriobdellid.†—Prof. W. A. Haswell has found an interesting little creature, related to *Histriobdella homari*, but differing from it in many respects, in the gill-chamber of the Tasmanian crayfish (*Astacopsis tasmanicus*). He names his find *Stratiodrilus tasmanicus* g. et sp. n. In external appearance a notable distinction from *Histriobdella* is the presence of four pairs of cirri consisting of two segments, and tipped with non-motile sensory cirri. In regard to the nervous system, the nerve-cord appears to be much more distinctly differentiated from the epidermis than in *Histriobdella*. The ciliated canals of the excretory system extend forwards into the head and backwards to the posterior region of the body, which they are said not to do in *Histriobdella*. There are also some points of contrast in the female ducts of the two forms.

As to affinities, the author is of opinion that the Histriobdellidæ are derived from the Rotifera. He regards their relation with the Polygordiidæ as extremely remote, and considers that there is a more obvious relation to *Dinophilus*, which he regards as an offshoot of the Rotiferan stock which gave rise to the Histriobdellidæ.

Rotatoria.

Apsilus vorax (Leidy).‡—Dr. Reinhard Gast records the sudden appearance of this rare and aberrant Rotifer in an aquarium. Unfortunately, the animals speedily disappeared again, but some observations on structure and development were made. The free-swimming period is brief, and is soon followed by the disappearance of the larval eyes and by fixation. After once having fixed itself, the animal is incapable of further locomotion, and cannot re-attach itself if forcibly removed. The "fixing-disc" or "sucker" of other authors proves to be the foot, which is furnished with glands which are the homologues of the cement glands of other Rotifers; this discovery brings *Apsilus* nearer to the Flosculariæ, to which the genus is undoubtedly related. The various organs and systems of *A. vorax* are described in detail, and a table of the species is given.

Echinoderma.

Protoplasmic Structure of Echinoderm Eggs.§—Prof. E. B. Wilson finds that the cytoplasm of the echinoderm egg is an alveolar structure, as maintained by Bütschli. There is no ground of distinction between this and Reinke's "pseudo-alveolar" structure. The "deuteroplasm granules" of molluscan and annelid eggs are to be regarded as enlarged alveoli, the substance of which has undergone specific chemical and physical changes, and has increased in amount.

The rays of the astral systems (astral rays and spindle-fibres) are actual fibrillæ, and not merely the optical sections of lamellar plates.

* Quart. Journ. Micr. Sci., xliii. (1900) pp. 225–97 (2 pls.).
† Tom. cit., pp. 299–335 (2 pls.).
‡ Zeitschr. wiss. Zool., lxvii. (1900) pp. 167–214 (2 pls.).
§ Journ. Morph., Supplement to vol. xv. (1899) 28 pp., 2 pls.

The astral fibrillæ do not therefore arise merely through the re-arrangement of a pre-existing alveolar structure (Bütschli, Eismond, Erlanger) or reticulum (van Beneden, Hertwig, Kostanecki), but are progressively differentiated out of the substance of the alveolar walls. Wilson's results are in harmony with the view advocated by Kölliker, Unna, Rhumbler, and many others, that an alveolar may readily pass over into a reticular or fibrillar structure, and that neither of these types of structure can be regarded as of universal occurrence or fundamental significance, or even as constant in the same cell.

The granules or microsomes imbedded in the meshwork are not coagulation products, but pre-exist in the living substance. There is ground for the conclusion that while the microsomes and alveoli differ both chemically and physically, both are liquid drops, and have the same origin in an apparently homogeneous basis or matrix, and that microsomes themselves graduate down to the smallest visible "granules." Thus the view is again suggested that the matrix itself, in which all these bodies lie, is composed of still smaller elements, by the enlargement and transformation of which the visible elements arise.

Cœlentera.

Zoophytes.*—Prof. S. J. Hickson took this for the subject of a presidential address to the Manchester Microscopical Society. From among his interesting remarks we select two:—"I have examined a very large number of specimens of *Millepora* from the East Indies, Indian Ocean, and West Indies, from the exposed reefs, to the depth of 30 feet, and have not yet found a single specimen in which the superficial canals were not crowded with Zooxanthellæ." It seems to be an essential symbiosis.

In some cases the surface of *Millepora* is almost covered with little key-hole apertures, through which the appendages of the barnacle *Pyrgoma milleporæ* project. If the crustacean dies, the tissues of the cœnenchym cover over the aperture, and the shell is buried. But the effects of the gall-like growth do not all at once vanish; the locality projects from the surface as a little tubercle for some time afterwards. These warted forms, which occur only in shallow water, have been called *M. verrucosa*; but this is absurd, for it is only the accident of the shallow water habitat that makes a millepore "verrucosa."

Sense-Organs of Deep-sea Medusæ.† — Dr. E. Vanhöffen finds that the medusæ of the German Deep-sea Expedition include species of *Periphylla*, of *Atolla*, and of a new genus, *Periphyllopsis*. All three genera are clearly of deep-sea habitat, and were sufficiently well preserved to allow of an examination of the sense-organs. These prove to be simpler than was supposed by Haeckel and Maas, no trace of ocelli being present. In *Periphylla* the rhopalia consist of a canal clothed in pigmented endoderm and protected by well-developed mesoglœa. Over the otoliths the canal becomes somewhat widened, and this produces an external swelling, further emphasised by a thick sensory cushion which surrounds the rhopalium on its under side. The rhopalia of *Atolla* are generally similar to those of *Periphylla*, but the sensory cushion has at either side a large ganglion, which the author regards as probably the

* Trans. Manchester Micr. Soc., 1899, pp. 26–35.
† Zool. Anzeig., xxiii. (1900) pp. 277–9.

central organ of the nervous system, whose existence was surmised on physiological grounds by Eimer and Romanes.

Memoir on Alcyonacea.* — Dr. W. May describes in systematic fashion the Alcyonacea of the Hamburg and Berlin Museums, 67 species, of which 38 are new:—4 Clavulariidæ, 8 Xeniidæ, 5 Alcyonidæ, and 21 Nephthyidæ. Nine families are recognised:—Clavulariidæ Hickson (= Cornularidæ M.-E.), Telestidæ M.-E., Tubiporidæ Gr., Xeniidæ Verrill, Organidæ Dan., Alcyonidæ Verrill, Nephthyidæ Verrill, Siphonogorgiidæ Köll, Helioporidæ Moseley. As the memoir is for the most part taxonomic, it does not readily admit of summary, but it will be of great value to those working at the Alcyonacea.

Ancestry of Helioporidæ.†—Prof. J. W. Gregory points out that the blue coral *Heliopora cœrulea* is one of the most isolated of living animals; it is the only known species of its genus (see *infra*), and it has been recently described as the only member of its family. Some Palæozoic corals have a very similar structure; but the view that these extinct Heliolitids are allied to the Helioporids is strongly opposed by some eminent palæontologists. If these authorities be right, then *Heliopora* is an animal with no close living relations and with no known ancestors.

The only fossil that has been regarded with any probability as a possible link between *Heliopora* and the extinct Heliolitidæ is the Cretaceous coral *Polytremacis*, a genus founded in 1849 by d'Orbigny. The author discusses the type species (*P. blainvillei* Mich. *non* Reuss), and describes the structure. Thereafter, he discusses the relations of Helioporidæ and Heliolitidæ.

Polytremacis agrees with the Heliolitidæ in many remarkable points of structure, such as the presence of the aureole, the closure of dead calicles by cœnenchymal overgrowth, and the inconstancy of the septa in the lower parts of the calicles. *Polytremacis* is allied to *Heliopora* by equally striking points of resemblance, such as the fluted calicular walls, with their numerous irregular septal ridges, the granular external surface with its circumcalicular ring of septal teeth. On the axiom that things that are allied to the same are allied to one another, the close affinity of *Heliopora* and *Heliolites* seems more probable than some palæontologists are inclined to admit. *Heliopora*, in fact, may have descended from the Heliolitidæ by the reduction in size and consequent increase in number and in variability of arrangement of the cœnenchymal cæca.

In his systematic synopsis, Prof. Gregory adopts the following arrangement:—

Order Cœnotheculia, Bourne.
- Fam. 1. Heliolitidæ.
- Fam. 2. Helioporidæ.
  - Genus 1. *Heliopora.*
    - *H. somaliensis* sp. n.
    - *H. edwardsi* Stoliczka
    - *H. boettgeri* Fritsch.
  - Genus 2. *Polytremacis*, 5 sp.
  - Genus 3. *Octotremacis* g. n.

* Jen. Zeitschr. Naturwiss., xxxiii. (1899) pp. 1–180 (5 pls.).
† Proc. Roy. Soc., lxvi. (1900) pp. 291–305 (1 pl.).

Porifera.

New Sponge Pigment.*—Dr. C. A. MacMunn has investigated the characters of the purple pigment of *Suberites wilsoni*, an Australian sponge. The pigment is soluble in dilute acid and dilute alkaline solutions, and gives a banded spectrum. It is very stable, and can be readily obtained in a fairly pure condition. Its relations and constitution have not yet been made out.

Later Development of Sycons.†—Dr. Otto Maas set before himself a double problem in reference to the development of Sycons:—(1) the conversion of the larva after fixation into the functional sponge in its simplest Ascon form; (2) the conversion of the tubular Ascon into the complicated Sycon. As the latter process is slow, the two could not be followed in the same species; *Sycandra setosa* therefore formed the object of the first investigation, and *S. raphanus* of the second. As to the first point, sections confirmed Schultze's observations on the metamorphosis, and showed the continuity of the two cell layers through the metamorphosis. The dermal cells divide by a mitotic process to produce small cells from which the first spicules arise. Further differentiation occurs among the dermal cells; and as the little sponge becomes distended the following kinds of elements become obvious:—

(*a*) Belonging to the gastral layer:
  (1) Collar cells.
(*b*) Belonging to the dermal layer:
  (2) Epithelial covering cells.
  (3) Pore-cells.
  (4) Spicule-cells.
(*c*) Belonging to no germinal layer:
  (5) Wandering amœboid cells which become genital cells later.

By the opening of the pores the sponge then reaches the functional Ascon stage.

In the process of conversion of such an Ascon into a Sycon, the Sycon tubes appear in a circle about the middle of the sponge, and this first circle is followed by others. As the tubes grow out from the central cavity, the collar-cells, as is well known, become confined to the tubes, and the central cavity between the tubes is lined by the flattened cells which constitute the so-called gastral membrane of authors. This "gastral membrane" is, however, not produced by a modification of gastral cells, but is due to the ingrowth of dermal cells, which push themselves inwards from the exterior so as to interrupt at regular intervals the original continuity of the gastral layer. This position is supported by some admirably clear figures of sections.

Collar-Cells of Sponges.‡—Fr. Zemlitschka has investigated the question whether the collar-cells of sponges actually take up solid particles, and if so, what becomes of the particles. He finds that in *Sycandra raphanus* it is the collar-cells only which take up particles suspended in sea-water. If the particles be indigestible, e.g. particles of carbon, they do not give them up to the cells of the intermediate

* Quart. Journ. Micr. Sci., xliii. (1900) pp. 337–49 (1 pl. and 2 charts).
† Zeitschr. wiss. Zool., lxvii. (1900) pp. 215–46 (4 pls.).
‡ Tom. cit., pp. 241–6 (2 figs.).

layer, but pass them out again into the sea-water. The cells in the neighbourhood of the chamber-pores take up particles suspended in the incoming sea-water more readily than the other cells.

Protozoa.

Sporulation in Amœba.*—Herr C. Scheel describes and figures this mode of multiplication in *Amœba proteus*. The pseudopodia are drawn in; a spheroidal form is assumed; a layered cyst is secreted; within this the amœba rotates rapidly, once a second, for several days, and then rests; the nucleus divides till there are about 500–600 arranged peripherally; cell-boundaries gradually appear, and the small amœbæ—10–14 μ in diameter—break out of the softened cyst. The whole process takes from $2\frac{1}{2}$ to 3 months.

Senility of Infusorians.†—Prof. N. Kulagin studied the generations of a species of *Paramœcium*, and observed the diminution of size and agility. But he also noticed that, if an individual is removed to a fresh vessel, there is immediate recuperation or rejuvenescence. This led him to a conclusion somewhat different from that of Maupas and others. He believes that when Infusoria have lived for several generations in the same water, they have, so to speak, spoilt the water by the excretion of substances analogous to toxines, and that these gradually accumulate until they affect the health of the nuclei.

Eye-Spot in Euglena.‡—Mr. Harold Wager has obtained some interesting and novel results from the study of this structure. He finds that the eye-spot consists of a mass of pigment-granules apparently imbedded in a protoplasmic framework. It is placed in close contact with the gullet, which is found to open into the large excretory reservoir. The flagellum is attached by a bifurcated base to the posterior side of the reservoir, and one of the forks has on it an oval swelling, which lies close to the eye-spot. It would appear that the light absorbed by the eye-spot acts upon this swelling, and so modifies the movements of the flagellum. If this be so, then *Euglena* possesses a very simple form of light-organ, consisting of a sensitive region—the swelling on the flagellum—and a light-absorbing pigment-spot. Special mention should be made of the figures, which are in every way worthy of this clear and precise piece of work.

Tick Fever Parasite.§—Mr. R. Greig Smith gives a general account of this wide-spread parasite *Apiosoma* (*Pyrosoma*) *bigeminum*, a hæmatozoon which destroys the red blood-corpuscles. In consequence of the degradation and disintegration of the corpuscles, the capillaries become clogged, the internal organs intensely swollen; and the liver and kidneys being frequently unable to cope with the task of eliminating the products of the corpuscle disintegration, death results from what is essentially capillary congestion. So far as is definitely known, the disease occurs only among cattle, but two diseases of sheep have been described which appear to be caused by the same parasite. Infection occurs by

* Festschrift C. von Kupffer, Jena, 1899. See Amer. Nat., xxxiv. (1900) p. 332.
† Physiol. Russe. i. (1899) pp. 269–75.
‡ Journ. Linn. Soc., xxvii. (1900) pp. 463–81 (1 pl.).
§ Proc. Linn. Soc. N.S. Wales, xxiv. (1900) pp. 585–95.

means of the cattle tick (*Ixodes bovis*) in cases of Texas fever, tick fever, and hæmoglobinuria. In the bovine malaria of the Roman Campagna and of Turkey, there is no record of ticks associated with the disease. The paper forms a useful summary of the facts at present known.

Gregarines and Intestinal Epithelium.* — MM. L. Léger and O. Duboscq have studied the life-history of *Pyxinia möbuszi* which occurs abundantly in the intestine of the larva of *Anthrenus muscorum*, as well as of various other Gregarines, with special reference to the reputed occurrence of a true intracellular stage in Gregarines in general. They find that in *Pyxinia* the sporozoites escape from the sporocyst, are at first thread-like, but later become pyriform, and develop a small mobile appendix at their anterior extremity. By this appendix they attach themselves to the intestinal cells, but it is the appendix only which penetrates the cell. Möbusz, in studying Gregarines, was deceived by the resemblance between the parasites and certain secretory appearances in the intestinal cells, and believed that the former penetrated the cell completely. The authors have never found *Pyxinia* completely within a cell, and believe that the phenomenon is at most very exceptional among Gregarines, which are generally attached by the cap only.

Serum Reaction of Proteus vulgaris.†—Dr. A. Rodella finds that *Proteus vulgaris* is agglutinated by the blood of guinea-pigs which have been injected with virulent or dead cultures or with filtrates, and which have been repeatedly fed with Proteus cultures. Clumping was also observed in the blood of new-born guinea-pigs whose mothers had been infected 20–40 days before pigging with virulent cultures, and the milk of such guinea-pigs was likewise agglutinating. Chain-formation was also a marked feature of the reaction, but this did not occur with every Proteus-race. The agglutination is regarded by the author as a specific reaction, and he expresses his belief that the microbes included in the designation *P. vulgaris* are varieties of several species rather than one.

* Comptes Rendus, cxxx. (1900) pp. 1566–8.
† Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 583–91 (3 figs.).

BOTANY.

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

a. Anatomy.

(1) Cell-Structure and Protoplasm.

Energids and Cells.*—Sig. R. Pirotta reverts to Hanstein's idea of the protoplast as a general fundamental conception. Protoplasts may carry on an independent existence, or may combine—"monoplasts" or "polyplasts." Monoplasts may be devoid of membrane, and may then be termed *gymnoplasts*, or may be invested with a membrane, and are then *dermoplasts*. Gymnoplasts may be uninucleate (*monokaric*) or multinucleate (*polykaric*); and the same may be the case with dermoplasts (Peronosporaceæ, Saprolegniaceæ, idioblasts, &c.). In the Schizophyta there is no sharp differentiation between cytoplasm and nucleus. In polyplasts the union may be such that the separate protoplasts remain distinct, and they may then be termed *meriplasts*; when the polyplasts are so completely fused together that their cytoplasms form a single mass in which a number of nuclei are imbedded, Hanstein's term "symplasts" may be applied. When the union of the meriplasts is only temporary, the individuality of the protoplasts not being disturbed, they form a "protoplast-colony" or "energid-colony" (Goebel); such colonies may be formed either of gymnoplasts or of dermoplasts. Symplasts may also be either *gymnosymplasts*, such as plasmodes, or *dermosymplasts*, as latex-vessels.

Position and Function of the Nucleus.†—Pursuing his researches on the formation of non-nucleated cells, Herr J. J. Gerassimoff states that if the cells of *Spirogyra* are subjected to a more or less considerable cooling during division, daughter-cells may be obtained containing no nucleus. The tendency to a symmetrical arrangement of the cell-contents in *Spirogyra* depends on two constant forces—the action on one-another of the nucleus and of the other cell-contents, and the action on one-another of the nuclei themselves. The function of the nucleus may be regarded as the transmission to the other cell-contents of an energy generated in itself, comparable to the electric energy.

Reduction-division, Spindle-formation, Centrosomes, and Blepharoplasts.‡—The following is chiefly extracted from Prof. C. J. Chamberlain's review of this important work by Prof. E. Strasburger.

In agreement with Guignard and Grégoire, but in opposition to Belajeff and Weismann, Prof. Strasburger maintains that in the formation of spores from spore-mother-cells, the splitting of the chromosomes is, in both the nuclear divisions, longitudinal; there is, therefore, no reducing division. In the formation of the pollen-mother-cells, he reverts

* Riv. Sci. Biol., 1899, fasc. 3, 14 pp. See Bot. Centralbl., lxxxii. (1900) p. 116.

† Bull. Soc. Imp. Moscou, 1899 (1900) pp. 220–67 (35 figs.). Cf. this Journal, 1897, p. 134.

‡ 'Ueb. Reductionstheilung, Spindelbildung, Centrosomes, u. Cilienbildner im Pflanzenreich,' Jena, 1900, xx. and 224 pp. and 4 pls. See Bot. Gazette, xxix. (1900) p. 145.

to his original view that it does not precede the act of impregnation, but is the result of it. There is no contrast, as Němec has suggested, between the nuclear spindles of vegetative and those of generative cells; but, on the other hand, there are all grades of transition between multipolar and bipolar spindles. In the root-tips of *Ephedra major*, in the early prophase of division, a layer of delicate kinoplasm is formed about the nucleus, and this layer soon collects at opposite poles of the nucleus, where it appears as a pair of caps, the filamentous nature of which is easily recognised. As the nuclear membrane disappears, threads grow into the cavity, some of them becoming fast to the chromosomes, and others forming continuous threads from pole to pole.

The author comes to the conclusion that centrosomes are not present, or at all events their presence has not yet been proved, in the higher plants; the kinoplasm appears to take their place, and to perform, in the higher plants, the functions which it elsewhere shares with the centrosome. The details are described of the mode of formation, in some algæ, of the swarm-spores on the blepharoplast. Strasburger differs from Belajeff's interpretation of the blepharoplast as being homologous to the centrosome. He regards the cilium-bearing portion of the swarmspores of algæ as homologous with the equivalent structures in the antherozoids of the Characeæ and Archegoniatæ, and partly also with those of Gymnosperms. While it would be difficult to doubt the centrosome nature of the organ which gives rise to the tail of the animal spermatozoon, it is not necessary to assume that the bodies at the base of cilia in animals are centrosomes. The evidence does not point to the existence of similar bodies at the base of the cilia of swarmspores and gametes in plants.

Development of the Connecting-Threads of the Cell-wall. * — Pursuing his researches on the origin and development of the connecting-threads in the cell-wall, Mr. W. Gardiner states that they arise from the median nodes of the fibres of the achromatic spindle. The nodes are either (*a*) all continued as connecting-threads (endosperm cells of *Tamus communis*); or (*b*) in part continued, and in part overlaid by superposed lamellæ of cellulose membrane (endosperm cells of *Lilium Martagon*); or (*c*) all overlaid (pollen-mother-cells and pollen-grains of *Helleborus fœtidus*). With regard to the genesis of the cell-plate, the author regards it as originating not directly from the spindle-fibres, but indirectly. It appears to consist of ordinary cytoplasm; the primary cell-wall is secreted from it as an equatorial membrane traversed by the nodes of the achromatin spindle fibres. There appear to be grounds for regarding this primary cell-wall as different in genesis and character from the secondary formations which succeed it and arise from the general cytoplasm. The author is disposed to regard the cell-wall as fundamentally of the nature of a mucilaginous secretion, and stratification as the necessary accompaniment of the rhythmic periods of activity and rest of the secreting protoplasm.

Protoplasmic Connections in Viscum and Cucurbita. † — Herr F. Kuhla finds that all the living cells of *Viscum album* are in communi-

* Proc. Royal Soc., lxvi. (1900) pp. 186–8. Cf. this Journal, 1898, p. 598.

† Bot. Ztg., lviii. (1900) 1te Abt., pp. 30–58 (1 pl.).

cation with one another by protoplasmic connections. Even the sieve-tubes, with their conducting cells, are connected in this way with the surrounding cambiform, both in *Viscum* and in *Cucurbita Pepo*. No form of tissue constitutes a protoplasmic system in itself; in the whole of the plant the protoplasts are in connection with one another unaffected by the limits of the tissues. The thickness of the protoplasmic connections is, in *Viscum*, nearly uniform for all the cells; in the pits their number is about 130 for every square μ. As a rule they occur only in the pits, though they are found, in *Viscum*, in the unpitted walls between sieve-tubes and conducting-cells. The largest number of pits, and consequently of protoplasmic connections, occurs in elongated cells, such as those of cambiform or of the medullary rays, and on the transverse walls at right-angles to their longer axis. No certain evidence was obtained of a secondary formation of protoplasmic connections.

Changes in the Cell resulting from Fermentation.*—From observations made on the gourd, *Cucurbita maxima*, MM. L. Matruchot and M. Molliard record the following as the chief changes which take place in the cells themselves as the result of fermentation properly so-called:—The nucleus assumes a very light colour from the partial disappearance of the chromatin, the portion which remains being located in the periphery of the nucleus; the protoplasm becomes greatly vacuolated, and in its interior are formed a number of drops of an essential oil. This latter process appears to be a constant result of fermentation.

Cell-Changes in Drosera.†—Herr O. Rosenberg publishes the result of a series of observations on the cytological changes produced in the cells of the tentacles of *Drosera rotundifolia* through the influence of various food-materials, as well as on the phenomena of cell-division in the various tissues, vegetative and reproductive.

In the vegetative cells the spindles are developed from caps of kinoplasm, and in the pollen-mother-cell the presence of a delicate zone of granular kinoplasm and fibrillæ encircling the nucleus indicates the beginning of the formation of the chromatin part of the nuclear figure.

The food-materials employed were very numerous:—Albumen, pepton, flesh, cheese, sugar, bread, hæmoglobin, and other organic substances; borax, calcium nitrate, calcium phosphate, ammonium oxalate, &c. Feeding the leaves with organic material brings about very shortly changes in the cytoplasm and nucleus of the epidermal cells of the tentacles. Peculiar granules appear in the cytoplasm near the nucleus, and the tannin vacuoles become more prominent. The chromatin of the nucleus increases greatly in quantity along the linin-network, and finally collects as longer or shorter rods on the membrane. The chromatin finally takes the form of a thick thread, and the linin-network cannot be followed. During the process of feeding, the nucleole usually grows smaller until it becomes very insignificant, but there is no fixed relation between the decrease in the size of the nucleole and the great increase in the amount of chromatin. Other cells in the tentacles are affected in the same way, those of the endoderm and stalk

* Comptes Rendus, cxxx. (1900) pp. 1203 5.

† 'Phys.-cytol. Unters. üb. Drosera rotundifolia,' Upsala, 1899, 126 pp., 2 pls., and 6 figs. See Bot. Gazette, xxiv. (1900) p. 294.

exhibiting similar changes. The feeding of the leaf is almost always accompanied by an excretion of mucilage from the epiderm.

Effect of Cold on the Nucleus.*—MM. L. Matruchot and M. Molliard describe the effect produced by cold on the nucleus of the parenchymatous cells of the leaves of *Narcissus Tazetta*. The phenomena may be compared, in general terms, to those of karyokinesis. In the first stage the meshes of the network become larger and the filaments thicker; the chromatin accumulates at the nodes of this network. The nucleus has a tendency to become bipolar, and the filaments of the chromatic network to place themselves in a direction parallel to a line connecting the poles. At a later stage a continuous equatorial ring is formed of uniform breadth; there is at this stage no trace of a nucleole. A subsequent stage is characterised by the formation of a number of protoplasmic vesicles.

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

Structure of Chlorophyll.†—According to Herr G. Bode, chlorophyll grains contain a lecithin-compound (glycerin phosphate, cholin, fatty acids), with which is combined the magnesium salt and a phytosterin. The magnesium compound is fully developed only in full light. The chlorophyll, which can be isolated from the lecithin-compound by the action of potash-lye or sulphuric acid, can enter into combination on the one hand with the alkalis, alkaline earths, and metals, on the other hand with hydrochloric, phosphoric, or sulphuric acid. Phylloxanthin is merely a mixture of various components of the lecithin-compound with chlorophyllar and yellow pigments.

Structure of Starch-grains.‡—Mr. H. Kraemer claims to have determined, from treatment with iodine and anilin pigments, that the layers in a starch-grain consist of a substance rich in colloids but poor in crystalloids, alternating with a substance rich in crystalloids but poor in colloids.

Proteinaceous Substances in Seeds.§—Dr. Th. Bokorny thus sums up the present state of our knowledge on this subject:—The proteinaceous substances soluble in a 5–10 per cent. solution of sodium chloride (globulins) are stored up in the protein-grains and albumen-crystals of seeds. The protein-grains (also known as aleurone-grains) vary in size from 1 to 55 μ; they attain the largest size in oily seeds; in the endosperm of cereals they are very small, but are never absent. The presence of active protein could never be detected in the grains. The fibrin (*Kleberstoff*) of cereals is a quite peculiar substance. It is soluble in 70–80 per cent. cold or hot alcohol, a reagent which precipitates other proteinaceous substances. The author was unable to detect any pepton, at least in dormant seeds; propeptons or albumoses are occasionally found in very minute quantities. Simple amido-substances, asparagin, tyrosin, leucin, &c., are very widely distributed in seeds and the vegetative parts of plants; they appear to be the first

* Comptes Rendus, cxxx. (1900) pp. 788–91.
† 'Unters. üb. d. Chlorophyll,' Cassel, 1898. See Bot. Centralbl., lxxxii. (1900) p. 51.
‡ Bot. Gazette, xxix. (1900) p. 139.
§ Bot. Centralbl., lxxxii. (1900) pp. 289–306.

products of decomposition, and the first stage in the formation of proteinaceous substances.

Occurrence of Albumin, Albumose and Pepton in the Vegetative Organs.* — By extracting the finely pulverised vegetative parts of plants with cold water and filtering, Dr. Th. Bokorny finds albumin (using the term to designate those coagulable substances which can be extracted by potassa) to be very widely distributed in the vegetative parts of plants, as in the seeds. It occurs also in Algæ (*Spirogyra*, *Oscillatoria*); but neither pepton nor propepton could be detected in them, though present in yeast and *Penicillium*. Both peptons and propeptons (albumoses) are very rare in plants; they appear to be confined to Fungi and carnivorous plants. Vegetable protoplasm breaks up the proteids directly into simple organic substances; and plants have also the property of transforming these simple substances again into albumen.

Ferment of Seeds with Horny Endosperm.† — MM. E. Bourquelot and H. Hérissey regard the carob, *Ceratonia siliqua*, as the type of seeds with a horny endosperm, composed, for the greater part, of mannane and galactane. During germination, the embryo secretes a soluble ferment, which hydrolyses the carbohydrates of the endosperm, producing mannose and galactose. They have obtained similar results with the fenugrec (*Trigonella fœnum-græcum*) and the lucerne (*Medicago sativa*). The action of these soluble ferments is comparable to that of dilute sulphuric acid. For the ferment obtained from these two plants, which appears to be distinct from that of the carob, they propose the term "seminase." The reserve-carbohydrates are mannogalactanes capable of being hydrolysed by the seminase.

Alleged Proteolytic Enzyme of Nepenthes.‡—M. E. Couvreur supports the statement of Dubois that there is, in the pitcher of *Nepenthes*, no proteolytic enzyme. He states that Prof. Vines has been led to a contrary conclusion by the use of sodium carbonate instead of soda. It is well known that solutions of neutral salts are capable of producing a true digestive action on albuminoids.

Crystals in Datura Stramonium.§—Mr. H. Kraemer has studied the form and distribution of the crystals of calcium oxalate in various species of the Solanaceæ. In *Atropa* and *Solanum* they occur uniformly in some of the parenchyme cells of the root, stem, and leaves. In *Hyoscyamus* these cryptocrystalline crystals may be replaced for the most part by monoclinic prisms or pyramids; and in *Datura stramonium* by rosette aggregates and other crystals. The form and distribution of the crystals in this species are described in detail. The cryptocrystalline crystals, which are found in such abundance in the parenchyme of the root and stem, are replaced in part in the petioles and veins of the leaf by prisms, pyramids, and rosette aggregates, while in the lamina the prisms and pyramids are combined to form rosette-shaped aggregates only. Pro-

* Pflüger's Arch. gesam. Phys., 1900. See Bot. Centralbl., lxxxii. (1900) p. 367. Biol. Centralbl., xx. (1900) pp. 53–7.

† Comptes Rendus, cxxix. (1899) pp. 391–3; cxxx. (1900) pp. 42–4, 340–2, 731–3.

‡ Op. cit., cxxx. (1900) pp. 848–9. Cf. this Journal, 1899, p. 292; *ante*, p. 76.

§ Bull. Torrey Bot. Club, xxvii. (1900) pp. 37–9.

bably all the various forms of crystal in *Datura stramonium* belong to the monoclinic system.

Lithium in Plants.*—Herr E. Tschermak finds lithium to be a much more widely diffused substance in the vegetable kingdom than has hitherto been supposed. He detected it only in the leaves, the finer portions of the stem, the flower, and the fruit.

(3) Structure of Tissues.

Vascular System in Ricinus.†—Miss Edith Chick has undertaken an examination of the vascular system of the hypocotyl and embryo of the castor-oil plant, with a view to determine the origin of the (eight) bundles in the young hypocotyl which are ultimately united by a band of interfascicular cambium. They were found always to result from the splitting of four original stem-bundles. Further details are given with regard to the branching and distribution of the bundles in the embryo, hypocotyl, and epicotyl; and the authoress emphasises the primary importance of the bundle as an anatomical unit in the stem of typical Angiosperms, and the dependence of the stele on the close lateral approximation of the bundles for continuity of the tissues of external conjunctive, since the latter are primarily arranged in relation to the separate bundles.

(4) Structure of Organs.

Structure of Flower of Dicentra.‡—Prof. E. Martel discusses in detail the floral structure of *Dicentra spectabilis*, and comes to the conclusion that the carpels of *Hypecoum* do not correspond to those of the Fumariaceæ and the Cruciferæ, but that, on the contrary, the antero-posterior stamens of *Hypecoum* are homologous to the antero-posterior carpels in those two orders.

Style and Stigma of Compositæ.§—M. F. Guégen has studied the structure of these organs in a large number of species belonging to the different tribes of Compositæ. As a general conclusion he states that their variations are not of systematic value in characterising the tribes or genera. The conducting tissue of the style presents great uniformity of structure. It is always composed of collenchymatous tissue, which guides the pollen-tube in its course to the ovary. The arrangement of the xylem of the fibrovascular system is also very uniform; that of the phloem is subject to great variation, except in the Cynareæ and Labiatifloræ. The style is the organ which, in Compositæ, least frequently contains a secreting system; but when laticiferous cells or tubes occur in it, they are more fully developed than in any other organ of the plant. The styles of the central and of the peripheral parts of the capitule often display a dimorphism in this respect, as in the Anthemideæ and Calenduleæ.

Heterocarpy of the Compositæ.‖—Sig. L. Nicotra describes in great detail the size, colour, form, &c., of the fruit, and the development of

* Zeit. Landw. Vers.-Wesen Oesterreich, ii. pp. 560–72. See Journ. Chem. Soc., 1900, Abstr. ii. p. 235.

† Proc. Roy. Soc. Edinburgh, xxii. (1900) pp. 652–72 (3 pls.).

‡ Mem. Accad. Sci. Torino, xlix. (1900) pp. 55–72 (3 pls.). Cf. this Journal, 1899, p. 504.

§ Bull. Soc. Bot. France, xlvii. (1900) pp. 51–70 (41 figs.).

‖ 'Della eterocarpia, segnatamente nelle Sinanteree,' Sassari, 1899. See Bot. Centralbl., lxxxii (1900) p. 331.

the pappus, in 113 genera of Compositæ, in which these points of structure vary in the same individual. This heterocarpy is most strongly displayed in the genera *Anthemis*, *Calendula*, *Hypochæris*, *Filago*, and *Buphthalmum*.

Theory of Phyllotaxis.*—Prof. S. Schwendener replies at length to Schumann's objections to his theory of phyllotaxis. He maintains that the problem of the law of arrangement, e.g. of the flowers in the capitule of a sunflower, cannot be determined by empirical observation, but only by the application of geometrical and mechanical laws.

Phyllotaxis of Impatiens glanduligera.†—The varying arrangement of the leaves in this plant can, according to M. P. Vuillemin, be traced back to an original decussate type. The greater number of the leaves on the stem are usually arranged in whorls of three, but, intermediate between the lowest of these whorls and the cotyledons, is a whorl of four, or less often two pairs of leaves arranged decussately. An examination of the occurrence of buds in the axils of the leaves shows that the whorls of three are false whorls, due to a torsion of the cotyledons which originates within the seed.

Roots and Mycorhiza of the Monotropaceæ.‡—Prof. D. T. MacDougal and Mr. F. E. Lloyd give the following as general characteristics of all the Monotropaceæ at present studied. The roots lack chlorophyll and usually also stomates. The stele is much reduced, and consists only of perforated vessels and companion cells. The mycorhiza encloses the tip and penetrates the epiderm, forming special structures in the latter. The relation of fungus to host is one of pure symbiosis.

β. Physiology.

(1) Reproduction and Embryology.

Double Impregnation in Tulipa.§—M. L. Guignard gives further details of his observations on this subject. *Tulipa celsiana* and *sylvestris* are characterised by the slight differentiation of the cells developed in the embryo-sac before impregnation. They are not, as in other plants, arranged in two groups, one at the apex, the other at the base of the sac, with the secondary nucleus towards its centre. Three of them only are distinguished from the others by their morphological characters; two of these, representing the nuclei of the synergids, occupy the summit of the sac, and remain smaller, and in appearance more chromatic. The third, situated towards the base of the sac, sometimes larger and sometimes smaller than the five others, grouped towards the centre of the sac, exhibits at a very early period a differentiation from these latter in the structure of its chromatic framework, formed of more delicate and more condensed elements, accompanied by a large number of nuclei. The central nuclei, on the contrary, exhibit distinct chromatic filaments, imbedded in which there are usually only one or two nuclei. The protoplasm of some of the nuclei is invested by a distinct membrane; even at the period when the pollen-tube passes its contents into the embryo-

* S.B. k. Preuss. Akad. Wiss. Berlin, 1899, pp. 895–915 (5 figs.).

† Bull. Soc. Bot. France, xlvii. (1900) pp. 70–4.

‡ Bot. Gazette, xxix. (1900) p. 138.

§ Ann. Sci. Nat. (Bot.), xi. (1900) pp. 365–87 (3 pls.). Cf. this Journal, *ante*, p. 349.

sac, there is nothing to distinguish the oosphere from the other nuclei. The antherozoids, when entering the embryo-sac, are elongated usually curved nuclei, but are not coiled. As in *Lilium*, *Fritillaria*, and *Endymion*, the first division of the ovum-cell which forms the embryo is always preceded by that of the impregnated secondary nucleus which gives birth to the endosperm.

Fertilisation in the Coniferæ.*—Z. Wójcicki gives the following as the results of his observations on *Larix dahurica*. In the pollen-tube are two generative cells and two nuclei, that of the pollen-tube and that of the posterior absorbed cell, which both enter the oosphere. The protoplasm of the generative cells soon coalesces with that of the oosphere. The larger of the two generative nuclei forces itself into the ovum-nucleus, and coalesces completely with it. Karyokinetic division then takes place in the nucleus of the embryo, in which only its central part participates; the relatively small spindle, with the chromosomes, lies in the interior of the membraneless nucleus, surrounded by a broad zone of nuclear substance, which may be recognised as a delicate network of small feebly stainable granules. The second stage of division takes place within these remains of nuclear substance, which appear subsequently to fuse with the adjacent zone of denser protoplasm. After the complete development of the four daughter-nuclei, they sink, together with the surrounding zone of protoplasm, to the base of the oosphere, forming there, by threefold division, four groups, each of four nuclei. The protoplasm of the three lower groups, which represent the embryo, is divided off by cell-walls, while the nuclei of the uppermost group remain free. The second sperm-nucleus can still be recognised at this stage in the upper part of the oosphere.

Endosperm of Sequoia.†—Herr W. Arnold describes the development of the endosperm in *Sequoia sempervirens*, comparing it with that in *Gnetum* on the one hand, and with that in typical conifers on the other hand; from which he draws the conclusion that *Sequoia* is a connecting link between *Gnetum* and the Angiosperms on the one hand, and between the Gymnosperms and the Archegoniatæ on the other hand.

The form of the embryo-sac is very variable. At a very early period the protoplasm forms a parietal layer through which numerous nuclei are distributed, enclosing a large vacuole; the nuclei multiply in the ordinary karyokinetic way. The layer of protoplasm increases in thickness, and accumulates especially at the lower end of the embryo-sac. In the upper and lower portions of the embryo-sac a formation of endosperm now takes place by free-cell-formation; while in the central portion it is formed in quite a different way. Here a large vacuole still remains after the increase of the protoplasm in the upper and lower portions, the vacuole being surrounded on all sides by protoplasm in which a number of nuclei are imbedded. In this protoplasm are found numerous vesicles (*Alveolen*), as in other Coniferæ, one being formed round each nucleus, each ultimately breaking up into several cells by the division of its nucleus. The tissue formed by free-cell-formation in the lower portion of the embryo-sac serves only as a store of nutriment for the future

* In Russian; Warschau, 1899, 2 pls. See Bot. Ztg., lviii. (1900) 2te Abt., p. 39.

† Bull. Soc. Imp. Nat. Moscou, 1899 (1900) pp. 329–41 (2 pls.). Cf. this Journal. 1896, p. 647.

embryo; it is in the central tissue alone, derived from the preliminary formation of vesicles, that the archegones are developed. In the division into vegetative and generative portions we have a form of endosperm at present known only in *Gnetum* and *Sequoia* among Gymnosperms.

Embryogeny of Silphium.*—In a general account of the structure and biology of this genus of Compositæ, Mr. W. D. Merrell has the following notes on its embryogeny. When the male nuclei enter the embryo-sac, they have (in three of the species examined) a sinuous or spiral form, a phenomenon not before recorded in Dicotyledons; but finally the spiral form is lost, the nucleus being merely slightly bent. The pollen-tube enters the embryo-sac just below the edge of the nucellar cap. Impregnation may be accomplished without the previous disorganisation of either of the synergids. The division of the definitive nucleus precedes that of the oosphere. The polar nuclei fuse before impregnation, and the definitive nucleus lies near the egg-apparatus. The antipodals are arranged in a row, as is usual in Compositæ. The nuclei of the pollen-mother-cells show a well-marked synapsis stage, and pass quickly from this to the formation of the spindles for the first division. In the equatorial plates of this spindle the reduced number of chromosomes, eight, was repeatedly counted. The second division follows immediately after the first.

Embryogeny of Lathræa.†—Prof. R. Chodat and M. C. Bernard describe the following speciality in the development of the embryo of *Lathræa squamaria.* From the chalazal cell of the two resulting from the division of the secondary nucleus there springs a "haustorium" immediately beneath the endosperm-cells, in an equatorial direction; it is thick, and grows in length until it reaches the raphe. The starch contained in the integument disappears when in contact with it. A second haustorium is then formed at the micropyle from one of the upper endosperm cells; it is thin at its base, but swells out to a gut-like form as it traverses the integument to reach the placenta. Within the tube a multiplication of nuclei takes place. The embryo-sac of *Lathræa squamaria* contains therefore two "haustoria," one equatorial, the other micropylar.

Embryo-sac of Saururus.‡—According to Mr. D. S. Johnson, the primary archesporial cell divides, in *Saururus cernuus* (nearly allied to Piperaceæ), into an upper tapetal and a definitive archesporial cell, which forms three potential megaspores, the lower one becoming functional, and developing the usual 7-nucleated embryo-sac, which becomes flask-shaped. The antipodals soon become indistinguishable, and endosperm forms in the neck of the flask before any change appears in the oosphere.

Development of the Pollen-grain in Symplocarpus and Peltandra.§—Mr. B. M. Duggar has studied the development of the pollen-grain in *Symplocarpus fœtidus* and *Peltandra undulata*, both belonging to the Aroideæ. Among the points of interest are the following. During the initiation of the spirem stage the nucleole has a distinctly budded form, sometimes consisting of a single large body and of one or two smaller

* Bot. Gazette, xxix. (1900) pp. 99–133 (8 pls.).
† Arch. Sci. Phys. et Nat., ix. (1900) pp. 92–4.
‡ Bot. Gazette, xxix. (1900) p. 136. § Tom. cit., pp. 81–98 (2 pls.).

ones closely united, or two of nearly equal size. It is often evident that the spirem thread is connected with these nuclear parts. On the disappearance of the nuclear membrane in *Symplocarpus* the kinoplasmic fibres entering the hollow are quickly oriented as a multipolar spindle with rather indefinite apices. The next stage is a multipolar spindle with very few poles, followed finally by a bipolar spindle. In *Peltandra* there is a less definite multipolar spindle than in *Symplocarpus*, although the general form is evident. On the dissolution of the membrane of the microspore mother-cells, the tapetal cells become free, and wander in between the maturing microspores; they lose their identity, and become a protoplasmic stratum in which the microspores are imbedded. In *Symplocarpus* there is no division of the generative nucleus in the pollen-grain. The vegetative nucleus usually passes first into the pollen-tube. The generative nucleus passes into the tube while still enclosed within its cell-membrane.

Cross-Pollination and Self-Pollination. — The late Mr. G. W. Ord * gives some interesting particulars respecting the visits of lepidoptera to flowers. With regard to moths, he believed that colour is of little importance in attracting them; they will find their way even to inconspicuous flowers by the sense of smell; white flowers seem to be a hindrance rather than a help even to night-flying moths.

All the species of *Romulea* are, according to Sig. A. Béguinot,† proterandrous, and are adapted for entomophily, but can be self-pollinated when this fails. The flowers are remarkably polymorphic, varying in colour, in the size of the perianth, in heterostyly, and in polygamy.

Prof. G. Arcangeli ‡ describes the facilities for the carriage of pollen in several species of Cucurbitaceæ, with the insects which assist in the process. In *Luffa cylindrica*, which has extra-floral as well as floral nectaries, the same kind of insect was in no case observed to visit both kinds of nectary.

Mr. J. G. Needham § gives an elaborate account of the floral biology of *Iris versicolor*, the contrivances for facilitating the obligatory cross-pollination by insects, the insect-visitors, and the mode in which hurtful insects are misled by the deceptive colour-streaks on the petals. He believes the efficient insects, mainly bees, to be largely guided in their visits to the nectaries by the coloration of the flowers.

Law of "Splitting" of Hybrids.‖ — M. H. de Vries lays down the law that a hybrid never "halves" any of the special characters either of the father or of the mother. It inherits some characters of the one, some of the other parent. When the parents differ on only one point, the hybrid does not occupy an intermediate position, but resembles one or the other parent. In the hybrid, the simple differential character of one of the parents is evident or "dominant," while the antagonistic character of the other parent is latent or "retrogressive." These antagonistic characters usually remain combined during the whole of the vegetative life of the hybrid, the one dominant, the other latent; but in the reproductive period they become separated; each pollen-grain and

* Trans. Nat. Hist. Soc. Glasgow, v. (1900) pp. 355–66.
† Bull. Soc. Bot. Ital., 1899, pp. 214–22. ‡ Tom. cit., pp. 198–204.
§ Amer. Natur., xxxiv. (1900) pp. 361–86 (1 pl. and 4 figs.).
‖ Comptes Rendus, cxxx. (1900) pp. 845–7.

each oosphere receives only one of the two. This is the law of "splitting" (*disjonction, Spaltung*).

Hybridisation in Citrus.*—Mr. H. J. Webber points out that in polyembryonal seeds of *Citrus* which are the result of hybridisation, only one of the embryos shows any trace of the characters of the male parent, while all the others resemble the female parent. Probably the true hybrid is derived from the fertilised oosphere, all the others from adventitious embryos produced in the nucellar tissue.

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

Physiological Action of Mineral Nutrient Substances.†—Herr O. Loew has investigated the part played by various mineral substances in the nutrition of the plant.

Phosphoric acid is used up in the formation of lecithin and of nucleo-proteids, e.g. chromatin and plastin. Salts of iron are utilised in the formation of chlorophyll and of hæmoglobin. Iron is universally present in Fungi. Potassium salts are absolutely necessary for the thrift of the plant; they cannot be replaced by corresponding salts of sodium or lithium. Calcium and magnesium occur in all parts of plants; the leaves usually contain more calcium, the seeds more magnesium, than the other parts. Calcium-proteinaceous substances appear to be necessary to the constitution of the organised substances from which the nucleus and the chlorophyll grains are formed; the calcium cannot be replaced by other bases. Calcium salts promote the growth of the root-hairs. They are not, however, necessary to the life of Fungi, Bacteria, or the lower Algæ. In the absence of calcium, magnesium is poisonous to the higher plants. It is readily dissociated, and hence assists assimilation, especially of the phosphoric acids, and is therefore of great service in the formation of the nucleo-proteids. Magnesium salts are necessary for the thrift of Fungi.

Effects of Diminished Pressure on the Growth of Plants.‡—Herr F. Schaible confirms the statement of Wieler and Jaccard that the growth of plants, and especially of the leaves, is promoted by a diminution of the atmospheric pressure, while germination is retarded. The latter phenomenon appears to be the result of a diminution of the amount of oxygen in the atmosphere, the former directly of a diminution in the pressure.

Relation of Arctic Plants to Light.§—Prof. J. Wiesner states that in the Arctic region the amount of light which reaches the plant amounts to very nearly the maximum possible. The leaves are deprived of very little by the shade either of the plant itself, or that of other plants; but it does suffer to some extent from the configuration of the ground. The necessity of a very large amount of light for Alpine plants is a result of

* Bot. Gazette, xxix. (1900) p. 141.

† U.S. Dept. Agriculture; Div. Veg. Phys. and Pathol., Bull. No. 18, 1899, 60 pp.

‡ Beitr. z. wiss. Bot. (Fünfstück), iv. (1900) pp. 93–148 (8 pls. and 3 figs.). See Bot. Centralbl., lxxxii. (1900) p. 52.

§ S.B. k. Akad. Wiss. Wien, May 3rd, 1900. See Bot. Centralbl., lxxxii. (1900) p. 316.

the low temperature; the two being in inverse proportion to one another. The leaves of Alpine plants exhibit, as a rule, but very slight heliotropism. In this and in other respects the relationship of Arctic plants to light differs materially from that of Alpine plants.

Biology of Creeping Plants.*—M. A. Maige has made a study of the structure and properties of those plants which present creeping stems, whether aërial or subterranean. The creeping habit of a branch is always due to a form of geotropism which may be termed transverse. These branches possess either positive or negative heliotropism, and a geo-epinasty which determines a more or less considerable convexity of the branch. When an erect becomes transformed into a creeping branch, it passes through a series of oblique positions, each of which corresponds to an oblique geotropic sensitiveness. Direct light produces on some species darkness, on others a variation in the geotropic sensitiveness of obliquely or transversely geotropic branches, and a return to a geotropism more nearly allied to negative. Diffused light may transform the negative geotropism of creeping branches into transverse. The first internodes of creeping branches display a rapid intercalary growth, giving a characteristic appearance to the terminal bud. The nodes are furnished with adventitious roots, and the power of producing these roots has become hereditary.

Carbon-dioxide Assimilation and Chlorophyll.†—Herr F. Czapek gives a useful *résumé* of recent literature on this subject, which shows that the assimilation of carbon dioxide by chloroplasts in the light is not dependent alone either on the action of the chlorophyll pigment, or on the activity of the colourless protoplasmic stroma of the chlorophyll grain.

Influence of Copper Salts on Plants.‡—Experiments made by MM. E. Chuard and F. Porchet tend to show that the favourable effects of compounds of copper (Bordeaux mixture) on the growth and fertility of plants have been exaggerated. The increase in the amount of sugar in the fruit (grapes, gooseberries) never exceeded from 1 to 2 per cent. Copper was never found in the leaves. The deeper colour of the leaves is not due, they assert, to an increase in the amount of chlorophyll.

Action of Leguminous Root-nodules in Water Cultures.§—Herren F. Nobbe and L. Hiltner find that the root-nodules of leguminous plants (*Robinia pseudacacia*) are of little use to the plant when growing in water. The structure of the nodules is altered, and they are filled with water instead of air. When kept under water, they increase but very little in size.

Transpiration from Leaves which live more than one year.‖—Herr O. Rosenberg records the results of observations on the amount of transpiration in those woody plants the leaves of which live more than one year. He states that the stomates of last year's leaves are still not closed for some time after the transpiration from this year's leaves

* Ann. Sci. Nat. (Bot.), xi. (1900) pp. 249–365 (4 pls. and 21 figs.).

† Bot. Ztg., lviii. (1900) 2te Abt., pp. 65–70.

‡ Bull. Soc. Vaudoise Sci. Nat., xxxvi. (1900) pp. 71–7.

§ Landwirth. Vers.-Stat., lii. (1899) pp. 455–65. See Journ. Chem. Soc., 1900, Abstr. ii. p. 234.

‖ Ofv. k. Vetensk. Akad. Förhandl. Stockholm, lvii. (1900) pp. 85–98 (German).

has fallen to a minimum. He further points out that Stahl's cobalt-test * can only be reduced with great caution in estimating the *amount* of transpiration from leaves.

(3) Irritability.

Conduction of Irritation in Plants.†—Dr. B. Němec claims to have detected, in the root of the hyacinth, a special tissue through which the irritation-current is conducted, comparable to the nerve-fibrillæ described by Apáthy in the Metazoa, and which he believes to exist in a large number of vascular plants. The structure consists of rows of cells running parallel to one another, and either merely in contact with one another or actually in communication by threads of protoplasm. The row of cells always lies in the direction in which the irritation is to be conducted. In the youngest portion of the root-apex their direction is usually nearly radial, in the central part longitudinal; they are often curved or twisted. In addition to protoplasm the cells contain starch-grains, the position of which is very unstable.

Geotropic Curvatures.‡—As the result of a series of experiments on nodes of grasses and roots of *Vicia Faba*, Mr. G. E. Stone has determined that the horizontal position is that of greatest geotropic excitability, and that the relationship in this respect between nodes at oblique angles and horizontal nodes is proportional to the cosines of their angles.

Periodic Movements of Plants.§—Miss D. F. M. Pertz and Mr. F. Darwin state that if a sleeping plant is placed in a dark room after its leaves have assumed the nocturnal position, its leaves will return on the next morning to the diurnal position, notwithstanding the darkness. In the same manner, if a plant is darkened after having responded to one-sided illumination, it will return to the oblique position on awaking next day in complete darkness.

Paratonic Growth-curvatures in "Hinge-plants."‖—By the term "hinge" (*Gelenk*) Dr. F. G. Kohl describes what he calls a special organ, that portion of a stem, always near a node, separated by an internode from the nearest similar portion capable of movement, and placed between two rigid portions of the stem. The "hinge-plants," or those which possess such an organ, may be divided into two groups, those in which the curvature movements are primarily and those in which they are secondarily paratonic. In the first class the paratonic curvature takes place during growth; in the second it is the result of subsequent external forces.

In the species which was chiefly the subject of investigation, *Tradescantia viridis*, it is usually the third or fourth node that is sensitive to geotropic irritation. The internodes are not subject to geotropic irritation, but can conduct it, though only in the basipetal direction. The cells in the neighbourhood of the hinge are characterised by the large amount of sugar which they contain.

* Cf. this Journal, 1895, p. 130.
† Biol. Centralbl., xx. (1900) pp. 369–73 (1 fig.).
‡ Bot. Gazette, xxix. (1900) p. 136.
§ Proc. Cambridge Phil. Soc., x. (1900) p. 259.
‖ Bot. Ztg., lviii. (1900) 1te Abt., pp. 1–28 (2 pls. and diagrams).

Mechanism of Root Curvature.*—From observations made chiefly on *Vicia Faba*, Mr. Jas. B. Pollock comes to the following general conclusions. The transmission of the stimulus from the sensitive tip to that part of the root which curves takes place in the cortex, and this may be on either the concave or the convex side. It is not probable that any part of the transmission takes place through the axial cylinder. The stimulus may be transmitted in the transverse or tangential, as well as in the longitudinal direction. The mechanism is closely connected with the tissue tensions existing in the organ previously to stimulation. The ordinary tissue tension of roots is the reverse of that in stems:—the outer cortical parenchyme is under positive, the central cylinder under negative tension. Stimulation causes an increase in the tension between the axial cylinder and the cortex on the side which becomes convex, and decreases or reverses the tension between the axial cylinder and the cortex on the other side. Not only is the tension between the axial cylinder and the cortex on the side that becomes concave changed by the stimulus, but the different layers of the cortex itself change in their tensile relation to one another. In curving roots the outer layers of the cortex on the concave side are under negative tension in relation to those layers which are more central. In traumatropic curvature (*Vicia Faba*), the zone of maximum curvature does not coincide with the zone of maximum growth, but is nearer the tip. The cells of the convex half of curved roots contain a larger quantity of water than those of the concave half.

After carefully examining all the theories that have been advanced to account for the curvatures due to stimulation, the author has come to the conclusion that no one of them is entirely adequate.

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

Transformations of Organic Substances during Germination.†—From experiments made chiefly on *Phaseolus*, M. G. André concludes that the regeneration of insoluble albuminoids takes place at the expense both of asparagin and of the nitrogen of the amide-acids. This takes place concurrently with the absorption of phosphoric acid by the plant. The soluble carbohydrates are apparently, in part at least, oxidised directly in respiration. Starch and the cellulose which can be saccharised by dilute acids at 100° C. decrease progressively from germination until the time when the weight of the plant is greater than that of the seed; while the amount of cellulose properly so-called (not saccharised by dilute acids) continually increases, this being largely due to the transformation of starch.

Chlorosis of the Vine.‡—Mr. G. Curtel has investigated the nature of the physiological injuries inflicted on the vine by chlorosis. It is shown by an evident weakening of the respiratory activity, and a diminution of the proportion $\frac{CO_2}{O}$ of the gases exchanged; by the diminution and final cessation of assimilation; and by a very great weakening of

* Bot. Gazette, xxix. (1900) pp. 1–63 (1 fig.).
† Comptes Rendus, cxxix. (1899) pp. 1262–5; cxxx. (1900) pp. 728–30.
‡ Op. cit., cxxx. (1900) pp. 1074–6.

the function of transpiration. The appearance of chlorosis and the lowering of the transpiratory function appear to be indissolubly connected with one another.

Changes resulting from Etiolation.*—According to M. G. André, the effect of etiolation on the maize and on the lupin is not identical. In each case the total amount of carbon is reduced by about one-half, while the proportion of nitrogen remains about the same. But the amount of asparagin in the lupin is much larger than that in the maize, the latter plant having apparently used up a portion of the asparagin for the production of new albuminoids. As regards mineral substances, silica is, in the maize, 30 times more abundant in the etiolated plant than in the seed, and 15 times more abundant in the lupin. The relative amount of lime is the reverse in the two plants when etiolated; phosphoric acid is more abundant in the etiolated than in the insolated plant. In the case of the maize the etiolated plant contains more potassium than the seed; but this is not the case with the lupin.

Function of Solanine.†—M. G. Albo finds this alkaloid in all parts, especially in the seed, of several species of Solanaceæ. It decreases in amount during germination, and again increases as the plant approaches maturity. The phenomena presented by seeds germinating and by plants growing in the dark show that solanine is not a migratory form of proteid substances, but is a true reserve substance which the plant utilises during early periods of growth. Its physiological function is entirely different from that of asparagin.

γ. General.

Stigmaria.‡—M. Grand'Eury has come to the conclusion that the fossils known as Stigmaria are not, as has been supposed, the roots of Sigillaria, but are an independent organism. The true roots of Sigillaria are Stigmariopsis, and M. Grand'Eury enumerates the points of difference between these structures and Stigmaria. The Stigmariæ are probably the rhizomes of aquatic and marsh plants.

B. D. Jackson's Glossary of Botanical Terms.§ —This most useful work of reference contains a definition of nearly 15,000 terms used by botanists in all works published down to the end of the year 1899. The etymological origin of the term is given in all cases, and, where necessary, the name of the author who first used it in the sense indicated. It is by far the most complete work of the kind yet published in any language.

B. CRYPTOGAMIA.

Muscineæ.

Development of the Peristome-teeth of the Sporogone of Mosses.‖ — Herr M. von Derschau traces two distinct periods in the development of the peristome of mosses, the species chiefly examined being *Funaria hygrometrica*, *Grimmia pulvinata*, *G. commutata*, and *Brachythecium velutinum*. The first period ends with the commencement of the appearance

* Comptes Rendus, cxxx. (1900) pp. 1198–1201.
† Ann. Agron., xxv. (1899) pp. 621–2. See Journ. Chem. Soc., 1900, Abstr. ii. p. 234.
‡ Comptes Rendus, cxxx. (1900) pp. 1054–7.
§ London, 1900, xii. and 327 pp.
‖ Bot. Centralbl., lxxxii. (1900) pp. 160–8, 192–200 (1 pl.).

of thickenings in the wall; the second including the development of the thickening-layers. In their youngest stages the mother-cells of the peristome do not differ in any way from ordinary meristematic cells. The nucleus acquires after a time a crescent shape. During the first period of development the movements and other changes in the cytoplasm of these cells are not directly dependent on the influence of the nucleus. The nucleus of these cells at first increases in size, but again diminishes after the commencement of the thickenings in the wall. The number of nucleoles in the nucleus increases and again diminishes in proportion to its increase and decrease in size. The formation of the thickening-layers of the membrane is directly dependent on the activity of the nucleus. The thickening-layers are composed, at all events in their early stages, of cellulose and pectinaceous substances.

Branching in the Hepaticæ.*—Mr. A. W. Evans records a new type of branching in the leafy Hepaticæ. According to Leitgeb, the terminal branching always occurs in this group in the ventral half of one of the lateral segments cut off from the apical cell. But in *Mastigobryum integrifolium* (Hawaian Islands) it takes place in both lateral and ventral segments.

Acromastigum, a New Genus of Hepaticæ.† —Mr. A. W. Evans separates from *Mastigobryum* a liverwort from the Hawaian Islands, as the type of a new genus *Acromastigum*, with the following diagnosis:—Plants medium-sized, yellowish-green, becoming brownish with age; stems stiff and wiry, mostly ascending or erect, sparingly branched; vegetative branches of three kinds—terminal branches from the lateral segments, "flagella" from the postical segments, intercalary branches axillary to the under-leaves; leaves distant or subimbricated; leaf-cells with thickened walls; sexual branches intercalary; ♀ branch very short; perianth long and slender; unfertilised archegones borne at the base of the calyptra; ♂ spike oblong; paraphyses wanting. Sporophyte not seen.

Algæ.

Tension and Passive Growth in Seaweeds.‡—Herr E. Küster has examined the condition of tension in the "tissues" of a number of marine algæ belonging to the Cyanophyceæ (*Rivularia polyotis*), Chlorophyceæ (*Codium bursa*), Florideæ, and Fucaceæ (especially in the swim-bladders). He lays it down as a general law that a pressure-tension is the condition in the cortex, a traction-tension in the pith. Minor differences exist from the fact that in the Florideæ we have a compact complex of much-branched hyphæ-like filaments; while in the Phæophyceæ we have intercalary cell-divisions, with a strong tendency to proliferation. With the unicellular *Codium* the conditions of growth are quite different, but the general law of tension appears to be the same in all cases.

Index of Desmids.§—This most useful book of reference, by Prof. C. F. O. Nordstedt, commences with a very complete alphabetical biblio-

* Bot. Gazette, xxix. (1900) p. 140.
† Bull. Torrey Bot. Club, xxvii. (1900) pp. 97–104 (1 pl. and 2 figs.).
‡ S.B. k. Preuss. Akad. Wiss. Berlin, 1899, pp. 819–50 (1 pl.).
§ 'Index Desmidiacearum citationibus locupletissimus atque Bibliographia,' Berlin [1900], 310 pp.

graphy; it then proceeds to a complete index of the Desmidiaceæ arranged under the *specific* names, every published figure being referred to. An index of the genera completes the work. It will be indispensable to the algologist as a work of reference.

Minute Structure of Diatoms.*—In a paper on this subject by Mr. A. A. Eliot Merlin, the most interesting point is the discovery that the eye-spot plate of a *Biddulphia* (*B. reticulata* Roper?) contains several perforations (ten have been counted) in place of the usual single central perforation. This is the first recorded instance of any multiple eye-spot structure in the Diatomaceæ. The structure of the outer covering cap resembles that of *Coscinodiscus Asteromphalus*. Mr. Merlin suggests the use of averted vision for the observation of extremely minute structures, the value of this method being well known to telescope observers.

Formation of Auxospores in Diatoms.†—Herr G. Karsten recounts some further observations on this subject. In *Rhabdonema arcuatum* the process is simply a modification of cell-division; the daughter-cells throw off the old valves which have become two small, and, after rapid enlargement, invest themselves in new ones. In *R. adriaticum* one of the daughter-cells does not increase in size, and is finally ejected from the cell-plasm. In the forms endowed with motion—*Cocconeis, Surirella*—two individuals take part in the formation of one or two auxospores, formed from the union of their contents. In two species of *Cymatopleura* two auxospores appear to be always formed from the contents of two mother-cells. This is also the case with by far the larger number of ground-species,—Naviculeæ, Cymbelleæ, Achnantheæ, and Nitzschieæ. Each mother-cell divides into two daughter-cells; and the four then conjugate in pairs, the two auxospores being formed from the two zygotes. The most essential point in the formation of an auxospore is that the cells increase in size.

Herr Karsten regards the desmids as the nearest relations of the diatoms.

Wax from Diatoms.‡—Herren G. Krämer and A. Spilker point out the probable importance, from a practical point of view, of the oil secreted in the protoplasm of diatoms. From this oily secretion a wax can be obtained, resembling ozokerite in appearance, chemical composition, and properties. The authors suggest that the decay of the diatoms gave rise to ammonium carbonate, which hydrolysed the wax; from the resulting acids carbon dioxide and monoxide and water were eliminated, and ozokerite formed. Further pressure, again, converted this ozokerite into petroleum; and the theory is advanced that this is one of the most important sources of the immense beds of this substance.

Formation of Chlorophyll in the Dark by a Green Alga. §—M. Radais confirms the statement of Beijerinck that *Chlorella vulgaris* has the faculty of cell-multiplication as rapidly in the dark as in the light. The spectrum of the pigment indicates that it is a chlorophyll.

* Journ. Quekett Micr. Club, vii. (1900) pp. 295–8 (1 pl.).

† Biol. Centralbl., xx. (1900) pp. 257–64. Cf. this Journal, 1899, p. 514.

‡ Ber. Deutsch. Chem. Ges., xxxii. (1899) pp. 2940–59. See Journ. Chem. Soc., 1900, Abstr. i. p. 73.

§ Comptes Rendus, cxxx. (1900) pp. 793–6.

The phenomena agree with those already recorded in the case of some lichen-gonids.

Reproduction of Chlorocystis.* — According to Mr. G. T. Moore, *Chlorocystis Cohnii*, a unicellular alga growing on *Enteromorpha*, is not always an endophyte, but as often merely an epiphyte. The chromatophores vary from a unilateral arrangement to a complete lining of the wall of the cell. The zoospores are of two different sizes, but they do not appear to conjugate. They are discharged through a circular opening, not through a tubular neck.

Caulerpa.†—Herr J. Reinke publishes a monograph of this very sharply differentiated genus of Multinucleatæ. Thirty-seven species are described, but without definite diagnoses. They are arranged in nine groups, viz. those of *C. verticillata*, *prolifera*, *taxifolia*, *Harveyi*, *cupressoides*, *racemosa*, *papillosa*, *Fergusonii*, and *hypnoides*, and he regards *C. fastigiata* as the ancestral form.

The morphology of the genus is then described in detail under the following heads:—General structure; the rhizome; the roots; the assimilating organs; the growing point; the internal differentiation (beams and fibres); adaptation to environment; propagation. In many species the growing point has not as yet been observed; where it has been, the appearance of the apex recalls that of Cormophytes. The author thinks it probable that all the Caulerpeæ have become aposporous, and that discovery of swarmspores is not to be expected. He regards *Caulerpa* as a true unicellular multinucleate structure.

Coccospheres and Coccoliths. — From material obtained from the West of Ireland (*Coccosphæra pelagica*), Dr. H. H. Dixon ‡ draws the following general conclusions:—The body of the coccolith extends for a short distance inside the internal valve. The coccolith is composed of calcium carbonate, and a trace of some substance soluble in a 1 per cent. solution of sodium carbonate. Coccospheres are covered over with an extremely delicate pellicle, which is less readily soluble in dilute acids than the coccoliths within it. The coccoliths on a coccosphere are partially imbedded in a slimy proteid material. Within the slimy layer there is a somewhat stratified internal spherical membrane. The specimens of coccospheres examined contained no chromatophore. In many instances the presence of a minute internal body, presumably a nucleus, was demonstrated. Coccoliths are secreted internally in close proximity to the nucleus; the collar uniting the valves is first formed, then the valves are developed, and finally the central body of the coccolith is secreted. The coccolith, when complete, is probably extruded to the surface, and takes up its position among its predecessors; its valves become interlocked with those of its neighbours. By this intercalation an increase in the volume of the sphere is provided for. The oval and disk-like form of the coccoliths are adaptations to allow of the rearrangement of the older coccoliths on the extrusion of a new one, and of suitable interlocking on the spherical surface.

* Bot. Gazette, xxix. (1900) p. 138.

† Wiss. Meeresunters.; herausgeg. v. d. Commission z. Unters. d. deutschen Meere, v., Heft 1, 98 pp. and 87 figs, 1899. See Bot. Centralbl., lxxxii. (1899) p. 110. Cf. this Journal, 1899, p. 62.

‡ Proc. Roy. Soc., lxvi. (1900) pp. 305–15 (1 pl.). Cf. this Journal, *ante*, p. 406.

Herr C. Ostenfeld * has now slightly changed his systematic classification of these bodies. The genus *Coccosphæra* includes *C. pelagica* Wall., *C. atlantica* Ost. (= *C. pelagica* M. and B.), and *C. leptopora* M. and B. The family Rhabdosphærales includes two genera: *Rhabdosphæra*, with the single species *R. claviger* M. and B. (syn. *R. Murrayi* Ost.); and *Discosphæra*, with the single species *D. tubifer* (= *Rhabdosphæra tubifer*, = *Discosphæra Thomsoni*).

Fungi.

Fungi in Dwellings.†—Herr G. Marpmann treats of the fungi injurious to health found in human dwellings, which may be either in themselves pathogenic, or may produce poisonous products of decomposition, which are given off into the air, or which produce poisonous products from certain special substances which they decompose, especially compounds of sulphur and arsenic. By far the largest number of these fungi are found on or in wall-papers, and the author gives a list of 24 species of fungi which were detected in these situations.

Fungi in Oil.‡—Experiments carried on by M. L. Lutz show that the growth of fungi—chiefly *Pholiota mutabilis*, *Cantharellus cibarius*, *Hypholoma fasciculare*, and *Clavaria formosa*—is affected very differently by different kinds of oil. In castor oil the growth was but slightly modified, while in vaselin oil or sweet almond oil very great changes were produced; the filaments were mostly excessively hypertrophied, and the hyphæ greatly contorted and often anastomosing, with frequent production of chlamydospores. This was especially the case with *Aspergillus repens*. The difference is attributed by the author to the degree to which the different oils undergo chemical change in contact with the atmosphere.

Turgidity in Myceles.§—Mr. C. G. Curtis thus summarises the result of his observations on this subject. The hyphæ of fungi possess remarkable powers of adaptation, but show considerable variability in this respect. The turgidity varies even under uniform conditions. The moment of recovery from a change of concentration can be accurately noted, since it is indicated by an apical enlargement preceding the elongation of the hypha. Changes from a higher to a lower concentration of the substratum resulted in a steadily increasing period of recovery in proportion to the concentration. Recovery from a change from a higher to a lower concentration was controlled only to a limited extent by the degree of concentration; but there was also to be observed an individuality peculiar to the genus employed, which brought about these changes in shorter or longer periods of time. The turgidity of a plant recovering from a change of concentration is the same as that of a plant germinating and growing in the concentration to which the trial plant had been changed. Turgidity appears to be a regulatory force.

The fungi employed were species of *Mucor*, *Botrytis*, and *Penicillium*. The basis of all media used in the experiments was a nutrient solution

* Zool. Anzeig., xxiii. (1900) pp. 198–200.
† Zeitschr. f. angew. Mikros., v. (1900) pp. 297–308.
‡ Bull. Soc. Bot. France, xlvii. (1900) pp. 76–82 (6 figs.).
§ Bull. Torrey Bot. Club, xxvii. (1900) pp. 1-13.

composed of 3 per cent. cane-sugar, 0·5 per cent. peptone, and 0·5 per cent. beef extract; and from this were made solutions containing various gram-molecule percentages of potassium nitrate.

Nuclear Phenomena in Ustilagineæ.* — Dr. R. A. Harper states that fusions of conids occur in *Ustilago antherarum* and *U. Scabiosæ* which are apparently caused by chemotactic stimuli. In these fusions no nuclear changes take place, but the cytoplasmic union of the cells causes them to increase in size, and gives them power to resist unfavourable conditions. He suggests that this may be a primitive or degenerate sexual union.

Proteolysis in Aspergillus niger.†—By cultivating this fungus in a variety of nutrient media, Dr. G. Malfitano claims to have established that there takes place in its cells a process of dissociation of the nitrogenous compounds, consisting in a proteolysis, the diastatic factor of which can be demonstrated in its cells and in the culture medium. The secretion of this proteolytic diastase appears to be a constant fact in the life of the organism; all the external conditions which influence it act at first directly on the development of the mycele. The appearance of the diastase in the medium appears to be associated not with the life but with the death of the cells.

Phyllactinia.‡ — Herr. F. W. Neger describes in more detail the peculiar contrivance, consisting of a pencil of jointed mucilaginous hairs, by which the perithecces of species of this genus of fungi attach themselves to the leaves of the plants on which they grow. The arrangement is found on several new species of *Phyllactinia* from Argentina, also on *Microsphæra Myoschili* sp. n.

Uredineæ.§—Herr H. Klebahn relates a further instalment of his experiments on the culture of Uredineæ, with the purpose of determining the genetic relationship of the heterœcious forms. Among the many interesting results may be mentioned that all the species of *Melampsora* are not, as has heretofore been supposed, heterœcious. On species of *Salix* he finds a parasitic fungus of this group which produces, on the same host-plant, cæoma, uredospore, and teleutospore forms.

Parasitic Fungi.—Prof. M. C. Potter ‖ describes a new disease of the swede caused by a species of *Phoma* characterised by its rose-coloured or carmine masses of spores. It appears to be nearly related to *P. Brassicæ* and *P. sanguinolenta*; the three may possibly be forms of the same species.

A destructive disease of the alder in Belgium is traced by M. P. Nypels ¶ to the attacks of *Valsa oxystoma*, the structure of which, and its destructive effects on the wood, are described in detail.

* Trans. Wisconsin Acad. Sci., xii. (1899) pp. 475–98 (2 pls.). See Amer. Nat., xxxiv. (1900) p. 448.
† Ann. Inst. Pasteur, xiv. (1900) pp. 60–81.
‡ Ber. Deutsch. Bot. Gesell., xvii. 1899 (1900) Ergänz.-Heft, pp. 235–42 (1 pl.). Bot. Centralbl., lxxxii. (1900) pp. 261–4. Cf. this Journal, *ante*, p. 94.
§ Pringsheim's Jahrb. f. wiss. Bot., xxxiv. (1900) pp. 347–404 (8 figs.). Cf. this Journal, 1898, p. 569.
‖ Journ. Board of Agriculture, vi. (1900) pp. 448–56 (1 pl. and 5 figs.).
¶ Bull. Soc. Belge Micros., xxv. (1900) pp. 93–104 (1 pl.).

Herr C. J. Svendsen * finds, on several arboreal lichens, especially on *Xanthorina parietina*, a sclerote-forming fungus, possibly a degraded basidiomycete, to which he gives the name *Sclerotium lichenicola* sp. n.

The haricot-bean, *Phaseolus vulgaris*, is, according to Dr. C. Massalongo,† liable to great damage from the attacks of a hyphomycetous fungus, *Isariopsis griseola*, which has at present been found only on the leaves and fruit of this plant.

A hitherto undescribed species of fungus, *Oospora Guerciana* sp. n., is, according to Dr. F. Cavara,‡ very destructive to the larvæ of *Agrotis aquilina*, and may therefore be useful to agriculture.

Herr N. N. von Speschnew § has determined the identity of *Phoma uvicola* and *P. reniformis*, which produce the black-rot of the vine. *P. flaccida* belongs also to the same cycle of development.

New Genera of Fungi.‖—A new American genus of Hydnaceæ is described by Mr. M. J. B. Ellis and Mr. B. M. Everhart, under the name *Echinodontium*, differing from *Hydnum* in the thick woody pileus, while the teeth are beset with spines. It is typified by *E. tinctorium*, growing on *Abies grandis* (*Fomes tinctorius* E. and E.)

Under the name *Arcangeliella Borziana* g. et sp. n., Dr. F. Cavara ¶ describes a fungus found in the pine-woods of Vallombrosa belonging to the Hymenogastres. The following is his diagnosis of the genus:—Peridium tenue, ægre separabile, basim versus interruptum v. laxe venoso-reticulatum, verticaliter a columella percursum; basis substerilis producta, byssa parva donata; caro fragilis, minute cellulosa, lactiflua; cellulæ irregulares, e basi radiantes; basidia clavata, 3–4 sterigmata gerentia; sporæ globosæ, echinulatæ; cystidia adsunt. Fungi gregarii, hypogœi, carnosi, lactiflui.

A new genus of Phalloideæ from Java is described by Prof. O. Penzig,** under the name *Jansia*, with the following diagnosis:—Receptacle tubular, fusiform, perforated at the apex or closed; sporiferous portion passing over directly into the wall of the stipe, which is composed of a single layer of bladder-like chambers enclosed on all sides; sporiferous portion of similar structure, but the chambers open internally, the glebe being composed on the outside of cylindrical prolongations or projecting reticulate bands.

Engleromyces is a new genus of Xylariaceæ from Eastern Africa, diagnosed as follows by Herr P. Hennings ††:—Stroma superficiale, carnosum, hemispherico-globosum, extus atro-corticatum, intus pallide molle, haud zonatum; perithecia pluristratosa, plerumque omnino immersa, vix ostiolata; asci clavati, octospori, paraphysati; sporæ ovoideo-ellipsoideæ v. late navicularieæ; conidia superficialia, æqualia.

Two new genera, *Stichospora* and *Pucciniostele*, are described by Herr P. Dietel ‡‡ in his account of the Uredineæ of Japan. The former

* Bot. Not., 1899, p. 219 (1 pl.). See Bot. Centralbl, lxxxii. (1900) p. 17.
† Bull. Soc. Bot. Ital., 1899, pp. 239–40.
‡ Tom. cit., pp. 241–3.
§ Zeitschr. f. Pflanzenkrankheiten, 1899, p. 257. See Bot. Centralbl., lxxxii. (1900) p. 391.
‖ Bull. Torrey Bot. Club, xxvii. (1900) p. 49.
¶ Nuov. Giorn. Bot. Ital., vii. (1900) pp. 117–28.
** Ann. Jard. Bot. Buitenzorg, xvi. (1899) pp. 140–3 (3 pls.).
†† Engler's Bot. Jahrb., xxviii. (1900) p. 327.
‡‡ Tom. cit., pp 564–76.

genus has teleutospores of a similar structure to those of *Coleosporium*, but arranged in two superposed layers; in the latter the teleutospores are also composed of four cells, but in two pairs lying side by side; they are abstricted in long straight rows.

Effect of Chemical Media on the Growth of the Dematieæ.*— M. L. Planchon recounts the results of a large number of experiments on the growth of about 20 species of this class of fungi in a number of different nutrient fluids and chemical solutions. The terms fumagoid, alternarioid, macrosporoid, cladosporoid, &c., are used to denote the different growth-forms in the various species. Among the more interesting results are the following. The solid nutritive medium most favourable for all the cultures (typical medium) is potato acidified by lying for a quarter of an hour in 1 per cent. sulphuric acid. The Dematieæ are much more subject to morphological diversity dependent on the chemical composition of the medium, than are the Mucedineæ. These modifications affect the vegetative much more than the reproductive organs, and are a mode of defence against desiccation and against the injurious effects of the medium. The most common forms of such modifications are the thickening, encysting, or gelification of the cell-wall, or the change in the form of the filament itself, the production of chlamydospores, or of isolated cells capable of germinating (oidia), or of toruloid forms in which the mycelial filament has entirely disappeared. All kinds of transitional forms between the extremes occur.

Dematium pullulans and *Cladosporium herbarum* must be regarded as distinct species. Two new species of *Alternaria* are described, *A. varians* and *A. polymorpha*.

Nodule Organism of the Leguminosæ.†—Mr. R. Greig Smith gives a *résumé* of the various views taken by different observers with regard to the nature of the organism found in the root-tubers of the Leguminosæ, and then gives his own conclusions, derived chiefly from an examination of the lupin. He obtained the organism in pure cultures as an oval vacuolated yeast with a faculty of budding; this property, together with the presence of a more or less persistent mucilaginous capsule, causes the organism to assume a variety of shapes. The more vigorous forms are motile, the motility being due to a single terminal tufted flagellum. The author adopts Frank's name for the organism, viz. *Rhizobium leguminosarum*. It is usually accompanied by *Bacillus megaterium*, and often by other bacteria.

Jörgensen's Micro-organisms and Fermentation.‡—The third edition of Dr. A. Jörgensen's treatise on Micro-organisms and Fermentation has recently appeared in an admirable translation by Mr. A. K. Miller and Mr. A. E. Lennholm. The general scope of the work is to give an account of the morphology and biology of the microbes of fermentation, and in this respect it occupies a prominent position among the books dealing with these subjects. As might be anticipated, there is much praise and appreciation of Hansen's work, methods, and results, which are described with commendable lucidity. The volume appeals

* Ann. Sci. Nat. (Bot.), xi. (1900) pp. 1–248 (4 pls. and 63 figs.).
† Proc. Linnean Soc. N.S. Wales, xxiv. 1899 (1900) pp. 653–73 (2 pls.).
‡ London, Macmillan & Co., Ld., 1900, xiii. and 318 pp., 83 figs.

not only to the chemist, botanist, and biologist, but also to the brewer, distiller, yeast-maker, and all such as are engaged in fermentation industries.

The present edition has been not only thoroughly revised, but incorporates new features and additional matter, among which are an examination of several English high fermentation yeasts, observations on the changes which yeast undergoes during its use in factories, descriptions of recently discovered yeasts, of the organisms occurring in milk, and the use of pure cultures of lactic acid bacteria in dairies and distilleries. The volume is copiously illustrated, and contains an ample bibliography.

Myxomycetes.

Dictyostelium mucoroides.*—G. A. Nadson finds this organism easy to cultivate on sterilised dung. It does not liquefy gelatin; it is distinctly aerobic, and prefers a slightly alkaline medium; fluid media are not favourable to its growth. It is usually accompanied by a variety of bacteria, some of which have a decidedly favourable influence on its development. Its most usual associate is *Bacillus fluorescens liquefaciens* Flügge, among its spores. Between these two organisms there seems to be a kind of symbiosis. The bacillus advantages the *Dictyostelium* by increasing the amount of ammonia in the substratum; while the latter supplies the former with the organic substances required for its complete development.

Protophyta.

α. Schizophyceæ.

Cyanophyceæ.†—In a general review of the structure of this family, Herr E. Zacharias states that the cell-contents are differentiated into a colourless central body and the coloured protoplasm which surrounds it on all sides; the latter is not properly a chromatophore. There is no evidence of a colourless border of protoplasm surrounding the coloured portion. The central body appears to be often homogeneous, or at most finely granular. It is often very irregular in form; whether it occasionally has a framework is uncertain; nor has the presence of vacuoles been established. Two kinds of substance are imbedded in the protoplasmic matrix, cyanophycin granules and central granules. The former swell up quickly in dilute hydrochloric acid and are strongly stained by acetic-carmin; they appear to be a reserve-substance. The central granules are clearly revealed in dilute hydrochloric acid as shining bodies; they appear to be imbedded in the central body after the manner of nucleoles, chiefly in its superficial portion. In addition to these, there is usually in the central body a varying quantity of a substance resembling glycogen; and in some cases oil-like drops and crystals.

Hormogoneæ of Denmark.‡—J. Schmidt has published a monograph of the Danish species of this section of Cyanophyceæ, of which he makes 118, including 2 new ones, *Anabæna baltica* and *Microchæte purpurea.*

* Scripta Botanica (St. Petersburg), xv. (1899). See Bot. Centralbl., lxxxii. (1900) p. 227.

† Abhandl. a. d. Geb. Naturw. Ver. Hamburg, xvi. (1900) 50 pp. and 1 pl See Bot. Ztg., lviii. (1900) 2te Abt., p. 135.

‡ In Danish. Copenhagen, 1899. See Journ. of Bot., xxxviii. (1899) p 232.

The anatomy of the group is first of all dealt with, including the trichomata, sheaths, and branching, then the development and reproduction, followed by biological remarks and method of examination; finally a systematic description and bibliography. The author holds that the Cyanophyceæ possess true chromatophores, though differing considerably from those of other algæ, and exhibiting a lower degree of differentiation. He has failed to find in them a true nucleus; the highly refractive granules are either evenly distributed through the cell, or are confined to the neighbourhood of the cell-wall and arranged in rows. Their chemical constitution is unknown; they do not consist of starch.

β. Schizomycetes.

Importance of Bacteria to the Development of Plants.*—Herr J. Stoklasa has performed contrast experiments on *Brassica oleracea* grown in enclosed vessels containing sterilised loamy sand. In one case the sand remained sterilised; in the other it was inoculated with a mixture of the following soil bacteria:—*Bacillus mycoides, B. fluorescens liquefaciens, B. proteus vulgaris, B. subtilis, B. butyricus, B. megaterium, B. ureæ, B. mesentericus vulgatus,* and *B. coli communis.* To the inoculated vessels were added 5 grm. of dextrose. In all cases the total weight of the dried plant, and the total weight of seed, were greater in the inoculated than in the sterile vessels. Stoklasa concludes that in the absence of micro-organisms vegetation is abnormal, and that incompletely developed seed is produced.

Diagnosis of Bacteria.†—Sig. L. Macchiati considers that the aureola which surrounds bacteria mounted in balsam, and which is visible at some stage of their development, is to be regarded as a specific indication. The appearance results from a solidification of the gelatinous outer layers of the investing membrane. The author also attaches great importance to photograms of impressions of colonies in the determination of bacterial species. The cultures should be made on agar plates, and should be young. Under such conditions the photographic appearances are typical and decisive.

Acquired Movement and the Loss of Flagella in Bacteria.‡—Herr F. Zierler made a careful examination of *Bacillus implexus* Zimmermann and *Bacillus subtilis* Cohn, and found that, besides some slight cultural differences, *B. implexus* was motile at all ages and on all media.

The conclusion drawn from this is that *B. implexus*, which was originally devoid of motion, had acquired motility in the course of time. This view is supported by Dr. K. B. Lehmann, who remarks that it is the first genuine instance of the acquisition of movement yet recorded.

The converse, namely, the loss of flagella in *Micrococcus agilis* and *M. citreus agilis*, after prolonged cultivation, has been already reported.

Influence of the Temperature of Liquid Air on Bacteria.—Dr. A. Macfadyen and Mr. S. Rowland,§ who had previously shown that no

* Zeit Zuckerind. Böhm., xxiv. (1900) pp. 222–7. See Journ. Chem. Soc., 1900, Abstr., ii. p. 360.

† Nuov. Giorn. Bot. Ital., vi. 1899, pp. 384–410 (2 pls. and 12 figs.).

‡ Arch. f. Hygiene, xxxiv. (1899) pp. 192 and 198. See Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 297–8.

§ Proc. Roy. Soc., lxvi. (1900) pp. 339–40. Cf. this Journal, *ante*, p. 371.

appreciable influence was exerted upon the vital properties of bacteria when exposed for 20 hours to the temperature of liquid air (−183° C. to −193° C.), have recently made experiments which prove that bacteria can be exposed to a temperature of −190° C. for a period of seven days without any appreciable impairment of their vitality. The organisms used were:—*B. typhosus*, *B. coli communis*, *B. diphtheriæ*, *B. proteus vulgaris*, *B. acidi lactici*, *B. anthracis*, *Sp. choleræ asiat.*, *Staph. py. aureus*, *B. phosphorescens*, a *Sarcina*, a *Saccharomyces*, and unsterilised milk. Broth emulsions in hermetically sealed fine quill tubing were used. When thawed after the cooling, a microscopical examination was made to discover if any structural changes had taken place. None were detected. The subcultures made at the conclusion of the experiment grew well, and no impairment of vitality was noticed.

The photogenic bacteria grew and emitted light, and the samples of milk became curdled.

Still later the authors,* with the aid of Prof. Dewar, as in the previous experiments, subjected this same series of bacteria to the temperature of liquid hydrogen, about −250° C., and again the results were nil.

Organic Matter and Bacteria in Surface Washings of the Soil.† —Dr. A. C. Houston reports on the chemical and bacteriological examination of the washings 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 results obtained in this inquiry clearly show that chemistry cannot be always relied on to detect in a water supply the presence of "flood-water," much less of "flood-water" of objectionable or dangerous sort. Though some of the "soil-waters" would have been condemned on chemical analysis, yet it was found that the "washings" from some soils of unobjectionable character yielded higher results (chemically as regards organic matter) than those known to be grossly and perhaps dangerously polluted.

The bacteriological results, though not entirely satisfactory, were of an encouraging nature. By taking a sufficiently large bulk (e.g. 1000 ccm.) of the water to be dealt with, and examining the filter brushing suspension, it is possible to demonstrate bacteriologically sewage pollution so minute as to defy detection by chemical means.

Bacteriological Evidence of Recent Sewage Pollution of Potable Waters.‡ —The report of Dr. E. Klein and Dr. A. C. Houston on the bacteriological evidence of recent, and therefore dangerous, sewage pollution of potable waters, shows that chemistry, as usually applied, is powerless to detect a degree of pollution of water with sewage which, from the point of view of the bacteriologist, would be considered gross in amount. It is also claimed that bacteriology is not only capable of detecting microbes characteristic of sewage under ordinary test conditions, but can do so when the sewage pollution is from ten to one hundred times less than that in which the organic matter contributed by the sewage to the water has failed to get recognition by the methods commonly in use by the chemist.

* English Mechanic, lxxi. (1900) p. 372.
† Rep. Med. Off. Loc. Gov. Board, 1898–9, pp. 439–66 (2 pls.).
‡ Tom. cit., pp. 498–504.

The bacteria dealt with were *B. coli* and *B. enteritidis sporogenes*, which are specially abundant in contaminated water. *B. coli* was detected in dilutions of 0·005 per cent., or 1 part of sewage in 20,000 parts of water, and *B. enteritidis* in a dilution of 1 in 500,000.

Bacterial Treatment of Sewage.* — Dr. F. Clowes describes the present aspect of the bacterial treatment of sewage in an article of great clearness, which is illustrated by some effective photomicrographs of sewage bacteria. A system which appears to give excellent results consists in passing the sewage over coke beds after a preliminary treatment in a septic tank, or, expressed, in other words, a preliminary anaerobic treatment is followed by intermittent aerobic treatment. In some places the septic tank is not employed, and in others the sewage is screened and sedimented previously, in order to prevent the beds from choking. The coke-fragments are about the size of walnuts, and the depth of beds 4–13 ft., the deeper bed giving the more satisfactory results. In the beds, aerobic and anaerobic organisms co-operate harmoniously, but not necessarily cotemporaneously; and, provided the beds are not overworked, their purifying power increases with age. This is in accord with the fact that new beds require to be primed in order to give them a start. The effluent from beds worked on the intermittent principle, i.e. allowing one day off in seven, is found to be clear and odourless, and sufficiently purified to be introduced into the tidal part of a river.

Lactic Acid Bacteria found in Ripe Cheese.†—Herr G. Leichmann and Herr S. v. Bazarewski examined bacteriologically samples of Emmenthal, Cheshire, and Gouda cheeses, and describe five species of bacteria, the plate colonies of which presented the appearance of *Bacterium lactis acidi* Leichmann. Microscopical examination of milk cultures showed, however, that they were quite different. Four of these bacteria are designated *Bact. casei* i., ii., iii., iv., and the fifth *Streptococcus casei*. The morphological and physiological characters are described at considerable length, and the differences between this group, *Bact. lactis acidi*, and *Bact. pabuli acidi* i. and ii. and others are discussed.

Gonotoxin.‡—Dr. J. De Christmas, who has been studying the toxin of *Gonococcus*, finds that when cultivated in appropriate media the microbe produces toxic substances which, when introduced even in small doses into the brain, rapidly cause death with the phenomena of intoxication. The toxin is dissolved in the medium. It is a biological product, and is formed only under certain determinate conditions of culture, and is not diffused from the bodies of dead gonococci. It is not dialysable; it resists heating to 60° for at least one hour; but when heated to 75° for 15 minutes it begins to change. It is precipitated from the culture by saturated solution of sulphate of ammonia. When injected into the subcutaneous tissue of laboratory animals, an antitoxin is produced in the blood. This antitoxin neutralises *in vitro* the gonococcic toxin, and when injected into the brain before the toxin, the phenomena of intoxication are inhibited. It has the same effect when injected into the blood-vascular system.

* Nature, lxii. (1900) pp. 128–32 (9 figs.).
† Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 245–53, 281–5, 314–31.
‡ Ann. Inst. Pasteur, xiv. (1900) pp. 331–49.

Tobacco Bacteria.*—According to Herr C. J. Koning, *Diplococcus tabaci* and *Bacillus tabaci* i. play an important part in the fermentation of Dutch tobacco. For examining the flora of fermenting tobacco, surface cultures are recommended. Little bits of leaves are shaken up in physiological salt solution, and the fluid poured over gelatin plates. *B. tabaci* i. is a motionless aerobe, and varies much in size in artificial cultures. It does not stain by Gram's method or form spores. At 60° it is killed in 20 minutes, at 50° in 5 hours. Peculiar yeast-like appearances were observed in agar cultures some weeks old, but on transference to fresh media the normal growth returned. Asparagin is decomposed with formation of ammonia, nitrate is reduced to nitrite, glucose consumed, and gelatin liquefied. On naturally acid tobacco extract the bacterium does not grow well, and does better when the acidity is diminished.

D. tabaci forms small round lemon-yellow colonies on gelatin plates. It grows best at room temperature, and, like *B. tabaci* i., forms ammonia. It is an essential aerobe, and does well on acid media. Gelatin is slowly and feebly liquefied. Besides the foregoing, other bacteria more or less resembling *Proteus* were found. These, as well as a potential anaerobe *B. tabaci* iii., which appears to have a share in raising the fermentation temperature, are also connected with the fermentation process.

Tumours of Microbic Origin in Juniperus phœnicea.†—Dr. F. Cavara gives a description of tumours found on the stem and branches of *Juniperus phœnicea* L. From the internal parts of the tumours were isolated two bacteria, one of which liquefied gelatin rapidly and the other very slowly. The liquefying bacterium was a bacillus with rounded ends occurring in pairs or chains, the joints measuring 2–8 μ in length by 0·7–0·8 μ in breadth. It was stained by Gram's method. The other bacterium was a micrococcus with a diameter of 2–2·5 μ. The elements were arranged in pairs or groups, and occasionally were isolated. In order to test the parasitism of these bacteria, healthy plants were inoculated with cultures of the bacillus and micrococcus. Not being able to obtain specimens of *J. phœnicea*, the author used *J. communis*. After some months the scar tissue about the inoculation sites was observed to be much thickened, but there was no definite tumour formation. There was no difference in the appearances produced by either organism.

Mechanism of Agglutination.‡—Herren Kraus and Seng, pursuing the same line as Nicolle, who showed that inorganic substances like chalk could be agglutinated as well as microbes, have tested other inorganic substances such as Indian-ink, cinnabar, ultramarine, and have found that they can be agglutinated by the addition of alcohol, if they are suspended in a fluid in which a precipitate falls on the addition of alcohol. From these experiments the authors conclude that the essential features of the mechanism of the agglutinations caused by serum and by chemical substances are precipitates and coagulation processes, whereby the microbes become clumped passively.

* De indische Mercuur, July 8, 1899. See Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 344–5. † Bull. Soc. Bot. Ital., 1898, pp. 241–50.

‡ Wiener Klin. Wochenschr., 1899, No. 1. See Beihefte z. Bot. Centralbl., ix. (1900) pp. 218–9. Cf. this Journal, 1898, p. 339.

Bacteriological Enzymes as Cause of Immunity.*—Herren R. Emmerich and O. Löw state that the enzymes secreted by various bacteria unite with the proteids of blood or of organs; the compounds so formed are termed "Immunproteidins"; the proteid of the leucocytes which unites with the enzyme of the pathogenic bacteria is termed "Proteidin." The so-called agglutination is nothing but the first stage of the effect of the enzyme. There are also bacterial enzymes which are not only bactericidal but which also destroy toxins; thus "pyocyanase," the enzyme of *Bacillus pyocyaneus*, destroys the deadly effect of the diphtheria toxin.

Fate of Pathogenic and other Infective Microbes in the Dead Animal Body.†—Dr. E. Klein states that direct experiment lends no confirmation to the belief that the microbes of infectious diseases retain their vitality and virulence for indefinite periods within dead and buried bodies. His researches show that, as far as guinea-pigs are concerned, the vitality and infective power of the microbes used pass away in a comparatively short time, in most cases within a month, whether the body be placed in a coffin or buried in earth or sand merely wrapped in a piece of fabric. The bacteria used were *B. prodigiosus*, *Staph. pyogenes aureus*, *Vibrio choleræ*, *B. typhosus*, *B. diphtheriæ*, *B. pestis*, *B. tuberculosis*, *B. enteritidis sporogenes*. The morphological and biological characters of *B. cadaveris sporogenes* are described, but require no further notice, as they have been already alluded to.‡ The author mentions an interesting observation in connection with *Proteus vulgaris*. No trace of this microbe could be found in guinea-pigs buried three, four, or five weeks, but in guinea-pigs dead of plague and exhumed twenty-eight days after death, *Proteus vulgaris* was easily detected in the usual way, viz. by injecting fresh guinea-pigs with emulsions from the spleen. Further experiments made with broth cultures on guinea-pigs and mice confirmed the foregoing result. In these last experiments it was found that the guinea-pigs died from local disease and general intoxication, and the mice from septicæmia, that is to say, the blood of the mice contained *Proteus*, while that of the guinea-pig did not.

Growth of Typhoid Bacilli in Soil, with Description of Four Soil Bacteria.§—In his third report on the growth of the typhoid bacillus in soil, Dr. S. Martin remarks that the contrast between the results obtained by a study of the growths of this bacillus in sterilised and unsterilised earth is marked. In sterilised soil the bacillus was found to live and grow for long periods; while in unsterilised soil it was only recovered once, and that not later than twenty-four hours after the addition. It follows therefore that the bacteria naturally present in the soil are inimical to the typhoid bacillus. The report also deals with the effect of each individual bacterium of the soil on the typhoid bacillus when the two micro-organisms were inoculated :—(1) into a liquid medium in which they could both grow; and (2) into the sterilised soil from which the soil bacterium had been obtained.

The soil bacteria described are designated Chichester i., ii., iii., and v.

* Zeitschr. f. Hygiene, xxxi. pp. 1-65. See Journ. Chem. Soc., lxxvii. and lxxviii. (1900), Abstr. ii. p. 159.

† Rep. Med. Off. Loc. Gov. Board, 1898-9, pp. 344-81 (32 figs.).

‡ Cf. this Journal, 1899, p. 318.

§ Rep. Med. Off. Loc. Gov. Board, 1898-9, pp. 382-412.

Chichester i. is a short nearly oval bacillus which grows readily on the ordinary media. On agar slopes it forms a moist translucent fluorescent or opalescent growth. In both it produces a deposit but no surface scum. On glucose-gelatin shake cultures, the growth is superficial without gas production or liquefaction of the medium. From the plates a strong putrefactive odour arises. No indol is produced within forty-eight hours. The agar colonies are circular and fluorescent.

Chichester ii. is a large stout bacillus, single or in short chains, which forms spores freely. It grows rapidly in the ordinary media. On agar slopes the growth is white and opaque; on potato it is pale yellow and moist; there is both scum and deposit in broth. No gas is formed, and gelatin is slowly liquefied. On agar the colonies are white with irregular margins.

Chichester iii. is a stout bacillus with rounded ends and forming long chains. On agar slopes the growth is dense, white, and opaque. In broth there is a copious flocculent deposit. No indol or gas is produced, and gelatin is slowly liquefied. On potato the growth is yellow and abundant. On agar plates the colonies are dense and opaque.

Chichester v. is a thick bacillus with rounded ends which occurs singly or in short chains. It stains fairly uniformly. On agar slopes the growth is white, opaque, and granular. In broth there forms a copious deposit with slight surface pellicle. It does not form gas or indol, and liquefies gelatin slowly. On potato the growth is reddish white. The agar colonies are dense and opaque, with very irregular margins.

Disease of Coscoroba Swans.*—M. E. Trétrop describes a disease which broke out in January 1900 among the swans in the Zoological Garden at Antwerp. Out of fifty swans half the number succumbed. The chief feature of the disease was diarrhœa, the excrement being yellow or greenish yellow with whitish little lumps, recalling the lienteric stools of sucklings. Though infectious to Coscoroba swans (*Coscoroba candida*) and sparrows, other kinds of swans and other birds were unaffected. In the viscera of affected birds a bacterium was constantly found. This organism, designated *Bacillus Coscoroba*, is ovoid, 1·5 μ to 2·8 μ long by 1 to 1·4 μ broad. It is easily stained, but not by Gram's method. It grows well on the ordinary media. It is both aerobic and anaerobic, though the cultures are more abundant in presence of oxygen. It coagulates milk, and forms indol. Gelatin is not liquefied. The aerobic cultures exhale a fish-like odour, but there is no smell from the anaerobic. Its optimum temperature is 37° C. Subcutaneous injections of pure cultures into mice, guinea-pigs, and sparrows, were followed by death, the bacillus being found in the blood and viscera. The bacillus loses virulence as it ages, and by injecting the attenuated virus into mice, the animals were able eventually to be inoculated with cultures heated for ten minutes to 58° with but slight inconvenience.

Presence of Bacillus capsulatus aerogenes in the Blood.†—Dr. N. B. Gwyn successfully isolated *B. capsulatus aerogenes* from the blood during life by means of anaerobic cultures in milk and bouillon. Agar plates and Loeffler's serum were also used. The bacillus was 8–10 μ long and 2 μ broad. It stained well by Gram's method. It only grew

* Ann. Inst. Pasteur, xiv. (1900) pp. 224–31.
† Bull. Johns Hopkins Hosp., x. (1899) pp. 134–6.

anaerobically, forming much gas and exhaling an odour of stale glue. Spores were formed on blood-serum. Guinea-pigs and pigeons were killed 24–48 hours after inoculation, the coarse post mortem appearances being an inflammatory œdema, tumefaction, and crackling of cellular tissues.

Identity of Bacillus aerogenes lactis and Friedlaender's Pneumobacillus.* — MM. L. Grimbert and C. Legros describe the morphological and biological characters of *Bacillus aerogenes lactis* and also its action on carbohydrates. Four different cultures were used. The bacilli are motionless; they measure from 1·5 to 2 μ; they do not stain by Gram's method or form spores; in the blood and pus of inoculated animals they possess a capsule; and they are potential anaerobes. They are cultivable in the usual media; do not liquefy gelatin; do not produce indol; coagulate milk. Nitrates are partially changed to nitrites. Carbohydrates, except dulcite, are fermented with the production of ethylic alcohol, acetic acid, lævolactic acid, and succinic acid. The foregoing characters are also those of Friedlaender's *Pneumobacillus*, and hence the two bacilli are identical. The species, however, embraces a number of varieties, but these varieties present a community of characters sufficiently clear to unite them into a single group, the essential features of which are:—(1) Absence of movement; (2) presence of capsules in the blood of inoculated animals; (3) non-liquefaction of gelatin; (4) non-production of indol; (5) energetic action on carbohydrates, the products varying with the sugar used in the medium.

Identity of Bacillus mucosus Ozænæ with Pneumobacillus.†—Dr. A. de Simoni, who has examined bacteriologically about 100 cases of ozæna, has arrived at the conclusion that under the name of *Bacillus mucosus ozænæ* have been described varieties of one and the same species. All these varieties may be collected into three principal groups, which are connected by transition forms. The chief stem of all these varieties is Friedlaender's *Pneumobacillus*, an ordinary inhabitant of the mucosa of the naso-pharynx. By the action of physical agents such as heat, one variety may be converted into another, so that though at first they appear to be quite different from one another, yet from the manner of development on artificial media they are found to be identical. The polymorphism of these bacilli depends on diverse factors, such as the biochemical conditions of the morbid nasal mucosa, the adaptability to these conditions, and the association with different kinds of bacteria.

General Infection by Diplococcus intracellularis Weichselbaum.‡—Dr. N. B. Gwyn records the occurrence of *Diplococcus intracellularis* in the blood and inflamed joints, as well as in the meningeal exudation, of a case of cerebro-spinal fever. Post-mortem the meningococcus was demonstrable only in the lesions of the brain and cord. This is the first recorded instance in which general infection or septicæmia has been demonstrated in cerebro-spinal meningitis.

Diplococcus reniformis.§—M. J. Cottet has found a diplococcus of reniform shape in abscesses connected with the urinary passages. It

* Comptes Rendus, cxxx. (1900) pp. 1424–5.
† Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 426–36, 493–502 (2 pls. and 14 figs.).
‡ Bull. Johns Hopkins Hosp., x. (1899) pp. 112–3.
§ C.R. Soc. Biol., lii. (1900) pp. 421–3.

stains well with the ordinary anilin dyes, but is decolorised by Gram's method. Cultivations were obtained under anaerobic conditions at 37° C. in saccharated gelose and in bouillon. Pure cultures inoculated on guinea-pigs produced suppuration.

New Diplococcus of Meningitis.* — Prof. L. Vincenzi describes a diplococcus which was isolated from a meningitic exudation, the result of otitis. The cocci were free in the exudate and also in the leucocytes. They are oval or lancet-shaped, possess a well-marked capsule, and resemble morphologically Fraenkel's diplococcus. The biological characters of the two organisms are however quite different. The coccus is an essential aerobe, is easily stained, and grows well on the usual media even at room temperature. It does not liquefy gelatin. The diplococcus is pathogenic to mice and rabbits, and, injected beneath the dura mater, excites meningitis and causes death in 12–16 hours.

Bacillus enteritidis sporogenes and its Relation to Typhoid Fever.†—Dr. E. Klein reports the results of a further investigation of *B. enteritidis sporogenes*, more especially as to its relations with the diarrhœa associated with typhoid fever. From a large number of cases he has found that though in the diarrhœa stages of typhoid fever the number of spores of *B. enteritidis* is, as a rule, great and easily demonstrable, in the non-diarrhœa condition, or in the convalescent stage of the malady, their number so greatly and conspicuously diminishes as to render it very difficult, if not practically impossible, to demonstrate them. There would, therefore, appear to be some connection between the fluid stool and the presence of large numbers of *B. enteritidis*; the exact conditions of this relationship appear difficult to determine, in view of the fact that *B. enteritidis* occurs under other diarrhœa conditions. The relationship becomes more obscure in view also of the fact that certain microbes of ubiquitous distribution may, occasionally in some instances and in others frequently, become pathogenic.

Experiments with this microbe in reference to "protection" showed that previous infection predisposed to a fatal result. No agglutinating action with blood-serum from a patient or from an animal artificially infected was observed.

Infection by Symptomatic Anthrax (Rauschbrand). ‡ — MM. E. Leclainche and H. Vallée record a series of experiments made for the purpose of ascertaining the part played by the bacterium of symptomatic anthrax and its toxin in the ætiology of the infection. They find that the bacterium produces an active toxin which by itself alone is capable of exciting severe symptoms and death.

Spores alone, and freed from toxin, when introduced even in large number into the tissues, are incapable of germinating and of exciting the infection. The resistance of the organism is associated with phagocytic action, and any cause capable of preventing or hindering phagocytosis favours or assures the infection.

Microbe Pathogenic to Rats.§—Having found that a coccobacillus isolated from an epidemic among *Mus arvicola* was somewhat pathogenic

* Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 561–4 (1 pl.).
† Rep. Med. Off. Loc. Gov. Board, 1898–9, pp. 312–43.
‡ Ann. Inst. Pasteur, xiv. (1900) pp. 202–23. § Tom. cit., pp. 193–201.

to rats (*M. decumanus*), M. J. Danysz made attempts to raise the virulence of the microbe for the purpose of obtaining a poison which could be used after the manner of Loeffler's *B. typhi murium*. He succeeded in increasing the virulence by infecting flasks filled with bouillon with pure cultures. Growth was started at incubation temperature, and then the flasks were kept at ordinary temperature for 4–5 days, by which time the bouillon had cleared up and a sediment deposited. The object of this step was to accustom the microbe to living without air.

Collodion-sac cultures made from the contents of these flasks were inserted in the abdominal cavity of a rat, from which they were transferred to bouillon, and then to flasks again. Gelose cultures from the flasks were made, and these, steeped in water and soaked in bread, were given to mice to eat. After four or five repetitions of the procedure, the virulence was found to be considerably augmented. Rats were then substituted for mice, and the procedure repeated for about ten times, when the cultures were found to be sufficiently virulent. The bouillon used was made of horse flesh, with 1 per cent. pepton, and a little carbonate of lime to neutralise the acids produced during cultivation.

Flask cultures, kept from air and light, preserve their virulence for several months; gelose cultures for 1–2 months.

Records of experiments for ridding sewers, ships, warehouses, and stables of rats are given. Some of these appear to have been successful, others not.

Value of the Agglutination Test as a means of Diagnosis of Bacillus typhosus from Coliform Organisms.*—Prof. W. H. Horrocks remarks that the correct interpretation of the agglutination test may be a matter of considerable difficulty. The experiments given show distinctly that there are at least two important factors which enter into the reaction, namely:—(1) the strength of the serum employed, and (2) the time during which the serum is allowed to act on the microbe; consequently no fixed dilution of typhoid serum can be laid down which will enable *B. typhosus* to be at once distinguished from coliform organisms. It may be said that an organism which fails to agglutinate with typhoid serum is certainly not *B. typhosus*; but on the other hand, it does not necessarily follow that an organism is *B. typhosus* because it is agglutinated by fairly dilute typhoid serum. With our present knowledge it appears essential to work with a powerful serum, and the suspected organism should be tested with serum diluted to the highest degree which has been found capable of agglutinating a true *B. typhosus*.

Endocarditis and the Influenza Bacillus.†—Miss M. F. Austin describes three cases of acute heart disease from the endocardium of which minute bacilli were isolated. In shape and staining reaction they resembled the bacillus of influenza. Cultures were not obtained, but the vast number of organisms present in the valves showed that they were causally connected with the endocarditis.

New Bacillus found in Vaccine Pustules.‡—Prof. K. Nakanishi has found in the vaccine pustules of calves, and in the vaccine lymph of children, a very polymorphic bacterium belonging to the diphtheria group. Five chief polymorphic modifications are described. In size

* Brit. Med. Journ., 1900, i. pp. 1015–7.
† Bull. Johns Hopkins Hosp., x. (1899) pp. 194–5.
‡ Centralbl. Bakt. u. Par., 1[te] Abt., xxvii. (1900) pp. 641–61 (2 pls.).

the bacillus varies from 0·5–3·5 μ, but the club and dumb-bell form may attain a length of 16 μ. Typical branched appearances were observed. The bacillus is easily stained by the ordinary anilin dyes, but imperfectly or not at all by Gram's method. It is a potential anaerobe, and is devoid of movement. At incubation temperature it grows on all the usual media, but the best substrata were found to be Loeffler's blood-serum, meat-pepton-agar with or without glycerin, and pepton-bouillon. Gelatin is not liquefied, and milk is not coagulated. Spore-formation was not observed. The resistance to the action of sunlight and of glycerin is considerable.

Appearances identical with *Cytorryctes Variolæ* Guarnieri were present in preparations from the inoculated cornea of rabbits; the amœboid movements, however, were not observed. What part this bacillus, which is designated *Bacillus variabilis lymphæ vaccinalis*, plays in the ætiology of vaccinia and variola remains to be proved.

Amœboid Granules of Vaccinia.*—Dr. S. M. Copeman and Dr. G. Mann, in their report on the histology of vaccinia, describe certain bodies which lie chiefly in the lymph-spaces of vaccinia vesicles. These bodies, designated Z-granules, vary in diameter from 0·75 to 1·5 μ. A few are spherical, but the greater number are irregular in outline. They are not improbably identical with the bodies found in the blood and lymph of vaccinia and of variola during the febrile stages, and the further suggestion may be hazarded that they are in reality leucocyte granules which have been discharged from the cells. But whatever the origin of these Z-granules may be, they seem to possess powers of amœboid movement and growth. Some of the preparations were treated as follows:—(1) 10 minutes in 1 per cent. acetic acid; (2) three days in Loeffler's methylen-blue containing ten times the normal amount of KOH; (3) 2½ hours in 1 per cent. acetic acid; (4) absolute alcohol; xylol.

Resistance to Disinfectants of the Swine-plague Bacillus.†—Herr Karliński tested the resisting power of the swine-plague bacillus to various physical and chemical influences, and his results are as follows. Pure cultures are killed when dried in an exsiccator in 18 hours if light be excluded, and in 14 hours in diffuse daylight. Moist heat at 60° kills in 20, steam in 2, 3 per cent. carbolic acid in 5, 1 per mil. sublimate in 2 minutes. Formalin vapour and lime are also very effective on pure cultures. In dejecta the bacillus retains its vitality for much longer periods. The infectivity of the dejecta lasts for 21 days in diffuse daylight, in darkness for 40 days. Chemical disinfectants do not act with the same facility on dejecta as on pure cultures. Lime water mixed with an equal bulk of dejecta did not disinfect under 24 hours, and a 2·5 per cent. formalin solution used in the proportion of 1 : 10 failed to disinfect after 8 days.

Hueppe's Principles of Bacteriology.‡—Prof. E. O. Jordan has given us an admirable translation of Prof. F. Hueppe's Principles of Bacteriology, and has certainly attained the object of reproducing the

* Rep. Med. Off. Loc. Gov. Board, 1898–9, pp. 505–32 (14 pls.).

† Œsterr. Monatbl. f. Thierheilk., 1899, No. 3. See Beihefte z. Bot. Centralbl., ix. (1900) pp. 216–7.

‡ Chicago, The Open Court Publishing Co.; London, Kegan Paul, Trench, Trübner and Co., 1899, pp. x. and 467 (1 pl. and 28 figs.).

author's ideas with clearness and fidelity. In these Principles the author's aim has been to present an attempt at a critical and comprehensive exposition of bacteriology, based on scientific conceptions. In the work are described first the structure and vital phenomena of bacteria, and the most important pathogenic organisms, after which are discussed the cause of infectious disease, the combating of the cause and immunity; the volume ending with a chapter on the history of bacteriology.

From this enumeration of the contents of the book it may be gathered that the general scope of these Principles of Bacteriology is mainly pathological. Perhaps on this account it is all the more useful and welcome in its English dress, for, if the doctrines enunciated are unacceptable to professional dogmatists on disease, the statement of the author's views cannot fail to act as a stimulus and a corrective.

The main thesis or rather the leading idea running through the whole is that disease is inherent in the internal organisation of man, and disease germs merely act as liberating impulses. Disease is innate, and only requires the advent of a morbific stimulus to set it free. This doctrine, practically the converse of what now generally obtains, seemingly tends to the view that the ideally perfect animal would be naturally immune to disease,—a consummation devoutly to be wished. The question of immunity is discussed at considerable length, and with conspicuous ability and clearness. In the chapter on the prevention of infectious disease, the author's conception of disinfection is given; he would use methods of disinfection only for the purpose of preventing disease. Disinfection can do no more than that; and even where it is successful it is "only where cleanliness is associated with it, for cleanliness is the first and better half of disinfection."

It is to be hoped that this common sense view will be universally accepted, and that disinfectants may soon be estimated at their proper value. Notwithstanding the somewhat polemical attitude adopted towards certain schools of bacteriology, especially that of Koch, we are not disposed to carp at the author's views, partly because they are supported by strong and cogent arguments, and partly because of the flattering unction laid on "the wisdom of the moderate conceptions of the English." In estimating the value of Prof. Hueppe's work, the time when it was published (1895) must be taken into consideration. Since then much has happened; the plague (p. 268), so far from dwindling to the vanishing point, has burst out anew, and the serum test has become of daily application. But though the march of bacteriological facts has been rapid, this will be found to detract but little from the value of the doctrines inculcated in the Principles of Bacteriology, which, it may be added, are marked by originality, a strong individuality, and a somewhat caustic style. We have said that the translation is excellent, but we should have been glad not to have seen those anglicised continentalisms, "obligatory" and "facultative."

BIBLIOGRAPHY.

BAUMGARTEN, P. v., & F. TANGL—**Jahresbericht über die Fortschritte in der Lehre von den pathogenen Mikroorganismen, umfassend Bakterien, Pilze und Protozoen.** Jahrg. xiv. 1898, 1. Hälfte, 384 pp. Braunschweig, 1900.

LEE, A. B.—**Microtomist's Vade-Mecum.** 5th edition, London, 1900, 532 pp.

MICROSCOPY.

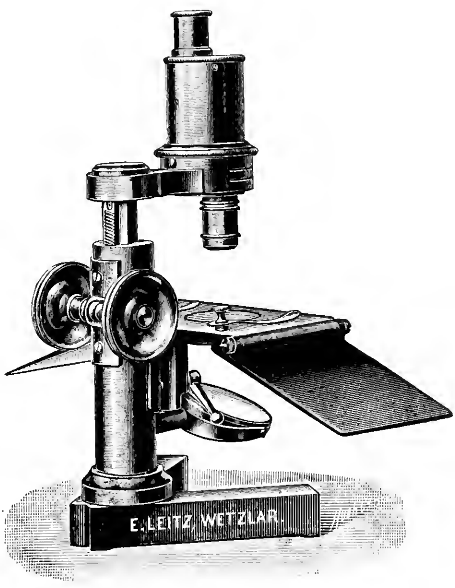
A. Instruments, Accessories, &c.*

(1) Stands.

Pfeiffer's New Preparation Microscope.—This has been designed by Prof. Pfeiffer to meet a want felt by him in his work on malarial parasites. He considered that an instrument of this kind should give an erect image, a maximum object-distance, large field, and sufficient magnification.

Fig. 123 shows the Microscope, which is built on the ordinary principle, but the inverted image produced by the objective is by a suitable prism arrangement presented to the eye as erect. These prisms are contained in a somewhat wide brass tube, which on its under side carries the objective excentrically, and on its upper the ocular. The bending of the light-path shortens the tube length, so that the eye is only 13–15 cm. above the stage on which the hands work. Three objectives are supplied; No. 1 gives 32-fold magnification at 45 mm. object distance; No. 2, 44-fold at 25 mm.; and No. 3, 65-fold at 15 mm. In spite of the passage of the light through the prisms, the image is full of light, sharp, and free from chromatic defects. The optical part is mounted on a firm stand with rack and pinion; the stage is spacious, and has supports for the hands. The stage-opening is provided with iris diaphragm, and the whole instrument can be very conveniently packed into a light box. The maker is Herr Leitz.

Fig. 123.



Erection of the microscopic image by means of prisms was first effected by Ahrens.† The same idea was carried out by Zeiss in 1895.‡

Vernier Microscope.—The Microscope shown in fig. 124 is of the type known as the Vernier or Micrometer Microscope. It was designed in the first instance for Prof. Baily of the Heriot-Watt College, and

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

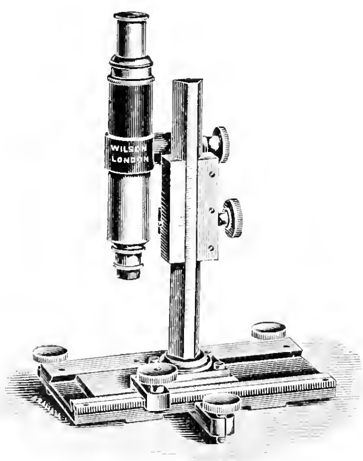
† Cf. this Journal, 1888, p. 1020, fig. 161.

‡ Cf. this Journal, 1895, p. 580, figs. 82–84.

embodies several suggestions made by his assistant, Mr. Cameron Smith. It is intended chiefly for use in a physical laboratory, where minute measurements of distances are very often required—such as the exact amount of bending of a rod, or of the stretching of a wire under a given weight, to determine Young's modulus; minute changes in thermometers and barometers; the comparison of two fiducial marks, or the distance between them; the measurement of refractive indices of plates and liquids; and numerous other purposes.

The instrument consists essentially of a horizontal and a vertical slide, along which scales to any practicable degree of fineness are engraved. The slides are actuated by rack-and-pinion movement where the scales are not read to a finer degree than 0·05 mm.; but for more minute readings a micrometer-screw arrangement is adapted. The Microscope proper is fixed at right angles to a horizontal axis, and thus turns in a vertical plane. At the common focus of the eye-piece (Ramsden) and the objective a finely divided glass micrometer-scale is placed, giving either the same reading as the verniers, or a finer one. As a higher power than 1 in. is seldom used with this class of Microscope, no fine adjustment is required. A divided circle has been added to the horizontal axis in some instruments to enable the Microscope to be placed at any required angle. The instrument is mounted on three levelling screws, and the lower slide is set in a horizontal position by means of a circular level let in at the base. By substituting a telescope object-glass for the objective, the instrument is converted into a very useful reading telescope, by which minute measurements can be taken at a considerable distance from the object.

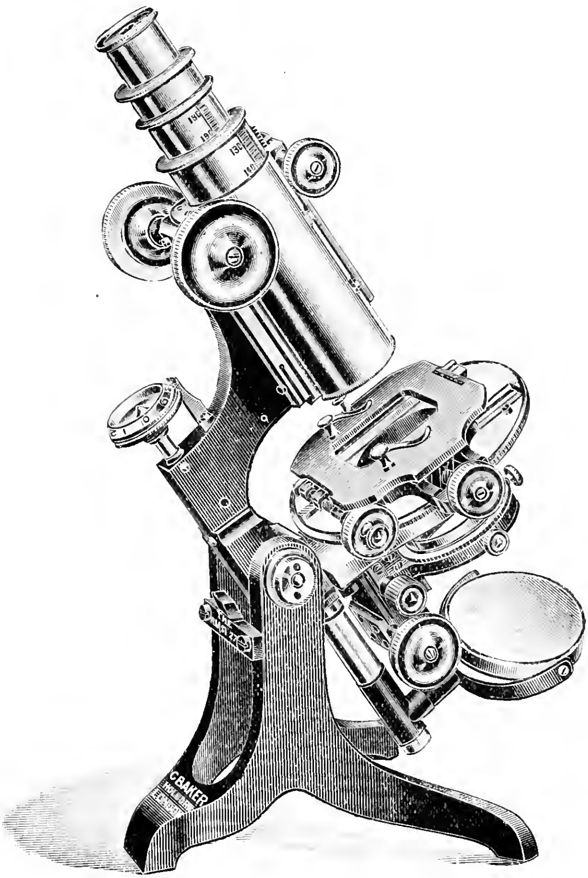
Fig. 124.



It will be seen from this description that readings can be taken in almost every direction.

C. Baker's R.M.S. 1·27 Gauge Microscope has diagonal rack-and-pinion movements and lever fine adjustments fitted to both the body-tube and the substage (fig. 125). Two draw-tubes are provided, one with rack-and-pinion adjustment; both are graduated in millimetres. The length of body with draw-tubes closed is 120 mm., when extended 250 mm. The diameter of draw-tube is the R.M.S. No. 3 size, viz. 1·27 in., and the body $1\frac{1}{2}$ in.; when the draw-tubes and nose-piece are removed, low-power objectives and photographic lenses can be placed in the body, and a longer working distance obtained. The distance between the nose-piece and the top plate of stage, when the body is racked back to the fullest extent, is $3\frac{1}{2}$ in. The rotating mechanical stage has a movement of 1 in. in either direction, and is graduated to 0·5 mm. The milled head of the horizontal movement is placed lower than the top plate of the stage, and the other milled head is removable, so that large slides or culture plates can be conveniently examined. The substage is of the R.M.S. standard size (1·527 in.), and is provided with centering screws; the milled heads of the coarse and fine adjustments are so

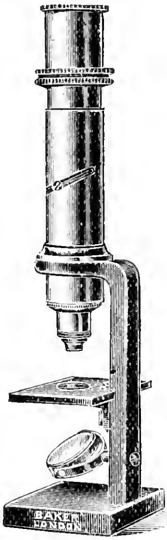
Fig. 125.



placed that they can be worked without shifting the hand; the plane and concave mirrors are $2\frac{1}{2}$ in. diameter. All the fittings are sprung, and have adjusting screws to compensate for wear. The foot is of the solid tripod form, and it has a bracket to support the stand when in a horizontal position.

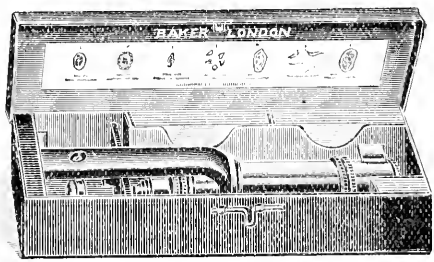
C. Baker's Plantation Microscope (figs. 126, 127) is constructed according to the advice of the London and Liverpool Schools of Tropical Medicine, and is designed to enable missionaries, planters, hospital assistants, and others, to detect the presence of parasites, &c., common on man and animals, especially in the tropics. The magnifying power is ×150, and the focussing adjustment is made by rotating the body in its outer jacket-tube; a pin fixed to the body travels in a spiral slot in the jacket-tube, by which means a steadier movement is obtained than with an ordinary push-tube fitting.

Fig. 126.



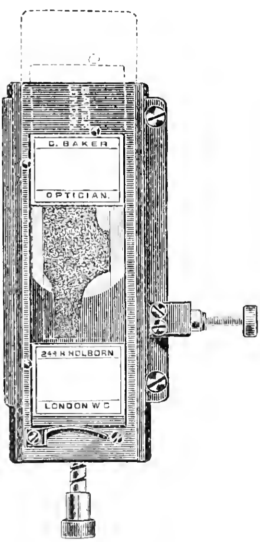
The instrument is packed in a japanned tin case, complete with glass slips and covers, also directions for use and illustrations of the eggs of the principal internal parasites, such as *Anchylostoma*, round and whip worms, *Amœbæ*, *Bilharzia*, *Distoma ringeri*, &c.

Fig. 127.



C. Baker's Attachable Mechanical Stage.—This stage (fig. 128) is specially designed for use with their diagnostic Microscope; it will be found useful in the systematic examination of covers as large as $1\frac{1}{2} \times 3/4$ in. The attachable stage is held in position by a spring runner fitting to the sides of the Microscope stage. A horizontal movement of $1\frac{1}{2}$ in. is obtained by a sliding top plate, which can be worked independently of the screw adjustment. This piece of apparatus, like the Microscope to which it is fitted, is very portable, being $4\frac{3}{4} \times 2\frac{1}{2} \times 1/2$ in.

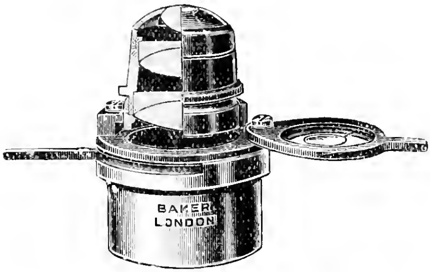
Fig. 128.



(3) Illuminating and other Apparatus.

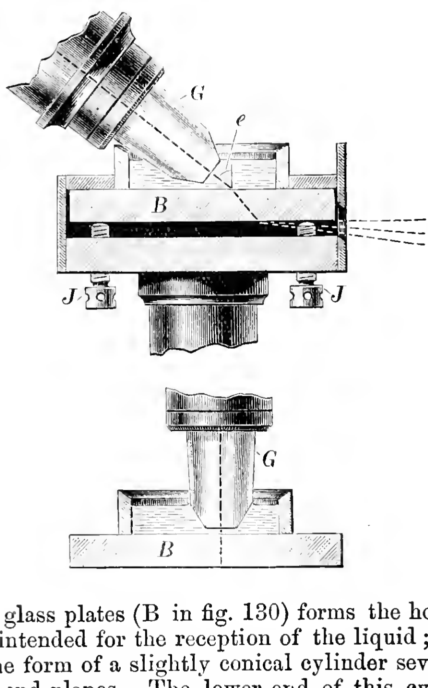
C. Baker's New Achromatic Condenser (fig. 129) has a N.A. of 1·0, and is a modified form of the well-known Abbe achromatic condenser; the lenses, however, are smaller, being 7/8 in. diameter instead of $1\frac{1}{16}$, and the aplanatic cone is not less than 0·90. It is supplied with an iris diaphragm, a turn-out stop carrier, and three stops for dark ground illumination. The power of the optical combination is 4/10 in.; working distance 1/10 in. With the front lens removed, this condenser has a power of 8/10 in. and 13/32 in. working distance, and is then suitable for use with the lower powers.

FIG. 129.



New Refractometer with Variable Refractive Angle.*— This instrument, made by Zeiss and designed by Dr. C. Pulfrich, is intended for the examination of a very highly refractive liquid, which is placed between two glass plates as in a kind of hollow prism, but with the difference that the refractive angle of the prism can be varied at pleasure.

FIG. 130.

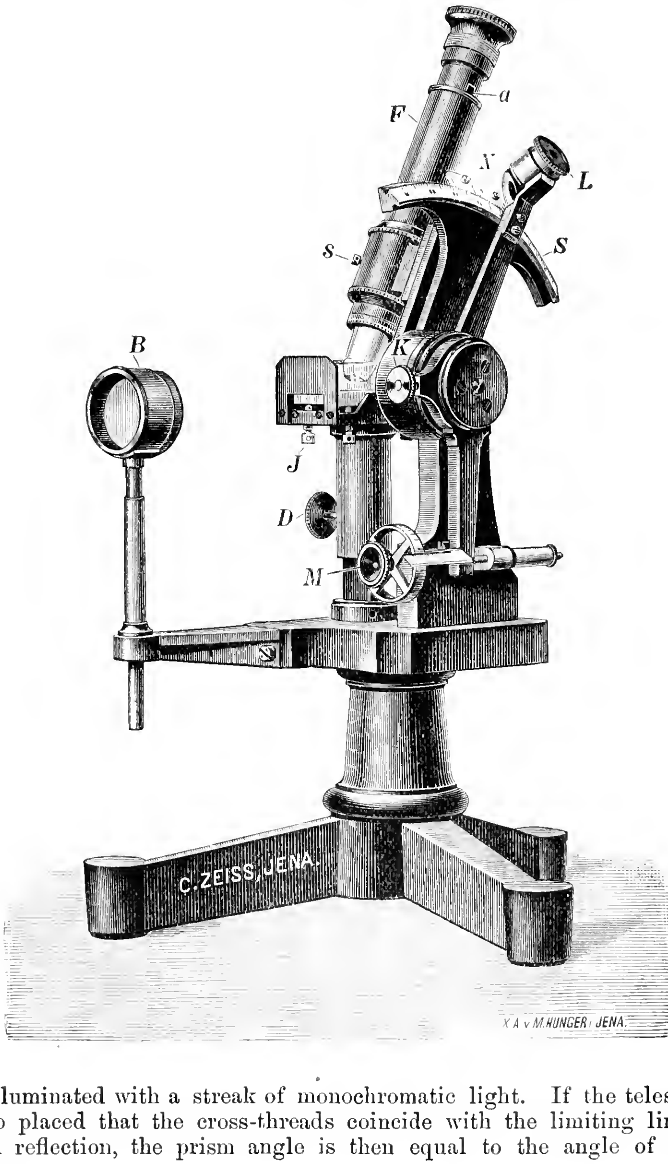


One of the two glass plates (B in fig. 130) forms the horizontal floor of a glass trough intended for the reception of the liquid; the other glass plate G takes the form of a slightly conical cylinder several centimetres long with even end-planes. The lower end of this cylinder dips into

* Zeitsch. f. Instr., 1899, pp. 335–9 (4 figs.).

the liquid, the other is in close connection with the observation-tube. Both telescope and glass cylinder are rotatory round an axis lying in the plane of the front face of the cylinder. The floor-plate of the trough

Fig. 131.



is illuminated with a streak of monochromatic light. If the telescope is so placed that the cross-threads coincide with the limiting line of total reflection, the prism angle is then equal to the angle of total reflection and we get $n = \frac{1}{\sin e}$, where n = refractive index and e the angle of total reflection. The method is, as it were, a special case of prismatic vision, and can be defined as the method of oblique incidence and normal emergence. As the refractive index of the less refractive medium (air, $\mu = 1$) is known, there is no limit to the applicability of the method. In the case of the very highly refractive liquids, the glass parts are made of a specially hard and dense kind.

If Δn, Δe be small variations in the values of n and e, then the degree of accuracy is given by the equation

$$\Delta n = - \frac{\Delta e}{\sin e \,.\, \tan e}\,.$$

Volatile liquids and liquids which easily solidify are difficult to deal with.

A view of the instrument is shown in fig. 131. The rigidly attached sector S carries a scale graduated from 0° to 75° into half degrees. The

FIG. 132.

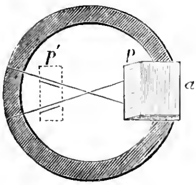
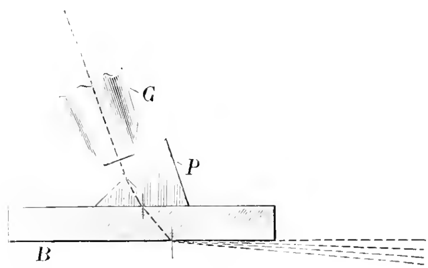


FIG 133.



telescope F rotates about the horizontal axis, and a vernier N, by means of the lens L, gives readings to 1′. The coarse adjustment of the telescope is by hand motion; and the fine by a drum-headed micrometer screw M graduated to 1′. The latter appliance adapts the instrument for dispersion readings, for which the previous formula suffices.

The glass body at the base of the telescope is tapered off and cone-shaped; its under surface is only a strip 5 mm. broad, which is placed accurately in the axis of rotation of the telescope. Thus the solution-trough can be approximated very closely to the strip, and the distance regulated by the milled screw-head D. The lens B serves for the oblique illumination of the under side of the glass trough. The light source is sufficiently far removed to allow of the formation of a flame-image on the screen before the glass plate. Diaphragms can be placed in the telescope to cut off any reflected images.

A little window a in the eye-piece (fig. 132) allows, by a method of reflections, the normal adjustment of the telescope-axis to the prism-planes; small adjustments are imparted by the screw J (fig. 131).

The method of examining solid bodies is clearly shown in fig. 133. The solid must be in the shape of a prism P, and is placed on a plane piece of glass B with parallel sides, the refracting angle of the prism being parallel to the rotation axis of the telescope. A drop of oil or water secures optical contact between the prism and glass plate.

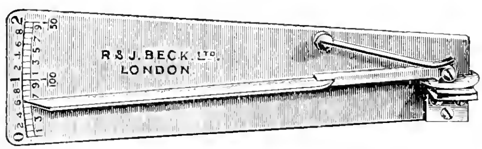
MARPMANN—**Ueber Prismenspektroskope und Mikrospektroskope mit Fernrohr.** (On Prism-spectroscopes and Micro-spectroscopes with Telescope.)
Zeit. f. angew. Mikr., V. (1900) pp. 309-13 (2 figs.).

(6) **Miscellaneous.**

Becks' Cover-glass Gauge.—Since the thickness of the cover-glass slightly alters the correction of a high-power object-glass, the purpose of this gauge (fig. 134, one-third full size) is for observing the thickness of thin glass covers under which objects are to be mounted.

All the object-glasses of these makers which are not provided with

FIG. 134.

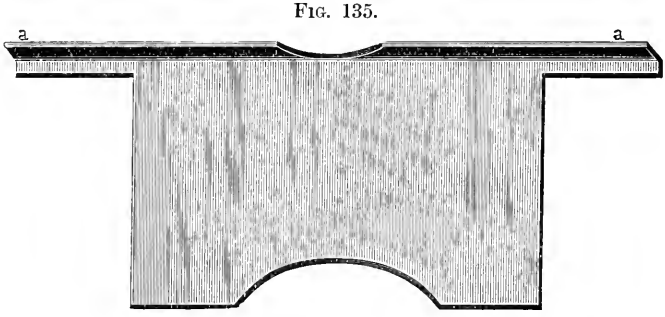


correction collars are corrected for cover-glass of 0·006 in.; this is the mean thickness of their No. 1 cover-glass, and it is advisable that no glass thicker than this should be used for high-power observation.

To ascertain the thickness of a cover-glass or lamina of any kind, first raise the long lever, and then slide in the cover-glass on the steel plate or bracket, and gently lower the lever on to it; the hardened steel point close to the fulcrum of the lever must rest on some portion of the cover-glass.

The thickness can then be read off on the scale in 0·001 in.; thus the scale illustrated above reads 0·006 in.

FIG. 135.

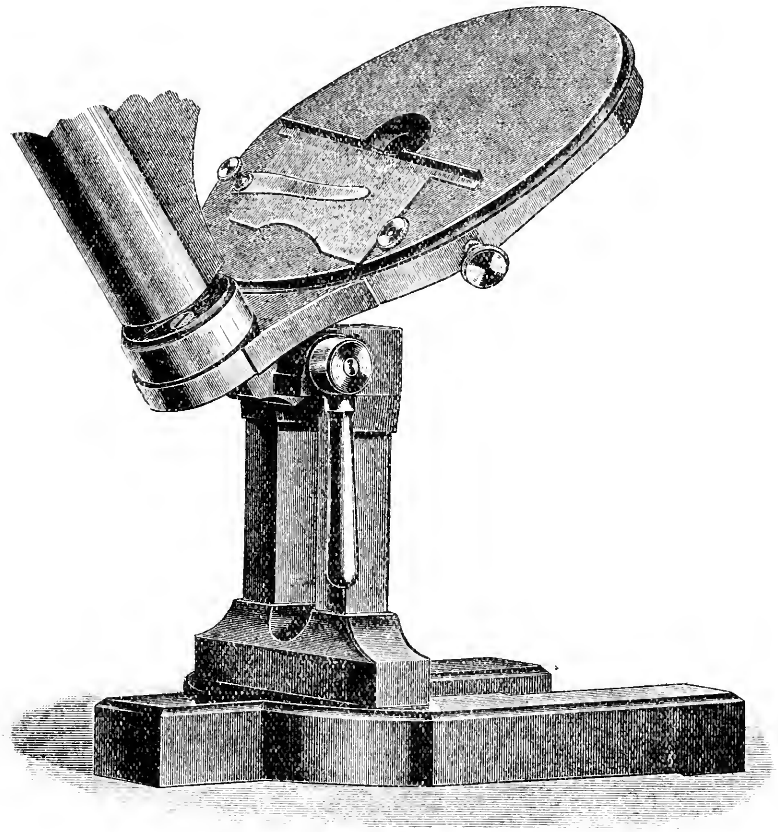


Mayer's Simple Object-pusher.*—Dr. Paul Mayer, of Naples, makes this convenient accessory (fig. 135) out of a thin metal plate, whose edges are cut accurately enough to move freely between the bases of the ordinary object-clamps (fig. 136). One spring is removed, and the other serves to press the plate on the stage with suitable pressure. The upper

* Zeit. f. wiss. Mikr., xvii. (1900) pp. 7–9 (2 figs.).

edge is bent upwards at right-angles, and the middle part is cut away so as not to interfere with high-power objectives. The object-slide rests

Fig. 136.



against the turned-up edge. By resting one's thumbs on the plate and one's forefingers on the object-slide, it is possible, with a little practice, to systematically and easily search every part of the preparation.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

New Medium containing Brain Substance for Cultivating Tubercle Bacilli.†—Dr. M. Ficker finds, from a series of comparative cultiva-

* 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., xxvii. (1900) pp. 504–11, 591–7.

tion researches on acid, amphoteric, neutral, and alkaline media which were made from sputum, potato, blood-serum, and from numerous human and animal organs, that substrata with acid or amphoteric reaction are far more favourable than those with neutral or alkaline reaction. The best of all was a medium containing brain substance and having an acid reaction. This was prepared in the following way:—Fresh brain was passed through a mincing machine, two or three times, and the mass mixed with an equal bulk of distilled water. This was then heated slowly to boiling, being constantly stirred the while. After having boiled for a quarter of an hour, the decoction was passed through a strainer. The strained broth was then distributed into flasks, and steam-sterilised for two hours. This stock broth was used to mix with serum or agar. For the brain-serum medium equal parts of stock and serum were used and then mixed with 3 per cent. glycerin. Slants in test-tubes were made of this mixture in the usual way. The brain-agar medium was made by mixing equal parts of a 2·5 per cent. solution of agar and the stock-broth and then adding 3 per cent. glycerin. The mixture was distributed into test-tubes, and the tubes steam-sterilised for half an hour.

During sterilisation brain-agar separates into two layers, the upper one being agar, the lower brain substance. It is, therefore, necessary to shake the tubes well and make them set as soon as possible to prevent the brain substance sedimenting. Any kind of brain may be used; the serum recommended is horse-serum. The growth on these brain media is very satisfactory, as regards both amount and rapidity of development. Brain may also be used after the manner of potato. For these cultures a brain is set by steaming it for 1–1½ hours. It is then cut up into slices which are placed in test-tubes or capsules. In the test-tubes about 10 drops of 3 per cent. glycerin are placed; in the plate-cultures 15–20 drops. The tubes and capsules are then steam-sterilised twice for half an hour. The slices should not be too thin.

Cultivating and Staining the Nodule Organism of the Leguminosæ.*—Mr. R. Greig Smith has obtained excellent growths of the nodule organism with a faintly acid medium containing 1 per cent. pepton, 5 per cent. glucose, and 0·5 per cent. potassium chloride. Air-dried films, fixed by floating on 5–10 per cent. formalin, were stained with carbol-violet, washed, air-dried, and mounted in balsam. When prepared in this way, the organisms appeared as more or less oval capsulated yeasts with vacuoles and terminal buds. The diversity of shape depends on the thickness of the capsule, the nature of which is dependent on the cultivation medium. Glucose tends to produce thin delicate capsules, while with sucrose they are tough. By using an undiluted young pepton-glucose culture, fixing in formalin, and staining with Cœrner-Fischer solution, the author succeeded in staining the flagellum. This flagellum is thin, single, terminal, about 2 μ long, with a tuft at the distal end.

Influence of Metals on Broth Cultures of Bacteria.†—Herr B. Isachenko states that experiments with *Bacillus spermophilinus* showed

* Centralbl. Bakt u. Par., 2te Abt., vi. (1900) pp. 371–2.
† Selsk. Khoz. Lyesov., clxxxix. (1898) pp. 35–42.

that when broth cultures are to be kept more than a month, only iron vessels should be used. Tinned iron, nickel-plated or zinc-plated iron vessels are quite unsuited for bacterial purposes. Copper vessels should be used only for a very short time for preserving sterilised broth.

(2) Preparing Objects.

Formaldehyde as a Killing and Fixing Agent. * — Prof. T. P. Carter has found that the following formula yields most satisfactory results when used for killing and fixing:—formaldehyde, 40 per cent. solution, 50 ccm.; distilled water, 50 ccm.; glacial acetic acid, 5 ccm.

By this solution tissues are killed and fixed in from 6–12 hours, but the immersion may be continued for 24 hours without damage. The pieces are then transferred to 50 per cent. alcohol for one hour, and afterwards to 75 per cent. and 95 per cent. alcohol for half an hour each.

Method of Examining Red Blood-corpuscles. † — Sig. A. Negri, in his researches on the nucleus of mammalian red corpuscles, adopted Petrone's method. The best results were obtained by removing the blood (man and rabbit) along with osmic acid 1 : 4000, placing it in picric acid 1 : 4000, and then staining with formic acid carmine. From the appearances observed the author arrives at the conclusion that the forms described by Petrone are not to be regarded as nuclei.

Apparatus for rapidly Dehydrating Pieces of Tissue. ‡ — Herr M. Pokrowsski describes a small apparatus (fig. 137) intended for dehydrating pieces of tissue as rapidly as possible. The essential part of this contrivance, as will be seen from the illustration, resembles a wine-glass in shape, the cup of which is perforated with numerous holes. In lieu of perforated metal the cup may be made of wire sieve. The apparatus is placed within a large glass vessel which is filled with alcohol or some other hardening fluid, and the tissue to be hardened is located in the cup.

Fig. 137.

New Maceration Medium for Vegetable Tissue. § — Herr O. Richter finds that strong ammonia will macerate vegetable tissue without injury to the cell contents such as starch and aleurone-grains, chlorophyll granules, &c. The fluid was used boiling, cold, and at a temperature of about 40° C. The rapidity of the maceration depends on the temperature.

Preparation of Conceptacles of Fucus. ‖ — M. J. Chalon finds that male and female carpomates (conceptacles) of *Fucus vesiculosus* and *serratus* can be preserved indefinitely in strong

* Amer. Mon. Micr. Journ., xxi. (1900) pp. 93–6 (1 pl.).
† Anat. Anzeig., xvi. (1899) pp. 33–8 (9 figs.).
‡ Medizinsskoe Obosrenie, Sept. 1899, 3 pp. and 1 fig. See Zeitschr. f. wiss. Mikroskopie, xvii. (1900) pp. 38–9 (1 fig.).
§ Oesterr. Bot. Zeitschr., lv. (1900) p. 5.
‖ Bull. Soc. Belge de Microscopie, xxv. (1898–9) pp. 107–9.

alcohol, and may be sectioned from this fluid. Some few specimens become brittle; these should be immersed for 24 hours in alcohol to which 20–25 per cent. glycerin has been added. No water is to be used. When the *Fucus* sections are placed in pure glycerin, they slowly assume their original bulk, and may be advantageously mounted in glycerin-jelly. This procedure should be carried out on the slide. The sections should be stained with alcohol solutions of anilin dyes, followed by glycerin and glycerin-jelly. The best results were obtained with acetic gentian violet. Behrens recommends staining *Fucus* with acetic carmin, passing slowly through alcohols up to 100°, oil of cloves, balsam. This acetic carmin is prepared by making a saturated hot solution of carmin in 45 per cent. acetic acid. The author tried this method on male *Fucus*; the sections were stained for one hour, then soaked in alcohol for 12 hours, followed by glycerin and glycerin-jelly. The results were excellent, but not so good as those mounted in balsam.

Demonstrating the Elastic Fibres of the Skin.* — Herr L. Merk obtained excellent results with the following solution:—absolute alcohol 40 ccm., distilled water 20 ccm., nitric acid 20 drops.

Eight to ten drops of this solution are mixed with 10 ccm. of a 3 per cent. solution of hydrochloric and alcohol. The sections (hardening in alcohol or Zenker's fluid) are left in the staining solution for 24 hours and then washed in distilled water, after which they may be examined in glycerin or in balsam, or they may be further stained with methylen-blue, vesuvin, hæmatoxylin.

Rapid Method for Demonstrating Amyloid Degeneration.†—The sections to be examined are placed for 2 or 3 minutes in an iodo-potassic iodide solution of the following composition:—Water 100, potassium iodide 1, iodine in excess. The sections are then immersed in 1 per cent. sulphuric acid. The degenerated parts then become dark green. The sections are further treated with 96 per cent. alcohol, which changes the green to a cœrulean blue. If mounted in glycerin, the degenerated parts are blue and the non-degenerated yellow.

Simple Apparatus for Washing several Preparations simultaneously.‡—Dr. R. Kolster describes an apparatus for washing several preparations at the same time, and which is specially adapted for the Marchi method. The essential features are easily understood from a glance at the illustrations (figs. 138 and 139). Above is a glass vessel capable of holding several litres, and having an opening near the bottom. This is plugged with cork perforated for the passage of a glass tube. A piece of rubber tubing connects the tube with another, the extremity of which is drawn out to a very fine point. A clamp is fitted to the rubber tubing, so that the outflow of water can be regulated. The rest of the arrangement consists of a number of large test-tubes, which are connected together by means of glass tubes and rubber tubing. One of these tubes is long, and reaches to near the bottom of the test-tube,

* S.B. k. Akad. Wiss. Wien, cviii. (1899) pp. 335–80 (3 pls.).
† Clinic. vet. Oesterr. Monatschr. See Zeitschr. f. angew. Mikr., v. (1900) p. 214.
‡ Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 9–13 (2 figs.).

while the outflow tube is short, and cut off close to the stopper. Some cotton-wool is placed at the bottom of each tube. The upper end of the

Fig. 138.

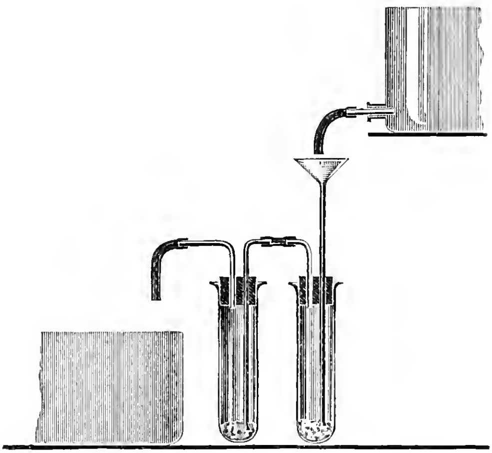
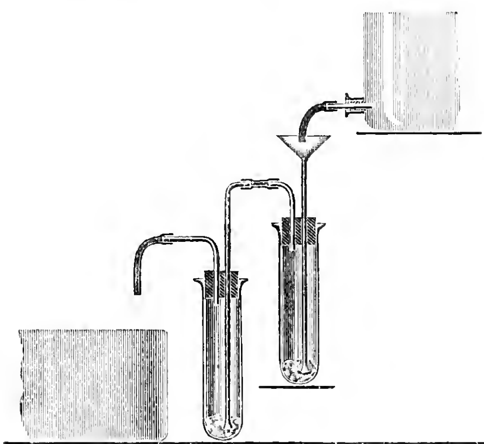


Fig. 139.



first tube is provided with a funnel. The test-tubes may be arranged on the same level or stepwise.

(3) Cutting, including Imbedding and Microtomes.

Neuberger's Simple School Microtome.*—Prof. Neuberger, of Freiburg in Baden, has invented this instrument as an improvement on the small student's microtome of Jung. While Jung's is admirable for cutting

* Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 1–6 (4 figs.).

paraffin series and frozen objects, it is not very successful with fresh or hardened plant specimens. Fig. 140 explains the theory of Neuberger's

FIG. 140.

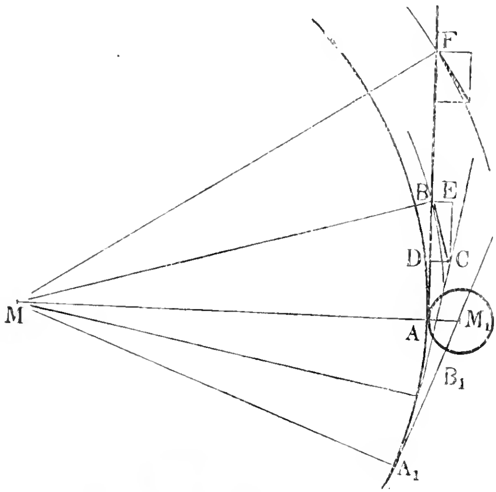
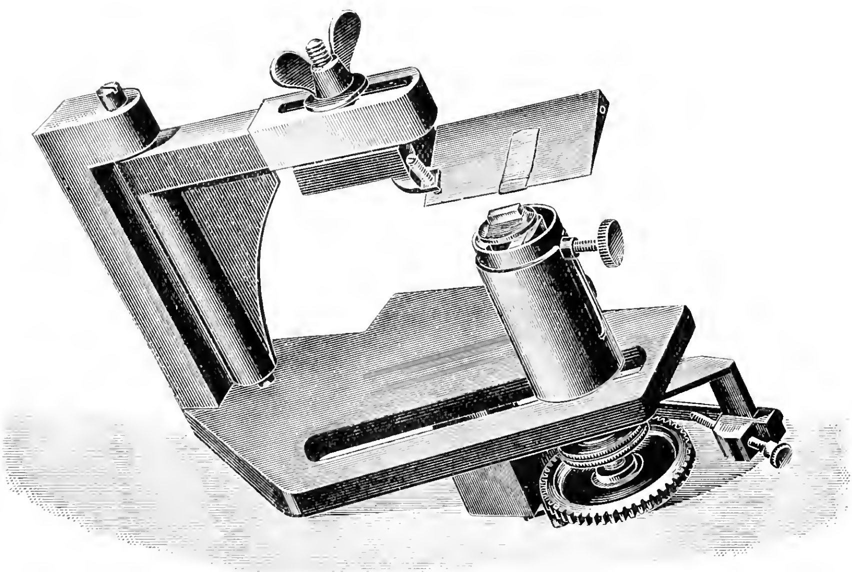


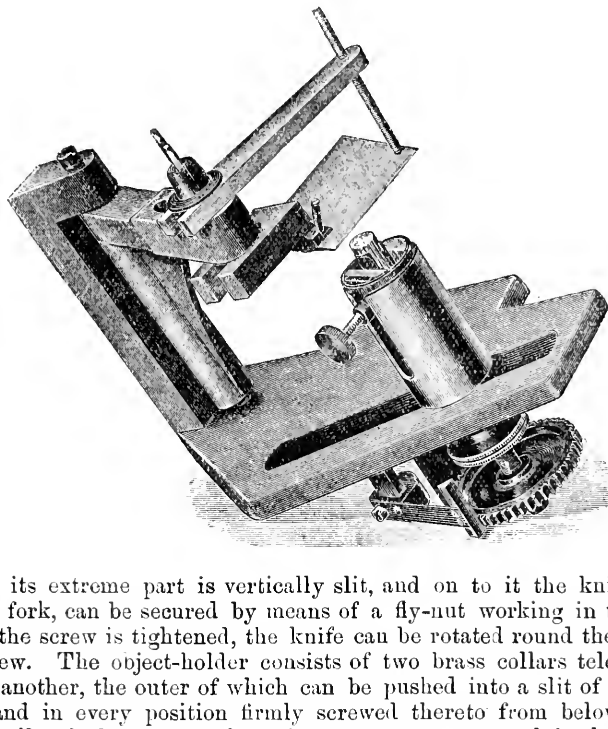
FIG. 141.



machine. Two circles, a large one of radius M A (about 11 cm.), and a small one of radius M_1 A (about 1 cm.), have external contact at A, at which point A B is their common tangent. If the large circle and tangent revolve around the centre M, and if any force B C at B perpendicular to the radius be resolved into components B D and B E, respectively along and perpendicular to the tangent, then the component B D glides along the small circle without action, and the only effective part of the force is the component B E. If the radius M A be replaced by a revolving arm, the tangent B A by a knife-edge, and the small edge by the article to be cut, then the principle of the machine will be understood (fig. 142). The excellent results obtained seem to show that this is the right view of the mechanical problem.

A horizontal beam-like arm moves on a horizontal base plate fastened to the table, and can be rotated, through more than 180°, about a vertical axis between two steel points, of which the lower is adjustable. The

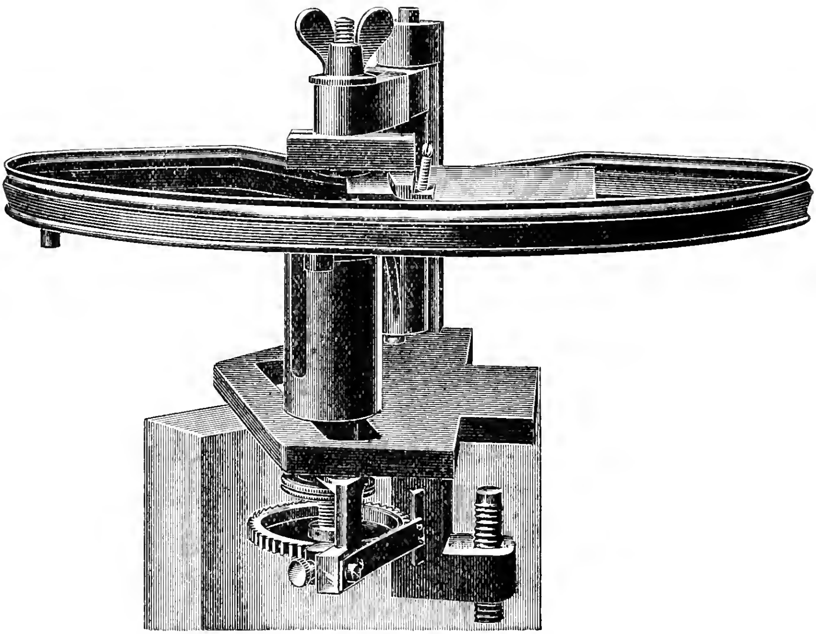
Fig. 142.



arm] in its extreme part is vertically slit, and on to it the knife, with Walb's fork, can be secured by means of a fly-nut working in this slit. When the screw is tightened, the knife can be rotated round the axis of the screw. The object-holder consists of two brass collars telescoping in one another, the outer of which can be pushed into a slit of the base plate, and in every position firmly screwed thereto from below. The inner collar is by means of a micrometer screw rotated by hand, and rises about 5 μ for every tooth of the wheel. In this inner neck is the object clamp, constructed out of two wooden brass-tipped cylinder-segments pressed against one another by a screw; the edges of these segments are always parallel. A spring with vertical catch, set in action or released by a rod in a simple way, serves as a check to the micrometer toothed wheel. Ordinarily it lies behind the micrometer screw (fig. 141), but can, by rotation of its bearer, be brought in front (fig. 142) and then can be used, after appropriate adjustment by means of its rod, as an indicator on the wheel-tooth, if one wishes to prepare thicker sections of 20 μ and upwards, and to save wear and tear on the gear.

For cutting celluloid objects (fig. 143) under alcohol, a thin metal tray is used, which bears on its under side a soldered-on mouthpiece of the shape and size of the inner object collar, thus allowing it to fit on to the outer collar. A small piece of paraffin is melted, and cements the celluloid plug on to the proper place; the tray is then filled with 70 per cent. alcohol, and cutting proceeds. Attention must of course be paid to orientation. This arrangement is also followed for cutting sections of plants between elder pith or liver.

Fig. 143.



The microtome produces good paraffin serial sections of 5 μ, celluloid in alcohol 10 μ, and pith 20 μ. The area of the slice is about a square centimetre.

The inventor recommends the advantages as (1) manifold applicability, on account of easy adjustability of knife, object and catch; (2) small knife, with accurate cut and easy withdrawal of section; (3) low price.

Bettling, C. J.—**Ueber die neuen Bogen-Mikrotome.** (On the new Circular Microtomes.)

[An interesting review of microtomes in general and of circular microtomes in particular.] *Zeitschr. f. angew. Mikr.*, VI. (1900) pp. 1–6 (2 figs.).

(4) Staining and Injecting.

New Staining Method for Demonstrating the Finer Structure of Bacteria.*—Herr K. Nakanishi describes a method in which the stain is first deposited on a slide. The most suitable pigment was found to be methylen-blue B.B. It is easily soluble in water, blood-serum, and other animal fluids. Some of the saturated aqueous solution is filtered on to a slide, and smeared up and down with filter-paper. The stain is wiped off so as to leave only a thin layer of a sky-blue colour. Or a layer of pigment may be deposited on the slide by boiling until it dries, and the excess afterwards rubbed away until the desired colour is obtained. A small drop of the fluid to be examined is placed on a cover-glass, and this on the stained slide.

This method is very suitable for blood and for blood-parasites, as well as for bacteria. In bacteria it demonstrates the presence of a nucleus which is stained red, the rest of the protoplasm being blue. Flagella and spores do not stain. By this method the various stages of cell-division are easily followed.

Staining Bacteria in Sections simultaneously treated by Van Gieson's Method.†— Herr G. Dreyer states that the following procedure gives excellent results and beautiful pictures. The tissue is fixed with formalin and imbedded in paraffin. The sections are stuck on in the usual way with 30 per cent. alcohol, and when freed from paraffin are treated as follows:—(1) Aqueous methyl-violet (1 per cent.) or gentian-violet for 3–5 minutes; (2) wash in distilled water; (3) saturated aqueous picric acid solution for 3–4 minutes; (4) mop up with filter-paper; (5) anilin oil, to which 1 per thousand picric acid is added until the section is quite yellow and no more violet is given off; (6) careful and prolonged washing in distilled water; (7) Delafield's hæmatoxylin for 5–8 minutes; (8) careful washing in distilled water for about 5 minutes; (9) acetic acid, picric acid fuchsin (about 2–3 ccm. picric acid fuchsin, to which one drop of 1 per cent. acetic acid solution is added) for 3–5 minutes; (10) immersion and dehydration in absolute alcohol for 1/2–1 minute; (11) xylol—xylol dammar.

Staining the Karyochromatophilous Granules in Blood.‡—Dr. A. Plehn adopts the following method for staining granules in the blood of persons residing in malarious districts. Dissolve hæmatoxylin 2 in a mixture of alcohol, glycerin, and distilled water 100 each; add acetic acid 10, alum as much as may be necessary, and allow the mixture to stand for 14–21 days; then add a few grains of eosin. The preparations are fixed in absolute alcohol for at least one hour. They are then placed in an air-tight capsule and stained for 8–12 hours. Only water is used for decolorising. Finally they are dried and mounted in balsam.

Staining the Parasites of Leucocythæmic Blood.§—Prof. M. Löwit stains the parasites of leukhæmia by the following procedure. The dry

* Münchener Med. Wochenschr., 1900, No. 6. See Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 57–9.

† Centralbl. Bakt. u. Par., xxvii. (1900) pp. 534–5.

‡ Deutsch. Med. Wochenschr., 1899, No. 44. See Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) p. 627.

§ Centralbl. Bakt. u. Par., xxvii. (1900) pp. 462–6.

blood-films are fixed by heating them for 1–2 hours at 110°–120°. When cool they are immersed in a saturated solution of thionin for half an hour. The preparations having been washed in running water are dried and placed for 10–20 seconds in iodopotassic iodide solution (iodine 1; iodide of potassium 2; distilled water 300). They are then washed again, dried, and mounted in balsam; the parasites are stained green. Fresh solutions of thionin stain only faintly, but they act better if heated till they vaporise, or by mixing 30 ccm. thionin solution with 15 ccm. of Löffler's methylen-blue solution.

Stain for Nuclei of Endoglobular Hæmatozoa.*—M. Laveran gives some further directions for making a solution especially suitable for staining the nuclei of endoglobular hæmatozoa. The stain is a mixture of three solutions:—(1) In a 150 ccm. bottle are placed a few crystals of silver nitrate and 50–60 ccm. of distilled water. When the crystals are dissolved, the bottle is filled up with soda solution, and the precipitated silver oxide is washed several times with distilled water. Saturated aqueous solution of medicinal methylen-blue (Höchst.) is added, and the mixture allowed to stand for seven or eight days; (2) aqueous solution of eosin 1 per 1000; (3) solution of tannin 1 per 100.

When required for use, the stain is made by mixing 4 ccm. of the eosin solution with 6 ccm. of distilled water and 1 ccm. of the methylen-blue solution (Borrel's blue). The eosin and methylen-blue solutions must be filtered separately at the time the mixture is made. The films are treated in the usual way.

Rapid Staining of Gonococcus in Fresh Unfixed Preparations.†—Herr Uhma describes the following simple method for staining Neisser's diplococcus. The advantages claimed are that the preparations require no fixing, and that gonococci are distinguished from other bacteria by the staining. The slides are moistened or smeared with an alcoholic (or acetic acid) 0·5–1 per cent. solution of neutral red, and dried. A small drop of pus is placed on a cover-glass, and the cover laid on the slide. The preparation is then ready for examination. The gonococci are the first elements to pick up the stain, and though very occasionally other bacteria may be stained, this is the exception rather than the rule.

Staining Gonococci.‡—Dr. E. Homberger states that he has used Kresylecht violet, a fluorescing dichromatic pigment, for some years for staining gonococci. The stain has a particular affinity for gonococci, especially in quite dilute solutions, e.g. 1 to 10,000. With this solution the nuclei of the cells become blue and the gonococci red-violet. Other bacteria are but faintly stained or not at all.

Even in sections Kresylecht violet possesses many advantages over other pigments for staining gonococci. The sections are placed in 1 per cent. solution for several minutes, then transferred to alcohol, followed by anilin oil-xylol in the proportion of two to one. If the section is overstained it may be differentiated and dehydrated by means

* C.R. Soc. Biol., lii. (1900) pp. 549–51.

† Arch. f. Dermatol. u. Syph., l. (1899) pp. 241–2. See Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 111–2. Cf. this Journal, *ante*, p. 264.

‡ Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) p. 533.

of alcohol, but if understained it should be dehydrated in anilin oil-xylol in equal proportions. Kresylecht violet is a good stain for amyloid, plasma-cells, blood-preparations, and malarial parasites.

Sudan iii. Stain for Tubercle Bacilli.* — Dr. D. M. Cowie finds that Sudan iii., recommended by Dorset † as a selective stain for the tubercle bacillus, is a failure, and this experience is corroborated by Dr. Le Doux ‡ of Grahamstown, South Africa, who states that his results are also negative.

Staining of Ligneous Tissue. §—M. J. Chalon gives the following résumé of the staining reactions of ligneous tissue after treating the sections with aqueous or alcoholic solutions of the reagents followed by sulphuric acid.

Phloroglucin (in this case hydrochloric acid should be substituted for sulphuric): the colour is a bright rose, lasting often 12 hours or more. Carbazol: red-violet. Orcine: red, passing to violet. Resorcin: pale violet blue. Naphthol A: yellow, passing to pale green. Pyrogallic acid: bronze-green. Indol: red.

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

Formalin and Alcohol as Preservatives for Zoological Specimens.‖ —Mr. J. Hornell, in discussing the respective values of formalin and alcohol as preservatives for museum specimens, expresses the opinion that the best effects of formalin are seen with Medusæ and Tunicata. Most animals should be mounted in formalin-alcohol after previous fixation. For some animals which contain lime salts, such as echinoderms and crustaceans, formalin is unsuitable, as it slowly decalcifies them and renders them very brittle.

In collecting trips formalin is more useful than alcohol, as in its concentrated form it does not occupy so much space, and is therefore more easily stowed. In microscopical technique, maceration of the objects, sections, &c., may be obviated by the use of a 2 per cent. solution, either as an addition to staining solutions, or to replace pure water in washing out fixatives.

Easy Method of Mounting and Preserving Mosquitos.¶—Mr. D. C. Rice describes the following method adopted in the London School of Tropical Medicine for mounting mosquitos. All that is required are slides, round cover-glasses, glass rings about 1/16 to 1/12 in. deep and 7/8 in. in diameter, and xylol Canada balsam. Kill the mosquito by placing in an ordinary killing bottle, or if this is not available, a little chloroform or tobacco smoke will do as well; when dead turn it over on its back, separate the legs if they are together, place a large drop of thick xylol Canada balsam on a slide, invert this gently on to the mosquito, and in this way it is picked up without any chance of injury; then with a fine needle spread out and arrange the wings and legs, and if necessary press down the thorax very carefully. Next pour on some thin xylol Canada balsam; as this runs out it straightens the

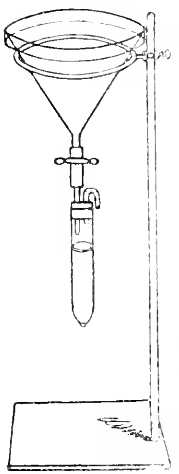
* New York Med. Journ., lxxi. (1900) pp. 16–7.
† Cf. this Journal, 1899, p. 236.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) p. 616.
§ Bull. Soc. Belge Micr., xxv. (1898–9) pp. 106–7.
‖ Laboratorium et Museum, 1900, pp. 85–9.
¶ Brit. Med. Journ., 1900, i. p. 1468.

proboscis and antennæ, and they do not, as a rule, require to be touched. Put the specimen on one side to harden, and then chip off excess of Canada balsam, place the glass ring on, and fill up the chamber that is thus formed with Canada balsam. The upper surface of the Canada balsam should be convex, so that when the cover-glass is applied no air bubbles are included. Allow the specimen to harden before sending by post. If glass rings are not at hand, the specimen will keep quite well in the Canada balsam alone, and the last part of the mounting may be completed after the specimen has been sent home. If the mosquito is intended for photographing, great care must be taken in mounting it so that it lies as far as possible in one plane.

6) Miscellaneous.

Simple Apparatus for filling Gelatin Tubes.* — Dr. R. J. Petri uses the following simple and inexpensive apparatus (fig. 144) for filling test-tubes with gelatin. An ordinary laboratory stand with a ring about 12 cm. in diameter supports a funnel which contains the liquefied gelatin heated to about 80°–90°. The top is covered with a cap or glass plate. To the pipe of the funnel is fitted a piece of rubber tubing closed by a stopcock. Into the lower end of the tubing fits a glass tube the free extremity of which is somewhat pointed. This tube is passed through a cork stopper. The stopper has a second perforation for a short bent tube which is stuffed with cotton-wool. The stopper fits into a glass tube or a test-tube the lower end of which is melted off in the flame so as to leave a round smooth hole. A small strip of paper is then stuck on the tube to indicate 10 ccm. The manipulation of the apparatus is very simple. The funnel is filled with fluid gelatin. The tube is taken in the left hand and the aperture closed with the thumb. With the right hand the stopcock is opened and gelatin allowed to flow in up to the paper mark. A test-tube is now taken up in the right hand and the cotton-wool plug removed by the 4th and 5th fingers of the left hand. The tube is then placed under the opening and the thumb removed so that the gelatin flows in. The cotton-wool plug is then replaced. In this way dozens of test-tubes are easily filled.

Fig. 144.



New Quantitative Method for Serum Diagnosis.† — Dr. R. T. Hewlett and Mr. S. Rowland describe a new quantitative method for obtaining accurate dilutions of serum or blood.

Ordinary vaccine tubes are taken, the large, the very small, and any irregular ones being discarded, those preferred varying in diameter from about 0·9–1·2 mm. They are boiled in strong nitric acid, thoroughly

* Centralbl. Bakt. u. Par., xxvii. (1900) 1te Abt., pp. 525–6 (1 fig.).
† Brit. Med. Journ., 1900, i. p. 1015.

rinsed in tap, and then in distilled water, and dried; a large number can thus be treated at one operation. The selected tubes are charged with the blood to be examined, being preferably one-half to two-thirds filled, and are carefully sealed by melting their ends in a flame in the ordinary way. In the laboratory the length of the column of blood between the bases of the two menisci is first measured by means of a scale graduated to half millimetres, assisted by a lens mounted to avoid parallax. The end of the tube is then cut off by means of a fine file or writing diamond, and its internal diameter is measured. This, the most important of all the manipulations, is carried out in the following manner.

The tube is supported in the axis of the Microscope by means of two iris diaphragms carried respectively by the stage and by the substage. These close concentrically, and support the tube, at the same time cutting off all light reflected from the mirror. The opaque blood in the interior of the tube in the same way cuts off all light that might pass through the lumen of the tube. The only light that thus reaches the optical system is that transmitted by the glass walls of the tube. In the field of vision the lumen of the tube now appears as a black circle surrounded by a brilliantly illuminated annulus. Owing to the extreme sharpness of the image, the measurement of the diameter of the tube can be carried out with great accuracy by means of an eye-piece micrometer arranged to give readings to the one-thousandth of a millimetre. From the formula $V = D^2 \times L \times 0 \cdot 7854$, where V = volume of the cylinder, D = diameter of the cylinder, L = the length of the cylinder, the volume of the blood is calculated. If many measurements have to be made, a Fuller's slide-rule greatly expedites the calculations. It is of the utmost importance that the diameter of the tube be accurately measured, and therefore the adjustment of the eye-piece micrometer must be carried out with great care, and the scale by which it is set should be one the accuracy of which is undoubted. For, considering the formula ($V = D^2 \times L \times 0 \cdot 7854$), it will be seen that any error in the measnrement of D will be increased in a geometrical ratio in the final result; hence the comparative inefficiency of a capillary tube method in which D is measured indirectly and with less accuracy.

Having ascertained the volume of blood, it remains to carry out the dilutions; this is accomplished as follows.

The capillary tube is placed in a vertical thick-walled glass tube of slightly larger bore, the lower end of which is submerged in the required amount of the diluting medium (measured out by a graduated pipette) contained in a hollowed-out block of glass, such as is used in histological and microscopical work. The capillary tube with its contained blood is then crushed *en masse* by means of a soft iron plunger, and the interior of the containing tube is washed out several times by drawing up the diluting medium into its lumen, either with the mouth or by means of an indiarubber teat. The powdered glass quickly falls to the bottom, and the mixture may be employed for conducting the serum reaction either by the microscopic or the macroscopic method.

Molybdenum Method for Demonstrating the Neuro-fibrils and the Golgi-network in the Central Nervous System.*—Herr A. Bethe de-

* Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 13–35.

scribes a method for demonstrating the primitive neuro-fibrils in the ganglion-cells and the nerve-fibres of Vertebrata and Invertebrata; at the same time the Golgi-network is also stained. The fresh material, in pieces 4–10 mm. thick, is placed in 3–7·5 per cent. nitric acid for 24 hours, and then transferred to 96 per cent. alcohol for 12–24 hours or more. The blocks are next immersed for 12–24 hours in the following solution:—Ammonia (sp. gr. 0·95–0·96) 1 part, water 3 parts, alcohol (96 per cent.) 8 parts. The temperature should not exceed 20° C. After this the blocks are again removed to alcohol for 6–12 hours, and then treated with acid-alcohol:—hydrochloric acid (sp. gr. 1·18 =37 per cent.) 1 part, water 3 parts, alcohol (96 per cent.) 8–12 parts. When this step is finished (the time required is not stated) the pieces are again transferred to alcohol for 10–24 hours before they are immersed in water (2–6 hours). The acid-alcohol stage should be omitted when the cells have many fibrils, and for obtaining good pictures of the Golgi-reticulum in the anterior cornua of the spinal cord. The blocks are now placed in 4 per cent. solution of ammonium molybdate for 24 hours. After having been washed in distilled water, the blocks are removed to 96 per cent. alcohol (10–24 hours), and then to absolute alcohol (10–24 hours). After this xylose or toluol and paraffin. The sections, 10 μ thick, are stuck on the slide with Mayer's albumen-glycerin.

The slide is now carefully washed with water to remove all traces of alcohol from the section, and its under surface and edges wiped dry. The preparation is covered with a layer of distilled water, $1\frac{1}{2}$–2 mm. thick, and the slide placed in an incubator at 55°–60° for 2–10 minutes. The water is then poured off, and replaced by a similar layer of toluidin blue solution (1–3000). The slide is then incubated for 10 minutes, after which the superfluous stain is removed, and the slide immersed in 96 per cent. alcohol for 3/4–2 minutes, during which time the unmordanted pigment is removed. When no more colour comes away, the preparation is transferred to absolute alcohol, then to xylol, and mounted in balsam. The procedure appears to require considerable care, and a large number of cautions and much advice to prevent failure at the various stages are given.

The procedure for Invertebrata is slightly different. The animals may be fixed with sublimate (12 hours), treated with iodine-alcohol (24 hours), and then imbedded. The sections (*Hirudo*) are placed for 10 minutes in 1 per cent. solution of ammonium molybdate (25°–30° C), washed with distilled water for 10 minutes, and then stained with 1–3000 toluidin-blue for 5 minutes at 58° C. For demonstrating the fibrils in the cells, the ammonia and hydrochloric acid stages must be passed through. The sections are differentiated in aqueous solution of ammonia or in alcoholic solution of sodium carbonate.

Microtomists' Vade Mecum.*—Mr. A. B. Lee's Microtomists' Vade Mecum or Handbook of the Methods of Microscopic Anatomy, has reached its fifth edition. It is only three years since the fourth edition appeared, and, excellent as it was, its successor is better. The text has undergone thorough revision, some portions, notably the chapter on

* London (J. and H. Churchill), 1900, xiv. and 532 pp.

cytological methods, having been rewritten. The amount of new matter added is very considerable ; and these additions, in order to keep within the limits of the old size, have necessitated severe condensation of the text and the rejection of superfluous methods. More space has been given to the principles of some of the methods described, and there is much additional information respecting the theory of fixation, microtome knives, serial section methods, and the like. The general features of this invaluable work are so well known that it is unnecessary to sketch them out again.

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on the 20th of June, 1900, at 20 Hanover Square, W. The President (W. Carruthers, Esq., F.R.S.) in the Chair.

The Minutes of the Meeting of May 16th, 1900, 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
Dr. Ferd. Hueppe, Principles of Bacteriology. (8vo, London, 1899)	*The Publishers.*
Dr. Edmund B. Wilson, The Cell in Development and Inheritance. 2nd edition. (8vo, New York, 1900)	*The Publishers.*
O. Noordgard, Report of the Norwegian North Atlantic Expedition, 1876–8. Vol. xxvii. Zoology, Polyzoa. (4to, Christiania, 1900)	*The Editorial Committee of the Expedition.*
A Solar Microscope	*Mr. A. Oxbrow.*

Mr. G. J. Rogers, of Maidstone, exhibited a modification of the Rousselet compressor, the chief feature of which consisted in the employment of two indiarubber bands in suitable grooves to keep the glass in position, instead of having it cemented. It was claimed that this saved trouble and time in the event of the glass being broken.

Mr. C. Lees Curties (C. Baker) exhibited an achromatic condenser which was a modification of the Zeiss model, the aperture being N.A. 1·0 and aplanatic cone 90, lenses 7/8 in. diameter, working distance 4/10 in.; when the front lens is removed this condenser is suitable for use with low-power objectives, the working distance then being 8/10 in. The mount is supplied with iris diaphragm and carrier for stops (see p. 512, fig. 129).

The thanks of the Society were voted to Mr. Rogers and Mr. Curties for these exhibits.

A short descriptive paper by Mr. E. B. Stringer, "On a new Projection Eye-piece, and an improved Polarizing Eye-piece"—sent to the meeting for exhibition—was taken as read.

Miss A. Lorrain Smith's paper "On some New Microscopic Fungi" was also taken as read, the President giving a short résumé of its contents, and expressing the opinion that this communication would be an important addition to our knowledge of microscopic fungi.

Mr. A. W. Bennett said he was particularly glad to have this paper offered to the Society by Miss Smith, as it was one of a kind of which there had been too few of late years in the Transactions of the Society. There was one special point with regard to parasitic fungi which he thought was worth calling special attention to, as it might prove to be one of considerable practical importance—and that was as to the cultivation of fungus parasites on certain insects. It had been proposed to do this on the Continent, and also in Australia and America, with a view to get rid of insect pests—locusts and others; and if efforts in this direction were successful, they might be the means of producing very beneficial economic results.

The thanks of the Society were voted to Mr. Stringer and to Miss A. L. Smith for their communications.

The President having requested Mr. Karop to occupy the chair *pro tem.*, read a paper and gave a lantern demonstration "On the Structure of some Palæozoic Plants." In the course of his remarks he said that the intelligent study of Palæozoic plants was not yet a century old; for although their presence had long been recognised, they appeared to have been regarded simply as freaks of nature—Sternberg in Germany in 1820, Brongniart in France in 1822, and Lindley and Hutton in England in 1831, must be regarded as the fathers of Palæobotany; they were followed by a host of others. The importance of fossils was first recognised by Wm. Smith, who observed that strata could be identified by the organised fossils found in them. He published this important fact in 1816, and thus laid the basis for what was known as stratigraphical geology.

The great majority of the plants preserved as fossils are found in these shales, which were the mud deposits of ancient lakes and rivers. The plants have been hermetically sealed in these shales, and, although the tissues have been converted into carbon, the form and venation of the leaves, and in some few cases the aspect of the fruits, have been preserved. The most important information as to these extinct floras has however been obtained from specimens in which the tissues have been replaced by minerals dissolved in the strata enclosing them. These often exhibit the most delicate structures, when thin sections properly prepared and mounted are examined under the Microscope; as for example, sections of the "Coal balls" of Halifax, of vegetable remains from King's Cliff, near Burntisland, and of the charred carboniferous forests in Arran. He had arranged for the lantern sections of plants from the Carboniferous system, and would show these on the screen; but before doing so wished to point out to what group of the vegetable kingdom they belong. The cellular plants, with very few exceptions, have been lost; they quickly decayed, and though they doubtless contributed a large proportion of the vegetable carbon found in the older rocks, they have left no structure, no indication of external form by which they could be recognised. Sir Wm. Dawson found specimens of a remarkable stem in the lower Devonian rocks of Canada, a description of which he published under the name of *Prototaxites*, considering it to be a representative of existing yews. A microscopic study of well preserved and authentic specimens of this fossil led him (the President) to publish a paper in the Society's Journal in 1872 in which, with the assistance of admirable plates, he demonstrated that this stem was that of a cellular plant belonging to the Algæ—a view at first strongly contested by Sir Wm. Dawson, but at length accepted. Fungal remains had also been detected in the Carboniferous strata by Alder, in the form of masses of mycelium in the shale, and also by himself as parasites penetrating the tissues of higher plants. The plants which, by their external form and internal structure, have been certainly determined, are vascular plants belonging to the Equisetaceæ, Filices, and Selaginellaceæ amongst Cryptogams, and to the Coniferæ, groups which exist in the present flora of the globe, and are represented in the indigenous flora of Britain.

I. The Equisetaceæ are herbaceous plants with underground stems and ascending leaf- and spore-bearing stems; the leaves are reduced to a tooth-sheath at the nodes; the fruit is in small cones consisting of stalked peltate leaves on a shortened axis, each leaf or sporophore having several sporanges attached to the flat apex. The spores are small and of uniform size, and are furnished with hygrometric elaters. In all essential characters the living plants agree with the Carboniferous Equisetaceæ; but these ancient plants had arborescent stems, distinct leaves, and cones composed of alternate whorls of sporophylls and bracts. Like other Vascular Cryptogams of the period, the stems increased in diameter through the presence of a cambium which added to the circumference of the vascular cylinder, just as the wood cells are produced in the higher exogenous stems of the present flora.

The structure of the cone was essentially the same in the living and the fossil Equisetaceæ, and this was the case also in regard to the structure of the sporanges and the character of the spores.

II. Filices are represented at the present time in England by herbaceous plants, some of which, like the male fern and Royal fern, have stems; but such stems attain a great size in the tree ferns of warmer regions. Some ferns have very simple leaves, but others have the most compound leaves found in any plants. The sporanges are borne on the under side or margins of the leaves, the spores being uniform in size. The Carboniferous ferns included many that could not be separated from living groups; but in addition there were two extinct groups represented by *Psaronius*, and by the more remarkable stem of *Heterangium*, which, as in Calamites, possessed a cambium by which additions were made to the circumference of the vascular cylinder.

III. Selaginellaceæ are common in the existing flora, though represented in Britain by a single species, a small plant, some 2 or 3 in. high, which like the others included in the order, is mainly distinguished from the closely allied Lycopodiaceæ by possessing two kinds of spore, macro- and microspores. The Carboniferous representatives were huge trees with large leaves and an exogenous stem as in the Calamites, and a larger cone than in the living species, but agreeing in the important details with those of living plants. These plants attained a great height, and, with the Calamites, supplied the chief materials of our coal-beds.

IV. Coniferæ. These Gymnosperms were the most highly organised plants of the Coal Measures. At the present day they are scattered over the earth, supplying the greatest quantity of timber for economic purposes. They are represented in our indigenous flora by the pine, juniper, and yew. A large variety of gymnospermous fruits have been described from the Coal Measures, whose affinities appear to him to be with the Taxineæ, held generally to be the highest group of conifers. Specimens of the wood also were frequently found preserved. A stem of great size had been set up in the grounds of the Natural History Museum.

In illustration of these remarks, a number of actual preparations were shown upon the screen, the majority of which showed the particular structure they were intended to illustrate—a few only being a little too thick to exhibit the details by that method of illumination.

Mr. A. W. Bennett felt quite incompetent to discuss the very interesting points mentioned by the President in connection with the Palæozoic plants. He should, however, like to say a few words to elicit an opinion on a matter which seemed to be of great interest. Most people who were at all interested in the subject must be aware of the recent discovery of the mode of impregnation in some of the Cycadeæ, by means of active spermatozoids, as in the case of the Vascular Cryptogams, and this seemed to suggest the question whether the Gymnosperms are not more closely allied to the Vascular Cryptogams than is usually recognised. Did the evidence of palæontology favour the view that Gymnosperms displayed a closer affinity to the Vascular Cryptogams than to the higher section of flowering plants, the Angiosperms?

The President said there could be no doubt that the question to which Mr. Bennett had called attention was one which deserved careful consideration; but it should be remembered that in these strata they only saw four groups of plants, and that the Coniferæ were found alongside the others, and were evidently living at the same period. They did not know of any moving male bodies which assisted in the fertilisation, and Brongniart had shown the presence of pollen grains in the apical cavities of fruits which had been preserved in silex. They did not know how these spermatozoids were developed in *Salisburia*; but if they rendered the pollen-grains unnecessary, then the evidence afforded by the presence of the pollen in these extinct fruits would be against the idea of including the Gymnosperms with the Cryptogams. In the Gymnosperms they had a seed formed by the union of the pollen-grain with the ovule; and they had also many cotyledons in the embryo, conditions which widely separated the Gymnosperms from the Cryptogams.

Mr. Karop said it would be in order for him to propose a formal vote of thanks to the President for the very excellent demonstration he had given them; and as the President could not put this to the meeting himself, he was sure they would pass this at once.

The President said he was very much obliged to Mr. Karop and the Fellows for the kind way in which they had passed this vote of thanks; he only regretted that some of his slides had not come out so well as he wished, on account of their being too dense for lantern purposes; there was no fault in the light. He hoped it was more interesting for the Fellows to see the actual objects themselves so far as the lantern would show them, than merely to exhibit drawings.

Dr. Hebb said that the Royal Photographic Society would be holding their Annual Exhibition in London in October next, and had written to ask if any Fellows of the Society would be willing to exhibit in Section V., which included the scientific applications of photography. If anyone were desirous of exhibiting he was requested to communicate with Mr. Vezey or with the Secretary, who would be very pleased to give aid and information.

The President announced that the rooms of the Society would be closed from 17th August to 17th September for the summer vacation—and that the next Ordinary Meeting of the Society would be held on 17th October.

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

Mr. Chas. Baker:—A new Achromatic Sub-stage Condenser.

Mr. G. H. J. Rogers:—A Modification of the Rousselet Compressor.

Mr. E. B. Stringer:—A new Projection Eye-piece, and an improved Polarising Eye-piece, in illustration of his paper.

New Fellow.—The following was elected an *Ordinary Fellow*:—Miss Marion I. Newbigin.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY

OCTOBER 1900.

TRANSACTIONS OF THE SOCIETY.

VIII.—*A New Projection Eye-piece and an Improved Polarising Eye-piece.*

By E. B. Stringer, B.A.

(*Read 20th June*, 1900.)

I have for some time past used for projection a positive eye-piece consisting of a single combination of Steinheil's construction. Its advantages for the purpose are, I believe, not known. It is indeed mentioned in Dr. Dallinger's edition of *Carpenter* as making a good eye-piece for visual work; but the reason it has been so little used for this purpose (if used at all) is probably because the field it gives is so small, and because only the lowest powers work really well; nothing above × 6 yielding perfect results.

But these, whilst being drawbacks to its use for visual work, are by no means so for projection. A projection eye-piece is always of low power, and smallness of field is desirable, or even necessary. Moreover, owing to its having only half the number of reflecting surfaces, this lens yields an image of greater brilliancy than the Huyghenian combination; and the greater flatness of field and absolute freedom from distortion in the projected image also give it a decided advantage.

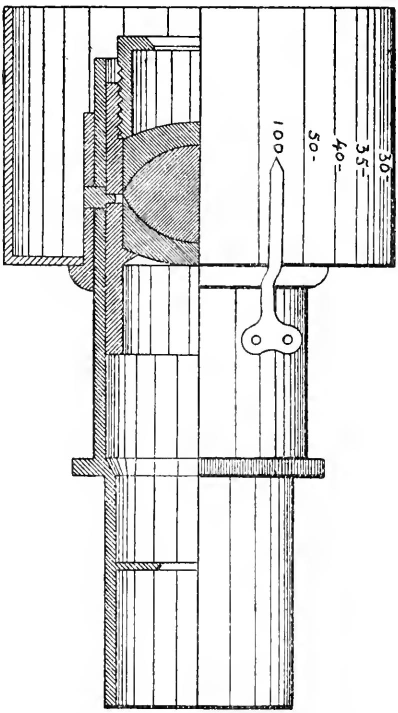
It may of course be easily made either over- or under-corrected for use either with apochromatic or achromatic objectives; thus affording if necessary a projection eye-piece for use with the latter; a thing which has not hitherto been available.

I have devised a mount for this lens for photographic purposes in which the connecting flange is attached to the eye-piece itself, and is graduated, and when made to rotate, causes the lens to travel backwards or forwards by means of a spiral slot, so that the diaphragm may be focused on the screen. The graduations on the flange (which are read off against the stationary pointer attached to the body of the eye-piece) are made empirically, the numbers representing the camera length in inches, so that the eye-piece may be instantly put into adjustment without the troublesome trials previously necessary.

Moreover the adjustment may be made without removing either the flange or the eye-piece from the Microscope-tube; and the stationary pointer remains always in sight.

The object of this adjustment is to ensure an invariable tube-length, and not, as in the Huyghenian form, to maintain the corrections of the eye-piece, which of course in this case remain unaffected.

Fig. 145.

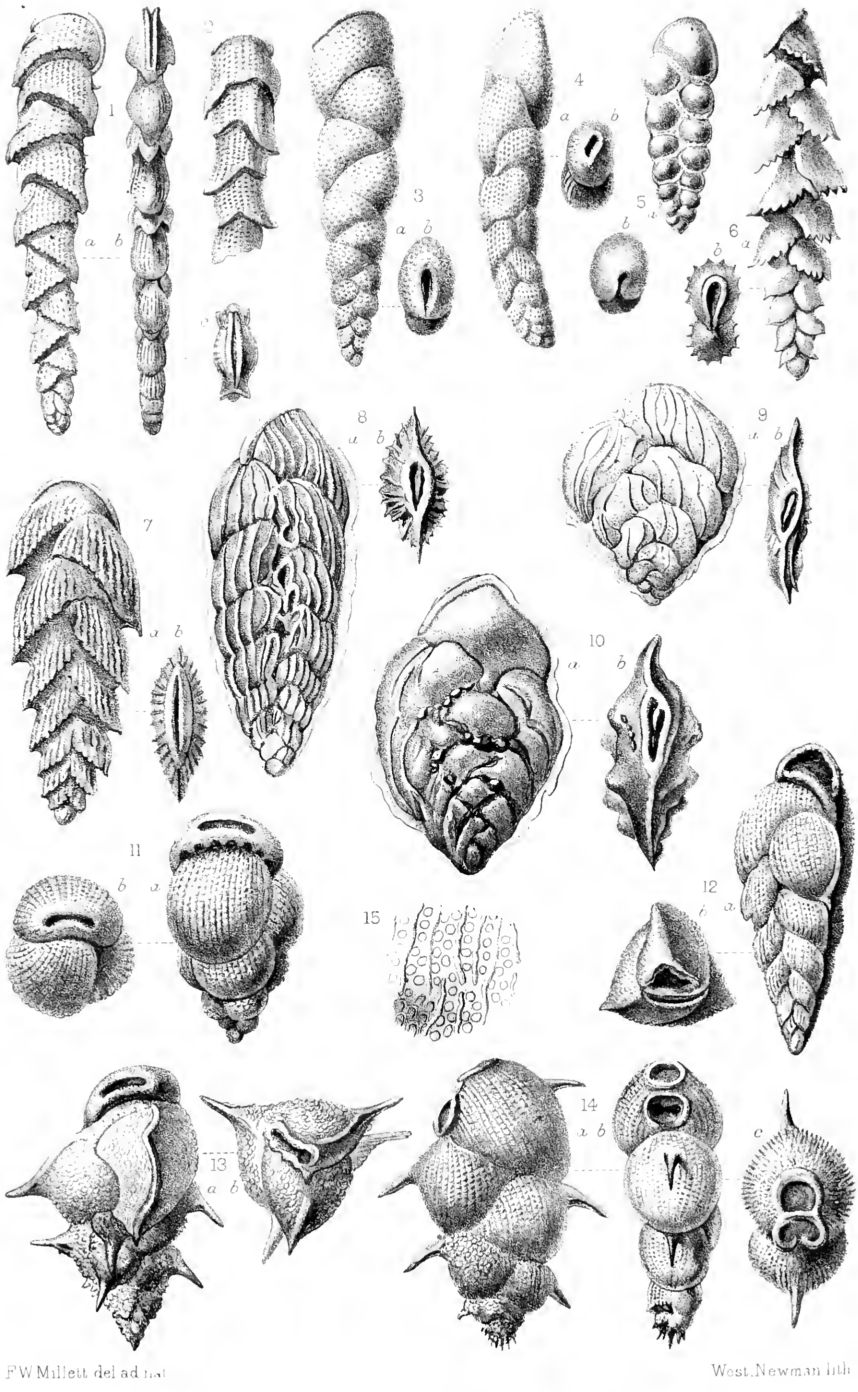


The lens may be easily removed from the mount by unscrewing the diaphragm in front of it. The same mount may thus be used for either the over- or under-corrected lens, and the user need have but one mount for both of them.

The present lens is an over-corrected one made specially for me some time ago by Messrs. Watson.

I find that the Steinheil positive eye-piece is also particularly adapted for visual work in conjunction with a nicol prism. The pencil issuing from it is so slightly convergent, and the distance between it and the eye so considerable, that the nicol may be used above it, and even a calcite plate as well, without cutting off any of the field; and though this field is small, yet it is much larger than can be got with the nicol over the Huyghenian eye-piece, where more than half of it is lost. The results obtained with the Steinheil are also of much greater brilliancy.

The lens of this eye-piece is one of the ordinary Continental *loups* magnifying six times, and the nicol is mounted so that it may also be used if necessary above the objective. It slips into the upper end of the eye-piece where it may be freely rotated, and is supported by a collar which maintains it at the proper distance from the lens.



F.W. Millett del. ad nat.

West, Newman lith.

FORAMINIFERA OF MALAY ARCHIPELAGO

IX.—*Report on the Recent Foraminifera of the Malay Archipelago collected by Mr. A. Durrand, F.R.M.S.—Part IX.*

By Fortescue William Millett, F.R.M.S.

(*Read* 17*th October*, 1900.)

Plate IV.

Bifarina elongata sp. n., plate IV. figs. 1, 2.

Test elongate, straight, compressed, tapering gradually towards the aboral end. The earlier chambers small and biserial or irregularly agglomerated. The uniserial chambers inflated, with projecting margins causing the peripheral margin of the test to be lobulated; the earlier of these chambers are trilateral, the terminal ones quadrilateral. Sutures depressed. Surface ornamented with longitudinal lines of puncta. Aperture a long bordered slit at the apex of the chamber. Length 0·76 mm.

There is very little variation in this interesting form. The lines of perforations may be more or less distinct; and frequently a constriction of the cell-wall causes an inflated lobe to be formed at the projecting base of the uniserial chambers.

A stage in the transition from the biserial to the uniserial arrangement of the chambers is well indicated in the *Bolivina porrecta* of Brady, with its zigzag sutures and triangular chambers extending the full width of the test. This is carried a step further by the Malay allied examples, which in the later stages attain the true uniserial plan of growth, and serve to bind the whole together in a very natural group. Having thus to deal with dimorphous forms derived from both *Virgulina* and *Bolivina*, it is convenient

---

EXPLANATION OF PLATE IV.

Fig. 1.—*Bifarina elongata* sp. n. × 75.
„ 2. „ „ „ A few of the uniserial chambers. × 75.
„ 3. „ *porrecta* Brady sp. × 90.
„ 4.—*Bolivina nobilis* Hantken. × 90.
„ 5. „ *textilarioides* Reuss. × 90.
„ 6. „ *convallaria* sp. n. × 100.
„ 7. „ *Durrandii* sp. n. × 100.
„ 8. „ *Karreriana* Brady var. *carinata* var. n. × 60.
„ 9. „ *Hantkeniana* Brady. × 55.
„ 10. „ *Schwageriana* Brady. × 65.
„ 11.—*Mimosina affinis* sp. n. × 90.
„ 12. „ *spinulosa* sp. n. × 75.
„ 13. „ „ „ var. × 90.
„ 14. „ *hystrix* sp. n. × 75.
„ 15. „ „ a portion of the cell-wall mounted in balsam and viewed by transmitted light. × 180.

to extend the subgenus *Bifarina* of Parker and Jones, so that it may include all the members of the series, and thus avoid the disadvantage of instituting a new name for forms which admittedly are scarcely separable.

In the genus *Pleurostomella* the triangular chambers with zigzag sutures are of common occurrence. Other figured forms of similar construction are *Textularia laminaris* Costa * and *Bolivina cylindracea* Schwager.† The single specimen from the North Atlantic, south-east of George's Bank, figured by Flint ‡ as *Bolivina porrecta* Brady, possesses the three different forms of chambers as in *Bifarina elongata*. It comes from a depth of 956 fathoms, and is much larger than the Malay examples, having a length of 1 mm.

Bifarina elongata is very common in the Malay Archipelago, and occurs at most of the Stations in both Areas.

Bifarina porrecta Brady sp., plate IV. fig. 3.

Bolivina porrecta Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 57. *B. porrecta* Brady, 1884, Chall. Rept., p. 418, pl. lii. fig. 22. *B. porrecta* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 300, pl. viii. figs. 7–9, 46, 47.

This is one of the commonest forms of the region, and occurs in abundance at nearly all the Stations. The walls are thin and clear, as stated by Brady of the 'Challenger' examples, but differ from them in being coarsely perforated. The aboral portion of the test is usually of a tawny colour, which becomes fainter and disappears when it reaches the triangular segments. In the specimens figured by Egger the change of form in the later chambers is not apparent.

Obtained at three 'Challenger' localities, namely:—Off Culebra Island, West Indies, 390 fathoms; off Tahiti, 420 fathoms; and in Humboldt Bay, north coast of Papua, 37 fathoms.

The 'Gazelle' Stations are Mauritius, 411 metres and 347 metres; and a rather doubtful locality, apparently on the western coast of New Guinea, "Galewostrasse" St. 104 *a*. 3 metres.

Bolivina d'Orbigny.

Bolivina punctata d'Orbigny.

Bolivina punctata d'Orbigny, 1843, Foram. Amér. Mérid., p. 63, pl. viii. figs. 6–12. *B. punctata* (d'Orb.) Woodward and Thomas, 1885. 13th Ann. Rept. Geol. and Nat. Hist. Survey of Minnesota for 1884, p. 169, pl. iii. fig. 12. *B. punctata* (d'Orb.) Sherborn and Chapman, 1886, Journ. R. Micr. Soc., vol. vi. p. 743, pl. xiv. fig. 10. *B. punctata* (d'Orb.) Malagoli, 1888, Boll. Soc. Geol. Ital., vol. vii. p. 375, pl. xiv. figs. 1–4. *B. punctata* (d'Orb.) Terrigi, 1891, Mem.

* Atti Accad. Pontaniana, vol. vii. fasc. 2, 1856, p. 290, pl. xxiii. fig. 15.
† Boll. R. Com. Geol. d'Italia, vol. ix. 1878, p. 528, pl. i. fig. 18.
‡ Rept. U.S. Nat. Mus. for 1897 (1899), p. 292, pl. xxxviii. fig. 2.

Com. Geol. d'Italia, vol. iv. p. 74, pl. i. figs. 26–28. *B. punctata* (d'Orb.) Woodward and Thomas, 1893, Geol. and Nat. Hist. Survey of Minnesota, vol. iii. p. 34, pl. c. figs. 27, 28. *B. punctata* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 298, pl. viii. figs. 1–3. *B. punctata* (d'Orb.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 49, pl. ix. figs. 475–478, 480. *B. punctata* (d'Orb.) Egger, 1895, Jahresber. xvi. Naturhist. Ver. Passau (p. 12) pl. i. fig. 11 ; and *B. antiqua* (d'Orb.) p. 11, pl. i. figs. 13, 15. *B. punctata* (d'Orb.) Morton, 1897, Proc. Portland Nat. Hist. Soc., vol. ii. p. 115, pl. i. fig. 11. *B. elongata* (Hantk.) Egger, 1899, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xxi. p. 14, pl. xvi. figs. 12, 13. *B. punctata* (d'Orb.) Flint, 1899, Rep. U.S. Nat. Mus. for 1897, p. 292, pl. xxxviii. fig. 1. *B. punctata* (d'Orb.) Wright, 1900, Geol. Mag., dec. iv. vol. vii. p. 100, pl. v. fig. 10.

This well known and widely diffused form is found in considerable abundance all over the Region, and exhibits the usual variations in length and breadth of the test, and in the number and form of the chambers. In one interesting variety there is on the surface of each chamber a clear patch quite free from puncta.

Bolivina nobilis Hantken, plate IV. fig. 4.

Bolivina nobilis Hantken, 1875 (1876), A magy. kir. földt. int. évkönyve, vol. iv. p. 56, pl. xv. fig. 4. *B. nobilis* (Hantk.) Chapman, 1892, Quart. Journ. Geol. Soc., vol. xlviii. p. 516, pl. xv. fig. 11. *B. nobilis* (Hantk.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 299, pl. viii. figs. 35–37.

This species, as instituted by von Hantken, seems to be nothing more nor less than a delicately striated variety of *B. punctata* ; and the transition from one to the other, as far as surface ornamentation is concerned, is well shown in the specimen selected for illustration, as well as in that figured by Egger. In both of these the puncta, instead of being diffused equally over the whole of the surface, resolve themselves into longitudinal rows of dots. A tendency to become dimorphous is well shown by the figured specimen, in which the aperture of the last formed chamber is situated at the apex and remote from the suture. One of the examples figured by Brady* shows two uniserial following the biserial chambers. Chapman's figured specimen from the Gault, referred to above, appears to have the like peculiarity. This variation is however unusual in the species, and not normal, as in the forms here assigned to the genus *Bifarina*.

In the Malay Archipelago this species is abundant and widely distributed.

It is stated to have been found only in 'Challenger' dredgings from the South Pacific ; but amongst the 'Gazelle' Stations there is one on the West Coast of Africa.

* Chall. Rept., 1884, pl. liii. fig. 14.

Bolivina textilarioides Reuss, plate IV. fig. 5.

Textularia variabilis var. *lævigata* Williamson, 1858, Rec. Foram. Gt. Britain, p. 77, pl. vi. fig. 168. *Bolivina textilarioides* Reuss, 1862 (1863), Sitzungsber. k. Akad. Wiss. Wien, vol. xlvi. p. 81, pl. x. fig. 1. *B. textilarioides* (Reuss) Terrigi, 1883, Atti Accad. Pontif. Nuovi Lincei, vol. xxxv. p. 191, pl. iii. fig. 32. *B. textilarioides* (Reuss) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 221, pl. xliii. fig. 1. *B. textularioides* (Reuss) Burrows, Sherborn, and Bailey, 1890, Journ. R. Micr. Soc., p. 554, pl. viii. fig. 25. *Bolivina textilarioides* Murray and Renard, 1891, Chall. Rept. 'On Deep-Sea Deposits,' pp. 110, 130, pl. xiii. fig. $3^{5, 22}$. *B. textilarioides* (Reuss) Chapman, 1892, Journ. R. Micr. Soc., p. 757, pl. xii. fig. 12. *B. textularioides* (Reuss) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 297, pl. viii. figs. 13–16, 110–112. *B. textularioides* (Reuss) Egger, 1895, Jahresbericht xvi. Naturhist. Ver. Passau, p. 12, pl. i. fig. 8. *B. textularioides* (Reuss) Egger, 1899, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xxi. p. 44, pl. xvi. figs. 1–3.

This variable species is represented by two well marked forms, both of which are figured by Brady in the 'Challenger' Report. In the one which is here selected for illustration, the cell-walls are quite smooth and clear, with the exception of the sutures, which are covered with opaque granular matter. In the other form, which is well figured by Terrigi, the chambers are much inflated and the surface porous.

It is abundant in the Malay Archipelago, and is found, in greater or smaller quantities, at most of the Stations.

Bolivina dilatata Reuss.

Bolivina dilatata Reuss, 1850, Denkschr. k. Akad. Wiss. Wien, vol. i. p. 381, pl. xlviii. fig. 15. *Textularia variabilis* var. *spathulata* Williamson, 1858, Rec. Foram. Gt. Britain, p. 76, pl. vi. figs. 164, 165. *B. dilatata* (Reuss) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 221, pl. xliii. figs. 3, 6. *B. dilatata* (Reuss) Malagoli, 1888, Boll. Soc. Geol. Ital., vol. vii. p. 376, pl. xiv. figs. 5–10. *B. dilatata* (Reuss) Terrigi, 1899, Mem. R. Acad. Lincei, ser. 4, vol. vi. p. 110, pl. v. fig. 7. *B. dilatata* Murray and Renard, 1891, Chall. Rept. 'On Deep-Sea Deposits,' p. 90, pl. xiii. fig. 2, 4. *B. dilatata* (Reuss) Terrigi, 1891, Mem. R. Com. Geol. d'Italia, vol. iv. p. 75, pl. i. fig. 29. *B. dilatata* (Reuss) Woodward and Thomas, 1893, Geol. and Nat. Hist. Survey of Minnesota, vol. iii. p. 33, pl. c. fig. 26. *B. dilatata* (Reuss) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 294, pl. viii. figs. 17–20. *B. dilatata* (Reuss) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 50, pl. ix. figs. 482–486, and pl. xiv. figs. 5–10. *B. dilatata* (Reuss) Egger, 1895, Jahresbericht xvi. Naturhist. Ver. Passau, p. 10, pl. 1, fig. 6.

The examples are few and small, but are distributed over both Areas.

According to Brady it is a North Atlantic species, but there are 'Gazelle' Stations in the Indian Ocean and in the South Pacific.

Bolivina tortuosa Brady.

Bolivina tortuosa Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 57. *B. tortuosa* Brady, 1884, Chall. Rept., p. 420, pl. lii. figs. 31–34. *B. tortuosa* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 298, pl. viii. figs. 43, 44.

This form, which appears to be nothing more than a twisted variety of *B. dilatata,* is rare in the Malay Archipelago, although the specimens are characteristic and fine. It is most numerous in Area 1.

It is abundant at 'Challenger' Station No. 120, off Pernambuco, 675 fathoms. This locality is not mentioned by Brady in his Report, and the depth of water is greater than at any of the Stations recorded by him.

Bolivina robusta Brady.

Bolivina robusta Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 57. *B. robusta* Brady, 1884, Chall. Rept., p. 421, pl. liii. figs. 7–9. *B. robusta* (Brady) Egger, 1893, Abhandl. k. bayer. Ak. Wiss., Cl. II. vol. xviii. p. 294, pl. viii. figs. 31, 32.

This species, so widely distributed over the globe, yet so rarely recorded, occurs sparingly in the Malay Archipelago, at Stations in both Areas. The examples are rather feeble, and approach *B. dilatata*.

It is very abundant in the Tertiary clay of St. Erth.

Bolivina limbata Brady.

Bolivina limbata Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 57. *B. limbata* Brady, 1884, Chall. Rept., p. 419, pl. lii. figs. 26–28. *B. limbata* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 300, pl. viii. figs. 10–12.

A few specimens occur in both Areas, but they are not quite typical, the margin being more rounded than usual.

The 'Gazelle' Stations are West Africa and Mauritius.

Bolivina lobata Brady, plate I. fig. 4.

Bolivina lobata Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 58. *B. lobata* Brady, 1884, Chall. Rept., p. 425, pl. liii. figs. 22, 23. *B. lobata* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 300, pl. viii. figs. 55, 56.

In Part VII. of this Report, this species has already been figured and alluded to in relation to *Bigenerina fimbriata.** It well illus-

* Possibly this form might as conveniently have been assigned to the genus *Bifarina*. See this Journal, *ante*, p. 6.

trates the difficulty of treating the dimorphous forms under the accepted system of classification, the simple and compound examples finding places in different genera.

It is by no means common in the Malay Archipelago.

There are four 'Challenger' Stations, all of which are near the Island of Papua. The 'Gazelle' localities are West Coast of Portugal, Mauritius, and West Australia.

Bolivina convallaria sp. n., plate IV. fig. 6.

Test elongate, straight, tapering towards the aboral end, peripheral edge lobulated; chambers numerous, inflated, with the peripheral margin rounded or acute; basal margin greatly projecting, reflected, and serrated. Sutures deeply sunk. Aperture large and variable in form. Length 0·47 mm.

This species varies greatly in the form and arrangement of the chambers and in the shape and size of the aperture. It may be described as resembling a much elongated *Bulimina marginata*, in which the chambers are loosely arranged biserially.

It is by no means common, but occurs at several Stations, mostly in Area 2.

Bolivina ænariensis Costa sp.

Brizalina ænariensis Costa, 1856, Atti Accad. Pontaniana, vol. vii. p. 297, pl. xv. fig. 1. *Bolivina ænariensis* Brady, 1882, Proc. R. Soc. Edin., vol. xi. p. 711—Table. *B. ænariensis* (Costa) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 221, pl. xliii. figs. 2–5. *B. ænariensis* (Costa) Malagoli, 1888, Boll. Soc. Geol. Ital., vol. vii. p. 377, pl. xiv. figs. 11, 12. *B. nobilis* (Hantken) Terrigi, 1891, Mem. R. Com. Geol. d'Italia, vol. iv. p. 75, pl. i. fig. 30. *B. ænariensis* (Costa) Flint, 1899, Rept. U.S. Nat. Mus. for 1897, p. 292, pl. xxxvii. fig. 8.

In the Malay Archipelago typical specimens of this species are very rare, but passage forms related to both *B. robusta* and *B. nobilis* are common. In these the margin becomes more or less rounded and the striæ more numerous and irregular.

Bolivina Durrandii sp. n., plate IV. fig. 7.

Test elongate, lanceolate, compressed; peripheral margin acute and serrated; chambers slightly inflated, inferior margin acute and projecting; sutures deeply sunk and smooth; surface of chambers ornamented with broken irregular costæ. Aperture a long fusiform slit. Length 0·45 mm.

This species is closely allied to *B. lobata* Brady, and differs principally in being more compressed and in having the peripheral margin acute. In these respects also it differs from the *B. campanu-*

lata of Egger,* a minute form which he states may be the juvenile stage of *B. lobata*.

In one variety the test becomes longer and less compact in the arrangement of the chambers, which also become more inflated, thus showing a tendency to approach *B. convallaria*.

It is one of the commonest forms in the Malay Archipelago, and is found in abundance at most of the Stations.

Bolivina plicata d'Orbigny.

Bolivina plicata d'Orbigny, 1843, Foram. Amér. Mérid., p. 42, pl. viii. figs. 4–7. *B. plicata* (d'Orb.) Halkyard, 1889, Trans. and Ann. Rept. Manchester Micr. Soc., p. 35, pl. i. fig. 13. *B. plicata* (d'Orb.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 51, pl. ix. figs. 487, 488. *B. plicata* (d'Orb.) Wright, 1900, Geol. Mag., dec. 4, vol. vii. p. 100, pl. v. fig. 7.

It is difficult to reconcile, one with the other, d'Orbigny's figures of *B. plicata* and *B. costata*. In his 'Amérique Méridionale,' plate viii. fig. 4, is described as *B. plicata*, whilst in his 'Bassin Tertiaire de Vienne' a copy of this figure with the addition of a representation of its oral aspect, appears under the name of *B. costata*. In Carpenter's 'Introduction' † these figures are copied to illustrate *B. costata*.

B. plicata is very rare in the Malay Archipelago, and the few specimens found mostly resemble those from brackish water figured by Brady.‡

Bolivina costata d'Orbigny.

Bolivina costata d'Orbigny, 1843, Foram. Amér. Mérid.. p. 62, pl. viii. figs. 8, 9. *B. costata* d'Orbigny, 1846, For. Foss. Vienne, p. 239, pl. xxi. figs. 44, 45. *B. costata* Brady, 1884, Chall. Rept., p. 426, pl. liii. figs. 26, 27.

The specimens are neither numerous nor in all respects characteristic. In contour they resemble those figured by Brady in the 'Challenger' Report, and as in them, the costæ are frequently interrupted and fail to bridge over the sutures. The aperture is however always without a thickened margin, which is, according to D'Orbigny, one of the characters of the species.

The 'Challenger' Stations are Raine Island, Torres Strait, 155 fathoms; Humboldt Bay, Papua, 37 fathoms; and off Amboyna, 15 to 20 fathoms. Goës records it from the Pacific, 730 fathoms.

Bolivina subangularis Brady.

Bolivina subangularis Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 59. *B. subangularis* Brady, 1884, Chall. Rept., p. 427, pl. liii. figs. 32, 33.

* Abhandl. k. bayer. Akad. Wiss., Cl. ii. vol. xviii. 1893, p. 301, pl. viii. figs. 53, 54.
† Page 196, pl. xii. fig. 22.
‡ Ann. and Mag. Nat. Hist., ser. 4, vol. vi. 1870, p. 302, pl. xii. fig. 7.

An unsatisfactory species at the best, and seemingly compounded of *B. plicata* and *B. costata.*

It occurs sparingly at a few Stations, mostly in Area 1.

'Challenger' Stations are, Philippine Islands, 95 fathoms; and off Raine Island, 155 fathoms.

Bolivina Hantkeniana Brady, plate IV. fig. 9.

Bolivina Hantkeniana Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 58. *B. Hantkeniana* Brady, 1884, Chall. Rept., p. 424, pl. liii. figs. 16–18. *B. Hantkeniana* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 296, pl. viii. figs. 40–42.

The Malay examples of this species are very fine, and are subject to the usual variations of form and ornamentation, but they are mostly of the broadly oval modification, and are all more or less costate. The aperture is very large, and is provided with the tongue characteristic of the group.

The species occurs in considerable abundance at Station 2, and is found sparingly at some other Stations, but it is confined almost exclusively to Area 1.

'Challenger' Stations are Tahiti, 420 and 620 fathoms; off Kandavu, 210 and 255 fathoms; off New Hebrides, 130 fathoms; and off Aru Island, 800 fathoms.

The sole 'Gazelle' Station is West Australia, 359 metres.

Bolivina Karreriana Brady.

Bolivina Karreriana Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 58. *B. Karreriana* Brady, 1884, Chall. Rept., p. 424, pl. liii. figs. 19–21. *B. Karreriana* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 299, pl. viii. figs. 38, 39.

In the Malay Archipelago the typical form of this species is very rare, although it occurs in both Areas.

With regard to its distribution, Brady writes, "This pretty species is abundant on the *Hyalonema*-ground, south of Japan, 345 fathoms. It occurs also in the South Pacific, at two points off Tahiti, 420 fathoms and 620 fathoms respectively; and in the South Atlantic, off Pernambuco, 675 fathoms."

'Gazelle' Stations are Mauritius, 411 metres; West Australia, 359 metres; and Fiji, 2432 metres.

Bolivina Karreriana var. *carinata* var. n., plate IV. fig. 8.

This variety differs from the type in having the peripheral margin acute or carinate, and the aperture is in every case provided with a more or less projecting tongue. It is much larger than the typical form. Length 0·80 mm.

Although described as a variety of *B. Karreriana*, it is equally allied to *B. Hantkeniana*, and may be treated as a passage form between the two.

It is by no means uncommon, and occurs at several Stations in both Areas.

Bolivina Schwageriana Brady, plate IV. fig. 10.

Bolivina Schwageriana Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 58. *B. Schwageriana* Brady, 1884, Chall. Rept., p. 425, pl. liii. figs. 24, 25.

Of this very rare form, hitherto known only from the 'Challenger' examples, there are some fine specimens from Stations in both Areas. They differ from the type in possessing a few delicate costæ near the peripheral margin, but in all the aperture is provided with a projecting tongue.

All that is known of its distribution elsewhere may be summed up in Brady's words (Chall. Rept., p. 426): "The figured specimens were obtained, amongst others, from Humboldt Bay, Papua, 37 fathoms; besides which, a few somewhat doubtful examples have been found at Station 185, off Raine Island, Torres Strait, 155 fathoms."

Bolivina reticulata Hantken.

Bolivina reticulata Hantken, 1875 (1876), A magy. kir. földt. int. évkönyve, vol. iv. p. 56, pl. xv. fig. 6. *B. reticulata* (Hantken) Brady, 1884, Chall. Rept., p. 426, pl. liii. figs. 30, 31. *B. reticulata* (Hantken) Egger, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 295, pl. viii. figs. 33, 34.

This form is rather rare in the Malay Archipelago, although it occurs at Stations in both Areas. Some of the specimens have the peripheral margin rounded, as in the fossil examples; in others it is acute, as figured by Brady.

Mimosina gen. n.

Test typically spiral, conical or trochoid; chambers arranged bi- or tri-serially about the longitudinal axis. Aperture compound, consisting of two distinct orifices; one of them usually being a slit at the base of the inner wall of the final chamber; the other an opening varying in shape and situated near the apex of the chamber; the two orifices frequently being connected internally by means of a bent tube or septum. Shell-wall cellular or spongy.

This is a collection of forms which, but for certain characters they possess in common, might not only be assigned to the genera *Verneuilina*, *Bulimina*, and *Ehrenbergina*, but to recognised species in each of these genera. These distinguishing characters are the compound aperture and the cellular structure of the shell-wall. Something analogous to the first of these may be found in certain members of the group of *Pulvinulina elegans* for which has been instituted the genus *Epistomina*; whilst something resembling the second may be found in the cell-walls of *Lagena Hertwigiana* and *Nodosaria intercellularis.*

Taken in the abstract these form a very natural group, and it becomes a question whether it is more convenient or even more zoologically accurate to treat them as a distinct genus, or to scatter them amongst already existing genera. It must be noted that they are not represented merely by a few obscure examples whose peculiarities might be ascribed to local influences, but all the forms here described are found in the greatest profusion all over the Malay Region. It is one of the problems of zoology that species so well marked and existing in such astonishing abundance should not hitherto have been observed in our existing oceans, nor in any of the geological formations.

Mimosina affinis sp. n., plate IV. fig. 11.

Test ovate; chambers globular, arranged tri-serially and rapidly increasing in size; sutures depressed. Sutural orifice a slit, usually cribrate; superior orifice a curved depression with the extremities rounded. Length 0·35 mm.

This is an isomorph of *Bulimina affinis* d'Orbigny, having little to distinguish it beyond the compound aperture and the structure of the shell-wall. The specimens are remarkably uniform in appearance, where there is any tendency to variation it is in the direction of *Mimosina spinulosa.*

It is the most abundant species of the genus, occurring in great profusion at nearly all the Stations in both Areas.

Mimosina spinulosa sp. n., plate IV. fig. 12.

Test elongate, trifacial, tapering towards the aboral end, margins acute; chambers slightly inflated, the marginal angle acute and slightly overlapping the preceding chambers, arranged tri-serially; sutures more or less depressed. Sutural orifice a narrow slit; superior orifice large and triangular or semilunar. Length 0·50 mm.

This is an isomorph of *Verneuilina.* It is very variable not only in length, but in the form and extent of inflation of the chambers, as well as in the degree of acuteness of the peripheral margins.

It is abundant, but less so than the other forms.

Mimosina spinulosa var., plate IV. fig. 13.

In this variety the marginal angles of the chambers are developed into lobes terminating in a spine. The chambers are more inflated and less regularly arranged, and the test is often contorted.

It is more abundant than the typical form, and the distribution is the same.

Mimosina hystrix sp. n., plate IV. fig. 14.

Test oblong ovate; tri-serial in the earlier stage, subsequently becoming bi-serial. Chambers inflated, those of the bi-serial portion provided with a spine at the rounded peripheral margin; sutures sunk. Aperture: both orifices circular or oval with a bordered margin. Length 0·50.

In some respects this form resembles *Ehrenbergina hystrix* Brady, but there is no real affinity. It differs from the other species in its dimorphous character as well as in the form and position of the sutural orifice.

It is abundant, but more local than the other species.

NOTES.

The Microscopes of Powell, Ross, and Smith.

By Edward M. Nelson.

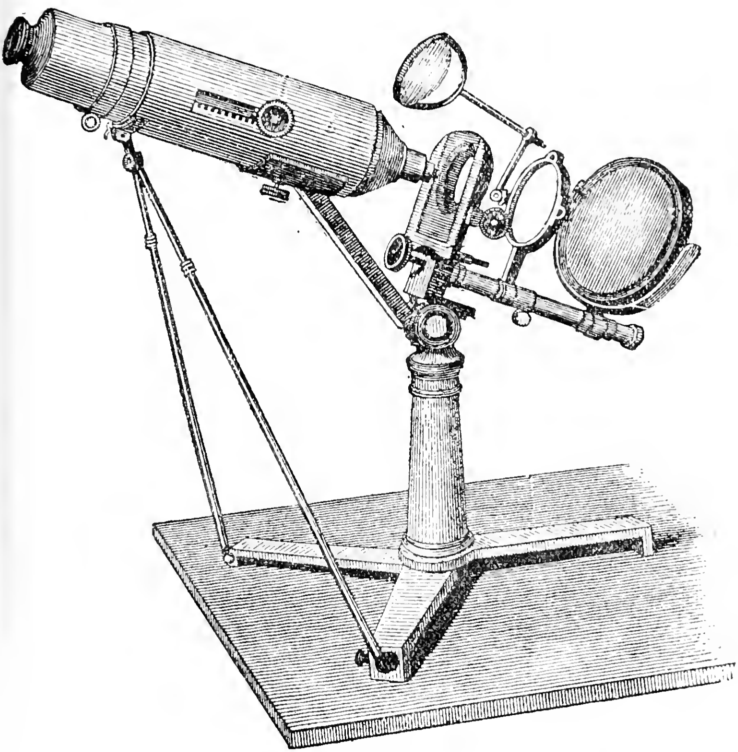
III.—James Smith and his Microscopes.

When Mr. Joseph J. Lister gave the order to Mr. W. Tulley, the celebrated telescope maker of Islington, for a Microscope to be made according to his own working drawings, Mr. Tulley put it into the hands of James Smith, a very expert philosophical instrument maker, to execute. James Smith finished this Microscope on May 30th, 1826, and therefore was the maker of the first achromatic Microscope in this country. The object-glass for this Microscope was said to have been made by Mr. Lister himself, a statement which is highly probable, as he practised lens-grinding so that he might be able to test his own formulæ.

This Microscope, seen in fig. 146, has a draw-tube into which the eye-piece was *screwed;* at the lower end of the draw-tube an erector could be fitted; rectangular movements were given to the stage by means of the pinion heads shown in the fig., one being placed in a vertical position. A substage is provided, and we are told that a compound condenser was fitted to it; it would be very interesting to know the form of this compound condenser, because the condensers of all previous Microscopes were very crude, being for the most part composed of a single biconvex lens. The steadying rods were of course suggested by the telescope mounts of that day, but the folding tripod foot, which was the usual form for Microscopes at that time, cannot now be commended. This Microscope differs from all those immediately preceding it in one essential point, viz. that it is solely a compound Microscope, whereas all Microscopes of that time and for upwards of fifteen years afterwards, were both simple and compound, or in the phraseology of that day, single and double. Very old models, such as John Marshall's (1704), Culpeper's (1738), Cuff's (1744), were solely compound Microscopes; but those of Benjamin Martin, Adams, Jones, Pritchard, Powell, and of Ross even as late as 1843, were both simple and compound; so in this respect this Microscope appears in strong contrast to those of its time. The solid limb, which clearly predated those both of Ross and Jackson, was quite an original idea.

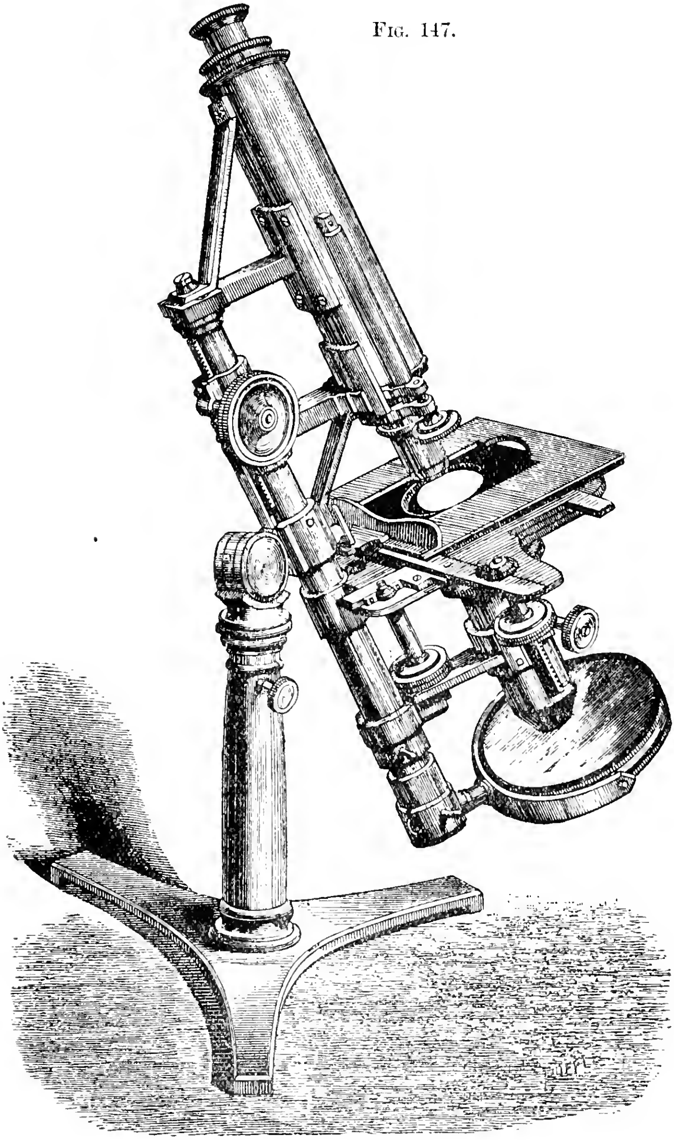
About 1840 James Smith commenced business on his own account at 50 Ironmonger Row, Old Street, E.C., and here he made the first Microscope, with his own name attached to it, for Mr. R. L. Beck; this Microscope (fig. 147) was finished on May 29th, 1839. This instrument must be regarded as an answer to the Ross Microscope, figured in the *Penny Cyclopedia* of 1839, which necessarily must have been made before the publication of that work. The flat folding tripod foot is replaced by a solid one, and rigidity is given to the body in a different way from that of Ross's model. There is a triangular bracing at the top of the limb, and a guide is placed lower down, upon which the body slides; the stage is evidently a modified form of Ross's, and there is a Wollaston condenser with rackwork focusing, the conical

Fig. 146.



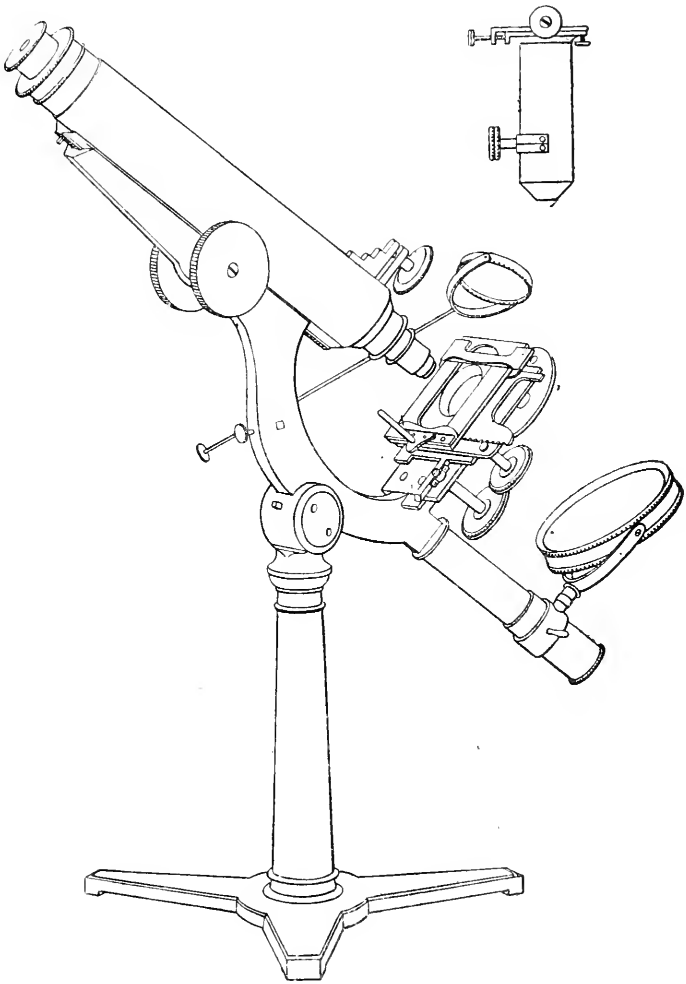
end reminding one of the cone diaphragms of earlier non-achromatic models. The fitting of this condenser to a separate arm on the limb shows a distinct improvement over all preceding models; both Powell and Ross attached theirs to the underneath part of the main stage, while in this there is an elementary kind of substage. The nose-piece fine adjustment of this Microscope possesses all the errors inseparable from those of its class. It has been stated that this Microscope was one of Jackson's early forms, but it is certain that Mr. Jackson had nothing whatever to do with it.

Fig. 147.



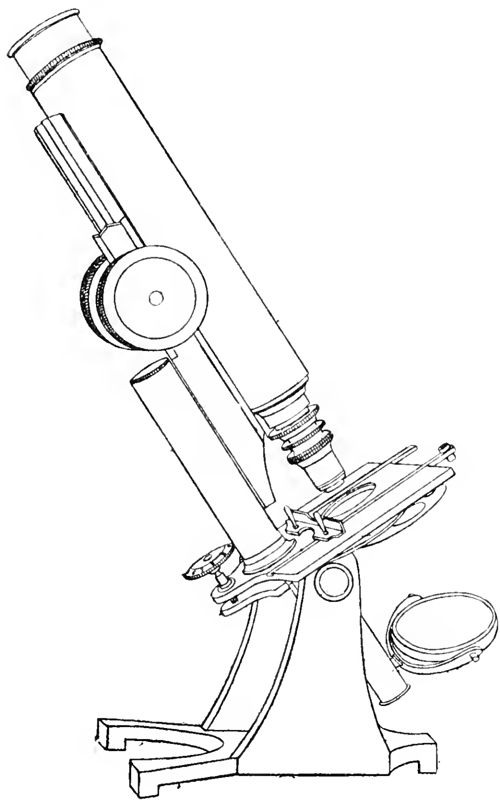
The next model made by James Smith is in our cabinet (fig. 148). It was ordered by the Society on August 19th, 1840, and was delivered on November 24th, 1841; it is figured on the frontispiece of vol. ii. of *Cooper's Microscopic Journal* for 1842. Here we have the first example of the Lister limb with the Jackson rabbetted groove; this is an excellent form of coarse adjustment, and even to-day it works

FIG. 148.



smoothly and steadily; the stage remains much the same, with the exception of the addition of a non-concentric rotating object-holder. There is an achromatic condenser, fitted with rectangular centering gear, but the substage is dispensed with, and the condenser slides in a groove beneath the main stage, following the plan previously adopted by Powell and Ross. The foot and pillar are unaltered. This is a carefully made and well-finished Microscope. The accompanying objectives are peculiar, and need explanation. There is a $1\frac{1}{2}$ in., over the front of which a diaphragm is placed; when a higher power is wanted, the diaphragm is removed and a front is substituted for it, the combination thus formed being of 8/10 focus. To make a 1/2 in.

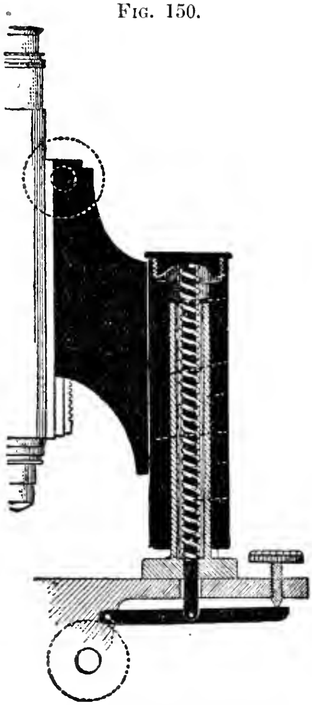
Fig. 149.



this front is exchanged for another one. This 1/2 in. front has a correctional collar graduated into ten divisions. The 1/4 in. is a complete objective in itself with a similarly graduated correctional collar. These were the first two correctional collars to be so graduated, and it was some years before this excellent plan was adopted by other makers, as they considered that two lines, marked covered and uncovered, were sufficient for the purpose. Lieberkühns were supplied with the 8/10, 1/2, and 1/4 in. objectives. I have examined these glasses, and have found them very well corrected.

In 1846, Mr. Smith removed to 6 Coleman Street, E.C., and entered into partnership with Mr. Richard Beck. Here the model just described underwent two slight modifications, the more important of which was the addition of the Jackson method of mounting the limb on a trunnion between two pillars; the second alteration was in the stage, by placing the pinions of the rectangular motion in the same plane as the stage, instead of at right angles to it. An alternative and cheaper form of stage was also made, viz. Alfred White's lever movement, described in a paper read before this Society on November 15th, 1843. This movement was merely Varley's with the handle of the lever inverted, i.e. pointing upwards instead of downwards. Messrs. Smith and Beck's No. 2 Microscope was the same as the old one, with the exception that the feet of the flat tripod were made to fold for convenience of packing.

Fig. 150.



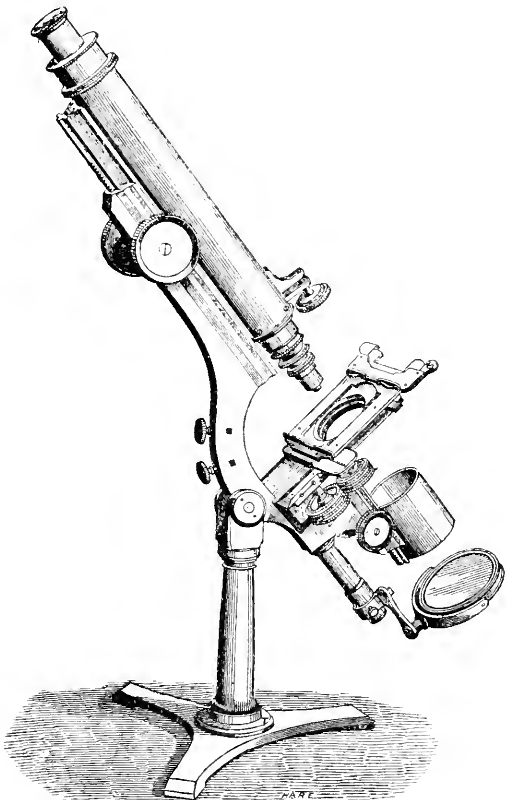
A No. 3 or Student's Microscope, which deserves special notice, was made at this time. The limb was mounted on a trunnion between two upright brass plates supported by a flat tripod, very similar to the Ross foot; the position of the flat foot was however reversed, the single toe being placed in front and the two toes behind (fig. 149). The stage was plain, with a sliding bar; the body was attached to the limb by the Jackson rabbetted groove. The important point about this instrument was its fine adjustment; rising from the stage was a strong triangular pillar, upon which the limb could slide smoothly; this limb was hauled down against an opposing spring by means of a lever of the second order, placed below the stage, as shown in fig 150. This was Smith's method of obtaining a steady fine adjustment in conjunction with Jackson's rabbetted groove coarse adjustment, and a very excellent plan it was, for it is still made, and therefore has stood the test of fifty-five years' trial.

In 1848, Messrs. Smith and Beck made the first concentric mechanical stage; this was the invention of Mr. M. S. Legg, and was described by him in vol. ii. of our *Transactions*, p. 127, pl. 27.

For the Exhibition of 1851 a new model was prepared, in which an important alteration was carried out at the suggestion of

Mr. Jackson, viz. the substage slide was made in one casting with the limb, and the rabbetted grooves both for the body and substage were ploughed in one cut. Fig. 151 is the earliest figure extant of this kind of Microscope. It will be observed that in this Microscope no centering gear is attached to the substage, because it was thought that the Jackson ploughed groove rendered such an appliance superfluous. This instrument was also mounted upon Jackson's trunnion and double

Fig. 151.



pillar (this was afterwards arranged so that the flat tripod foot could be rotated beneath the pillars); a concentric rotating mechanical stage was added; and after 1860 the single body was exchanged for the Wenham binocular. In 1873 one of these Microscopes, which is frequently used at our Meetings, was presented to the Society by Mr. Charles Woodward. Fig. 152 is taken from R. L. Beck's *Achromatic Microscope.*

In 1852, Mr. Joseph Beck joined the firm, which then became known as Messrs. Smith, Beck, and Beck; and in 1853 they removed to Cornhill. In the Exhibition of 1862 the firm's principal Microscopes did not differ at all from the one just described, but there were some new models of which a short account is necessary. First, there was a cheap class of instrument called a "Universal Microscope," introduced in October 1861; this had a flat circular foot, upon one side of which a stout vertical pillar was fixed; to this pillar the limb holding both the body and the stage was attached. There was a peculiar kind

Fig. 152.

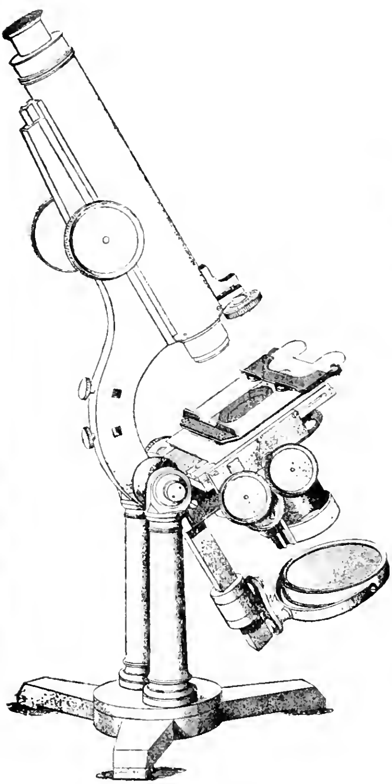
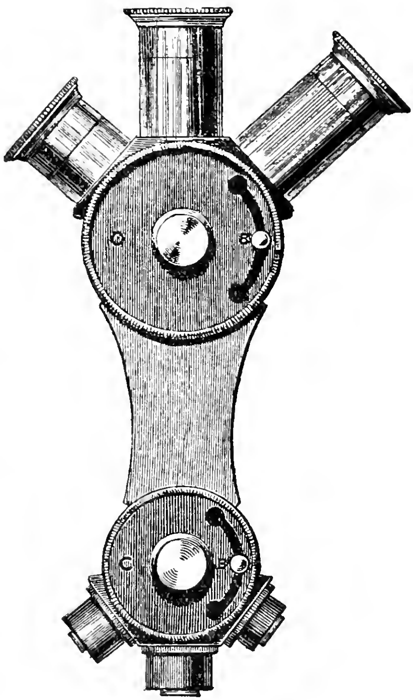


Fig. 153.



½ size.

of coarse and fine adjustment formed by a lever gripping the coarse adjustment pinion, the coarse adjustment being a chain movement like Ladd's. But the interesting feature in this Microscope was its body (fig. 153), which had three objectives at one end and three eye-pieces at the other; this seems to be an excellent idea, and it is difficult to understand why it has not been largely adopted. This Microscope, probably on account of its inadequate focusing adjustments, had an ephemeral existence. Secondly, there was a "Museum Microscope" holding 500 objects, which were arranged round large cylinders, the instrument being something like a musical box. I cannot see why some such appliance as this should not be displayed in our museums. Foraminifera, Polycystines, and many other objects requiring low powers, are not only very suitable for exhibition in this manner, but are more instructive and interesting than wall pictures; a few typical objects might be placed under glass alongside the instrument so that their actual size might be directly compared with their magnified images; this would give to the uninitiated a better idea of the real size of the objects than any amount of tabulated magnifications in diameters. It is also obvious that a Microscope exhibiting the objects themselves would not only be cheaper but would occupy far less space than a quantity of enlarged models.

In 1864 Mr. James Smith retired, the Microscopes, in the perfecting of which he had bestowed so much labour, long surviving him.

The objectives of James Smith will not require a prolonged notice, because his early ones were made under the directions of Mr. Lister, and therefore did not materially differ from those made by Andrew Ross. Smith, however, was singular in the production of separating or dividing lenses, i.e. an objective capable of forming a lower power by the removal of its front lens; these have already been noticed above. The following is a list of objectives, dating 1852, with their apertures.

1½	N.A. ·11	1/4	N.A. ·57	1/8	N.A. ·71
2/3	„ ·23	1/5	„ ·68	1/8	„ ·82
4/10	„ ·46	1/5	„ ·77	1/10	„ ·87
4/10	„ ·54				

With regard to Smith's illuminating apparatus, it is probable that his achromatic condensers did not differ greatly from those of Powell and Ross already mentioned; but in 1850 Smith was the first to construct a Wenham's parabolic reflector; this was made of metal, and not, as afterwards, of glass. The parabolic reflector, which is figured by Pritchard in his *Micrographia* (1837), was, we are told, the invention of the Rev. Mr. Packman, but Smith appears to have been the first actually to make it. The original one is in our cabinet. I am informed that James Smith died about 1870.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Segmentation induced by Sperm-Extract.‡—Herr Hans Winkler has succeeded in inducing cleavage-phenomena in ova of *Sphærechinus granularis* and *Arbacia pustulosa* by application of "sperm-extract." The extract was made by shaking spermatozoa in distilled water and filtering half-a-dozen times. The cleavage, which occurred in some ova, was regular to the four-cell stage, and then abnormal. Control experiments were made. Mitoses were observed. The author rejects Loeb's idea that the spermatozoon introduces certain metallic ions into the ovum.

Alleged Transmission of artificially induced Epilepsy in Guinea-pigs.§—Herr Max Sommer has repeated Brown-Séquard's famous experiments, and the net result is absolutely the opposite of that reached by the French physiologist and by Obersteiner. Sommer finds no support in this direction for the supposed transmission of modifications.

Multinucleate Ova.‖—S. von Schumacher and C. Schwarz describe a remarkable case, the abundant occurrence of multinucleate ova and of follicles with several ova in the ovary of a woman of forty-two, the mother of ten children.

Envelopes of Hen's Egg.¶—Prof. Max Schüller has succeeded in demonstrating the existence of a layer of epithelial cells on the inner

* 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, Reproduction, and allied subjects.

‡ Nachr. Ges. Wiss. Göttingen, 1900, Heft 2, 7 pp. See Zool. Centralbl., vii. (1900) pp. 551–2.

§ Dissertatio, Jena, 1900, 46 pp. See Zool. Centralbl., vii. (1900) pp. 478–80.

‖ Anat. Anzeig., xviii. (1900) pp. 1–8 (6 figs.).

¶ Op. cit., xvi. (1899) pp. 460–7 (7 figs.).

surface of the shell-membrane in the egg of the hen. The epithelial cells lie between the shell-membrane and the albumen, require a very high power for their demonstration, and do not form a continuous layer, but are present sometimes singly, sometimes in groups. The author is of opinion that the cells represent the remnants of the follicular epithelium, the whole egg being the follicle. The albumen of the egg must be supposed to have filtered through the egg-envelopes.

Sex of Extra-uterine Fœtus.*—Prof. A. Rauber gives a list (made by his assistant, P. Jurjan) of twelve cases of extra-uterine pregnancy, in which the sex distribution was eight males to four females. From this a hasty judgment might infer that the unfavourable nutritive conditions led to a preponderance of males. But in another list which Rauber recently published, there were in eight cases two males and six females. So that the total result shows equality in the occurrence of the two sexes. In man, the author thinks that the evidence points to an *ovarian* determination of sex.

Artificial Parthenogenesis in Amphibia and Fishes.†—E. Bataillon has experimented with the eggs of *Rana esculenta* and various fresh-water fishes. He finds that various solutions provoke segmentation, but he thinks that this is due to a relative dehydration. The influence seems to be physical rather than chemical; thus the serum of a mammal, both anti-diphtheritic and normal, acts like an isotonic saline or saccharine solution. The influence is one of osmotic pressure.

Placenta of Macacus.‡—Prof. J. Kollmann finds that in *Macacus* the development of the placenta is more easily followed than in other mammals. He finds that the mesodermal cone of the villus consists of a double epithelial layer, an outer covering layer, and a deeper layer (Langhans' cells). Both layers originate from the primary ectoderm of the blastodermic vesicle, and neither the cells of the decidua nor the uterine glands take any part in their formation. Neither in *Macacus* nor in *Homo* do the chorionic villi possess an endothelial membrane. The spaces between the villi are in the earliest stages a part of the uterine cavity. Until the sixth week they do not normally contain blood. They are extravascular, and the maternal blood bathes directly the embryonic villi.

Origin and Development of Carotid Gland.§—Dr. A. Kohn concludes that the structure found in mammals in the vicinity of the carotid artery is not a gland, nor a network of vessels, but is an organ of peculiar character belonging to the sympathetic system. Its special elements, which he calls chromaffine cells on account of their colour reactions, its nerve-fibres and ganglion-cells, all originate from the sympathetic, the chromaffine cells arising directly from the cells of the embryonic sympathetic. The organ is best called the paraganglion intercaroticum, and such paraganglia occur in various regions in connection with sympathetic ganglia. According to the author, the medulla of the adrenal body is to be reckoned among these paraganglia. In

* Anat. Anzeig., xvii. (1900) pp. 455–7.
† Comptes Rendus, cxxxi. (1900) pp. 115–8.
‡ Anat. Anzeig., xvii. (1900) pp. 465–79 (6 figs.).
§ Arch. Mikr. Anat., lvi. (1900) pp. 81–148 (2 pls.).

addition to the paraganglia themselves, isolated groups of chromaffine cells, or single cells, occur in the sympathetic trunks. Further, the suprarenal bodies of Selachians, the cell-nests of Amphibia, the groups of brown cells in Reptiles, are all to be regarded as paraganglia. The thickening of the wall of the internal carotid in mammalian embryos, a thickening often interpenetrated by blood-vessels, and the carotid labyrinth in Amphibia, have nothing to do with paraganglia.

Development of Adrenal Bodies.*—Dr. Otto Aichel has investigated the development of these structures throughout the vertebrate phylum, with a view to the determination of the homologies of their various elements. He finds that they are universally present above cyclostomes, but finds nothing to support the current view that the suprarenals of the lower vertebrates, like the medulla of the adrenals in the higher, originate from the sympathetic. His results, on the other hand, show that the interrenals of the lower vertebrates, like the adrenals of the higher, originate from the funnels of the mesonephros. The suprarenals of the lower vertebrates arise from the transverse canals of the mesonephros, as do the adrenals found in the broad ligament in the female of higher vertebrates and the spermatic cord in the male (accessory adrenals). In consequence, in the whole vertebrate series two separate adrenal systems occur. The one is represented by the adrenals of the higher vertebrates and the interrenals of the lower; the other is represented by the accessory adrenals in the higher vertebrates and the suprarenals in the lower. These accessory adrenals (Marchand's adrenals) the author finds to be universally present in the higher vertebrates, though often minute, and they are not to be confused with the so-called accessory adrenals which occasionally occur as the result of the dismemberment of the true adrenal body—a phenomenon analogous to the not infrequent dismemberment of salivary glands, spleen, &c. The differences between higher and lower vertebrates the author explains as follows. In the lower the mesonephros retains throughout life its excretory function, and its two parts (funnels and transverse canals) give rise respectively to interrenals and suprarenals which are equivalent structures. The interrenals are originally paired, but later become unpaired. In the higher vertebrates the mesonephros has only a temporary excretory significance, and though suprarenal bodies originate from its transverse canals as in Selachians, yet these never reach full development, and become the rudimentary accessory adrenals. The interrenals originate in the same manner as in Selachians, remain paired throughout life, and form the obvious adrenals of the higher vertebrates.

Development of the Duodenal Papillæ.†—Dr. Konrad K. Helly has investigated the development of the primordia of the pancreas, and of the duodenal papillæ on which the pancreatic and bile-ducts open in human embryos, in order to determine the reason of the variations in size of the papillæ during development. He finds that the portion of pancreatic tissue found in the papilla minor in the adult appears at a very early stage in the embryo, before the appearance of the papilla

* Arch. Mikr. Anat., lvi. (1900) pp. 1–80 (3 pls. and 1 fig.).
† Tom. cit., pp. 291–308 (1 pl. and 12 figs.).

itself. The reason why this pancreatic tissue appears in the papilla minor rather than in the papilla major, appears to be that while the ductus Santorini does not undergo a change of position during development, the ductus Wirsungianus does. The papillæ themselves appear when the fibres of the intestinal musculature become obvious, and their growth results mechanically from the increase in length of the contained ducts.

Germinal Cells of Spinal Cord.*—Prof. G. Sclavunos notes that while His supposed the round cells of the developing spinal cord to be special cells and the forerunners of the nerve-cells, others (e. g. v. Kölliker and Schaper) regarded these cells (the germinal cells of His) as the forerunners of both nerve-cells and glia-cells, and as merely young unspecialised epithelial cells. As the formation of the neuroglia occurs during the later period of development, the question should be solved by finding whether or not these cells persist after the formation of the nerve-tissue. The author studied late embryos and new-born young of dogs, cats, and mice, and finds that the elements of the spinal cord go on dividing until after birth, and that His' germinal cells do not disappear from the white substance with the formation of the nerve-cells, but persist until birth as formative material. These germinal cells occur at the point of entrance of the posterior root, in the posterior root itself, and in the spinal ganglia of new-born mammals. The author further finds that nerve-cells occur in the arachnoids, where they have not been previously described.

Sexual Kineses in Triton.†—Prof. J. A. Janssens finds that there is a very remarkable analogy between the divisions which occur in the formation of the spermatozoa in *Triton* and those which occur in the formation of pollen-grains as described by Grégoire for the lily.‡ He finds that in the two sexual kineses of the spermatocytes of *Triton*, the four rods which arise from each primitively single chromosome originate by two *longitudinal* divisions. After the synapsis the nuclear thread divides into twelve blocks, and the result of the two longitudinal divisions is to convert each of these blocks into a quaternary group, the latter process following immediately on the former. In the details of the process the author finds a remarkable resemblance to the conditions in the lily.

Another Hermaphrodite Frog.§—Mr. R. C. Punnett describes a case in which the right side showed a well-developed Müllerian duct, a ureter with a seminal vesicle, a well-developed testis, on it a pigmented patch with one normal ovum; while the left side had a well-developed Müllerian duct, a small seminal vesicle, and an unmistakable ovary, with an almost isolated patch of testicular tissue including spermatozoa and one ovum. The fatty body was well developed on each side, and the male glandular enlargement of the first finger was well marked.

Dentition of Rodents.‖—Elin Cederblom has investigated the problem of replacement in the teeth of Rodents. In those with more than

* Anat. Anzeig., xvi. (1899) pp. 467–73 (5 figs.).
† Op. cit., xvii. (1900) pp. 520–4 (10 figs.).
‡ Cf. this Journal, 1899, p. 498.
§ Ann. Nat. Hist., vi. (1900) pp. 179–80 (1 pl.).
‖ Zool. Jahrb. (Abth. Syst.), xiii. (1900) pp. 269–86.

three back teeth,—in Anomaluridæ, Geomyidæ, Heteromyidæ, Bathyergidæ, Dipodidæ, Pedetidæ, Octodontidæ, and Chinchillidæ, there seems to be no succession of teeth. But further research is necessary to show whether there may not be a replacement during fœtal life, as is known to be the case in Caviidæ.

Dental Ridge of Selachians.* — Paul Laaser has investigated the development of the dental ridge in embryos of *Spinax niger*, *Mustelus lævis*, and *Acanthias vulgaris*. In *Spinax* the development of the teeth takes place somewhat more rapidly in the lower than in the upper jaw; whereas in *Mustelus* the reverse is the case. Otherwise the author's observations appear to confirm exactly Hertwig's previous descriptions for *Acanthias*.

Homology of Kupffer's Vesicle.†—Fr. Kopsch notes that many suggestions have been made as to the significance of this characteristic of the embryos of Teleosts; as that it is the homologue of the allantois, of the terminal vesicle of the post-anal gut in Selachians, of the archenteron. The progress of knowledge has, according to the author, made the first position impossible, and he does not believe that there is any evidence for the third, but is of opinion that the evidence all supports the second view. Further, he believes that the post-anal gut of Selachians and the vesicle of Teleost embryos are both to be explained as remnants of the primitive food-canal which extended to the posterior end of the body. As Selachians are nearer the primitive type than the more aberrant Teleosts, it is natural that the post-anal gut should reach a higher degree of development in the former than does its homologue in the latter. In more detail, Kupffer's vesicle is to be regarded as a part of the primitive cloaca neurenterica.

Rearing of Sea-fish Larvæ.‡ — Mr. Walter Garstang has made a series of experiments on this subject, choosing *Blennius ocellaris* as the subject of observation. He was successful in rearing a certain percentage of larvæ through the critical stages, and believes that the essential conditions for the obtaining of this result are a liberal supply of pure water, a moderate agitation of the water, the provision of suitable food prior to the absorption of the yolk, and a constant but not excessive food-supply. In regard to the food-supply it is essential that the tastes of the individual larvæ be considered. Incidentally the paper contains some notes on the habits, &c. of *Blennius ocellaris*.

Recent Teratological Literature.§ — Prof. Bertram C. A. Windle publishes the tenth of his very useful reports. In the experimental part he summarises, *inter alia*, Bertacchini's ‖ observations on the results of puncturing the blastoporic rim in *Rana esculenta*; Barfurth's¶ evidence that the *cauda bifida* of amphibian larvæ is due to regeneration after injury; Barfurth's ** remarkable case of a larval lamprey with three tails, each containing a spinal cord, a notochord, a caudal artery, and myomeres. In the section on duplicity, he summarises among others, a

* Anat. Anzeig., xvii. (1900) pp. 479–89 (8 figs.). † Tom. cit., pp. 497–509.
‡ Journ. Mar. Biol. Ass., vi. (1900) pp. 70–93.
§ Journ. Anat. Physiol. Norm. Path., xxxiv. (1900) pp. 410–25.
‖ Int. Monatschr. Anat. Phys., xvi. Heft 7, 8.
¶ Arch. Entwickelungsmech., ix. ** Tom. cit.

paper by O. Schultze* on the origin of double monstrosities. This result may follow from three possibilities:—(*a*) The ovum escapes from the ovary with two nuclei, and may be fertilised by two spermatozoa, from which two processes of segmentation would follow. (*b*) Through over-ripeness, the innate tendency to division on the part of the ovum may lead to its division into two parts, each of which may subsequently be fertilised. (*c*) The ovum may be normally fertilised and proceed to the first division. Then, by some unknown process, each of the first two blastomeres may go on to an independent development.

Homogamy and Fertility.† — Prof. Karl Pearson, some time ago, asked the interesting question:—"When any form of life breaks up into two groups under the influence of natural selection, what is to prevent them intercrossing and so destroying the differentiation at each fresh reproductive stage?" The answer, he suggested, was twofold—(1) homogamy [i.e. mating of like with like], which he demonstrates to exist in the case of man; and (2) a possible dependence of fertility on homogamy, which would render the cross-unions relatively sterile. His view was, that a correlation of homogamy with fertility, together with natural selection, could produce a permanent differentiation of species, but that neither *alone* could be effectual.

After giving evidence that a progressive change, but no differentiation, can be produced by reproductive selection, he discusses the whole theory of the influence on evolution of a relation between homogamy and fertility. Reproductive divergence has not an effective existence. "So far as I can yet see, differentiation must involve natural selection, and one can only appeal to reproductive selection as a means, but I think an effective means, of maintaining a differentiation already brought about by Darwin's fundamental factor in evolution."

Secondary Sexual Characters.‡—Mr. G. E. H. Barrett-Hamilton says that no attempt, so far as he knows, has been made to trace the primary physiological meaning, as apart from secondary utility, of these characters. He thinks, as many have thought, that "there must be some widespread and fundamental causes to which all owe their origin." A clue has suggested itself to him in his study of the nuptial changes of the anadromous salmonoid genus *Oncorhynchus*, whose spawning he observed in Kamchatkan waters. The nuptial changes of form and coloration occur in both sexes, and the fish when thus affected are most obviously out of condition. They are, indeed, in a pathological state. It is said that one species only, *O. orientalis*, survives the spawning, and this is one of the species which becomes least distorted and discoloured. In a pathological state, induced by the influence of the gonads on the general metabolism, he finds the starting point whence "natural selection by alteration, suppression, or accentuation of the details, might easily produce many or all of the nuptial changes of animals as we now see them."

Segmentation of Vertebrate Head.§—Mr. Charles Hill now publishes in full his paper on this subject, with an introductory review of

* Ziegler's Centralbl. f. Pathol., x., Heft 10.
† Proc. Roy. Soc. London, lxvi. (1900) pp. 316-23.
‡ Proc. Cambridge Phil. Soc., x. (1900) pp. 279-85.
§ Zool. Jahrb. (Abt. Anat.), xiii. (1900) pp. 393-446 (3 pls. and 4 figs.).

literature and a full bibliography. His material included various Teleosts, especially species of *Salmo*, and the chick, but to the ordinary methods of sectioning he added dissection under a simple Microscope, and examination of living embryos. In Teleosts he finds that the encephalon is divided into eleven primary segments, which are indicated both externally and internally, and which precede the familiar division into fore-brain, mid-brain, and hind-brain. These latter are not simple divisions, but result from a fusion of the original segments in the following way:—3 segments go to the fore-brain, 2 to the mid-brain, and 6 to the hind-brain. In the last case, 1 segment constitutes the cerebellum, and the remaining 5 constitute the medulla. In the chick the same 11 segments are represented, but in the anterior region they are very transient. In consequence of this, and of the fact that in the region of the medulla the segments persist for some time, the segments of the medulla have been erroneously homologised with secondary expansions of mid-brain and fore-brain, instead of with the primary segments of these regions. If this error be avoided, there is no difficulty in showing that the primary encephalic segments of the chick are in all essentials identical with those of the trout, and have the same relations to the adult parts.

b. Histology.

Cell-Structure.* —Prof. G. Ballowitz has studied the epithelium of the membrana elastica posterior of the eye as a good subject for minute histological study. He finds that the cells contain a giant sphere which modifies in a remarkable way the form of the excentric nucleus, and is more distinct in old than in young animals. Within the sphere lies the microcentrum, usually made up of two central corpuscles. These appearances resemble in all respects the conditions previously found by the author in *Salpa*; and he believes that only technical difficulties stand in the way of the demonstration of similar conditions in other cells. The most important distinction between the corneal epithelium and the epithelium of *Salpa* is as regards the minute structure of the sphere. In the corneal cells the sphere consists of a basket-work of threads, the meshes being of unequal size, and the spheres of the different cells showing extraordinary variability. In spite of this variability and the differences from the spheres of other cells, the author is of opinion that the spheres are not peculiar structures, but true cell-spheres. They show no "system of organic radii," and the peculiar basket-work remains unaltered during the changes of the nucleus; and therefore the author believes that they disprove Heidenhain's "law of tension," and all the theories involved in that law. The giant spheres are to be regarded as special cell-organs; but as in adult animals the cells of the membrana elastica posterior do not undergo division, the relation of the spheres to the mitotic process could not be studied. The very extensive modifications of the form of the nucleus which occur under the influence of the sphere both in the epithelium of *Salpa* and in that of the eye, are to be explained as the result of the great thinness of the flattened cells, and the consequent internal pressure.

* Arch. Mikr. Anat., lvi. (1900) pp. 230–90 (3 pls. and 49 figs.).

Centrosome and Blepharoplast.*—Prof. F. K. Studnička has studied the little swelling (blepharoplast, basal piece) which occurs at the base of the cilia in the ciliated cells of animals and the spermatozoids and swarm-spores of plants. The swelling has been homologised with the centrosome, but the author finds that swelling and centrosome may coexist, e.g. in *Petromyzon fluviatilis* and *Salamandra maculata.* The fact that in the non-motile ciliated cells of the gut in *Ascaris* the basal piece is very slightly developed, confirms the view that it is the motor centre for the cilia. In consequence, the existence of the blepharoplast in the spermatozoids of certain of the higher plants cannot be taken as evidence that the vegetative cells of those plants must contain a centrosome; for as blepharoplast and centrosome may coexist, it is reasonable to suppose that the former may appear in a cell which does not contain a centrosome and never possessed such a structure.

Function of Nucleus.†—M. Henri Stassano finds that the cells of the vascular endothelium manifest a strong affinity for mercury and other poisons introduced into the circulation, and believes that this is effected by the nucleus, by virtue of its contained nucleins which form compounds with metals and bases analogous to salts. He arranges the evidence in support of this thesis under five heads:—(1) Leucocytes, which are very rich in nucleins, display a strong affinity for metals. (2) In young dogs the endothelial cells contain granulations shown by Kowalewsky to present the characters of nuclear granulations, and the author finds that the organs of such young dogs absorb more mercury than equal weights of the organs of adult dogs, in which the granulations are absent, under identical experimental conditions. (3) It has been shown that the proportion of nuclein contained in an organ depends upon the number of cell-nuclei present, and the author's experiments show that the amount of mercury absorbed by an organ depends upon the amount of nuclein present in it. (4) The non-nucleated red blood-corpuscles of mammals are the only cellular elements which do not absorb mercury. (5) An intravenous injection of methyl-violet reduces considerably the absorption of mercury by the cells of the vascular endothelium. With this may be compared the fact that cells subjected for a prolonged period to such reagents as osmic acid refuse to take up stains subsequently. Indeed, the familiar affinity of the nucleus for basic stains may be regarded as in itself a proof of the author's position; and if the nucleins be, as it were, previously saturated by a metal or an acid, then the nucleus will no longer take up a stain.

New Theory of the Nucleus.‡—J. Kunstler has been impressed, in the course of his studies on Bacteriaceæ (e.g. *Bacterioidomonas sporifera* Kunstler), with the resemblance between spores and nuclei; and ventures the suggestion that the nucleus of the cell may be the result of the transformation of a sporogenic bud, or the vestige of a reproductive process diverted from its primitive end.

Structure of Nerve-Cells.§—C. Martinotti and V. Tirelli have applied the method of photomicrography to the study of the nerve-cells of the

* S.B. Böhm. Ges., xxxv. (1899) 22 pp. (1 pl. and 4 figs.). See also Bot. Centralbl., lxxxii. (1900) pp. 374–5. † Comptes Rendus, cxxx. (1900) pp. 1780–3.
‡ Tom. cit., pp. 1416–8. § Anat. Anzeig., xvii. (1900) pp. 369–80 (1 pl.).

spinal ganglia of various mammals. The cells were photographed both in the stained and in the unstained condition, and the photographs were found to yield an exact reproduction of the structure of the cells. The cells in the different animals examined, though varying much in detail, all showed the existence of a stroma or intertwisted reticulum, the size of the meshes apparently depending on the shape of the chromatophilous elements. At first sight, photographs of stained and unstained preparations seemed not to differ from one another, but a more careful examination of the former showed the presence of the chromatic substance, as it were, spread on the subjacent stroma. The shape of the chromatophilous elements appears to depend on the way in which the fibrils interlace, and the structure of these fibrils appears to be more complex than has hitherto been supposed. It is probable that during life the chromatic substance is semi-fluid, and it is only in hardened tissues that it coagulates and becomes arranged about the reticular fibrils.

Grandry's Corpuscles.*—Prof. A. S. Dogiel and K. Willanen find that the relation of the nerves to these bodies is not so simple as has hitherto been supposed. They have studied the corpuscles in the domestic duck, staining with methylen-blue, followed by ammonia and picric acid, or by a modification of Bethe's method. The result is to show that two kinds of medullated fibres end in the corpuscles. Of these the first penetrate between the tactile cells, and after forming a tactile disc, produce very fine fibrillæ, which apparently pass into the protoplasm of the cells. The second set of fibres form pericellular reticula on the surface of the cells. There can be no doubt that similar conditions obtain wherever tactile cells occur, as in the skin of the pig's snout, and in the outer root-sheath of tactile hairs.

Innervation of Lymphatic Glands.† — Dr. W. Tonkoff points out that considerable uncertainty still exists as to the nerve supply of lymphatic glands. He has used Golgi's method for the glands of various mammals, especially the cat, and finds that the blood-vessels are accompanied by nerve-stems, which form networks about the vessels. These nerves are naturally present only in those parts of the glands in which blood-vessels occur, but trabecular nerves also occur, which serve for the innervation of the unstriped muscles of the trabeculæ. The nerves which form networks about the vessels send off also fibrils which interpenetrate the substance of the gland itself. Lymphatic glands must therefore be included among organs possessing an abundant nerve-supply.

Nerve-endings.‡ — Dr. A. Sokolow has applied the methylen-blue method to the Vater-Pacinian corpuscles, in order to investigate the question whether, in addition to the medullated nerve-fibre, there is not within the corpuscle another slender nerve-fibre, as Dogiel § has recently described in Herbert's corpuscles. His material was the mesorectum and mesocolon of a kitten, and he experienced no difficulty in demonstrating the existence of the slender fibril, which forms a network with varicose thickenings over the surface of the inner cylinder. This non-

* Zeitschr. wiss. Zool., lxvii. (1900) pp. 349–60 (1 pl.).
† Anat. Anzeig., xvi. (1900) pp. 456–9. ‡ Tom. cit., pp. 452–5 (2 figs.).
§ Cf. this Journal, 1899, p. 581.

medullated fibril accompanies the stout medullated fibre, and on its approach to the inner cylinder, divides dichotomously to form the network, which the preparations showed clearly picked out in blue.

Nerve-endings in Frog.* — Prof. Julius Arnold describes a very simple method for demonstrating the nerve-endings in the tongue of the frog. The tongue of a curarised frog is fixed on a Thoma object-carrier, dusted with fine particles of methylen-blue, and covered with a drop of 1 per cent. sodium chloride and a cover-slip. After 15–20 minutes the cells of the so-called nerve-papillæ exhibit a bluish-green tint, the colouring being confined to the surface and to the central cells. Subsequently coloured cells appear at the periphery of the papillæ. Soon numerous intensely coloured granules appear beneath the epithelium, which are later seen to be in connection with fine varicose fibrils forming a dense sub-epithelial network. In the centre of the papillæ elements of various shapes appear, furnished with nuclei which are no longer seen when the colouring becomes intense. The elements give off forked or branched prolongations which sometimes cross the epithelial cells, and pass between them towards the surface.

Structure of Spleen.†—H. Hoyer has investigated the structure of the capillary veins of the spleen, with a special view of determining the nature of the circular fibres, described by v. Ebner as elastic tissue. Careful observation at different periods of growth has convinced him that the venous capillaries originally form a system of branched endothelial tubes, imbedded in the framework of the spleen, and supported by the cells of the splenic reticulum. As the vessels become increasingly functional with the growth of the organ, the reticular cells surrounding them become modified and form a close investment around them. Later these cells and their prolongations form a definite fibrillar sheath about the capillaries, and the fibrils give under certain conditions the reactions of elastic tissue. The author believes that the reason why this reaction is so difficult to obtain, is that the elastic tissue is present only in very small amount within the connective-tissue sheath. The result is to give the walls of the venous capillaries great firmness, and so adapt the spleen for what the author regards as its main function, that of a blood-filter.

Structure of Epidermis.‡ — Dr. Franz Weidenreich has studied the structure and process of cornification of the epidermis of man, and finds that the cells of the horny layer are more or less strongly flattened non-nucleated structures. Each consists of a cornified membrane, a network of fine threads consisting of modified protoplasm, and an empty nuclear space. The meshes of the network are filled in the superficial cells with pareleidin, in the deeper with eleidin, otherwise the structure of the cells is identical from the stratum granulosum to the surface. The horny membrane arises from the modification of the fibrillar exoplasm of the cells of the Malpighian stratum, the fibrillar network originates from the persistent protoplasmic fibrils. The eleidin originates from the keratohyalin, and its conversion into pareleidin depends upon impregnation with sweat. There is no very striking

* Anat. Anzeig., xvii. (1900) pp. 517–9. † Tom. cit., pp. 490–7 (2 figs.).
‡ Arch. Mikr. Anat., lvi. (1900) pp. 169–229 (2 pls.).

difference between the epidermis of the palms and soles and that of the other regions of the body.

Matrix of Connective-Tissue.*—Herr Fr. C. C. Hansen has investigated various forms of connective-tissue with special reference to the origin of the ground-substance. He finds that in the intervertebral discs the connective-tissue fibrils have both an intracellular and an extracellular origin, and there are also transitional forms between the two. The development of connective-tissue in cartilage takes place in various ways, one of the most interesting being the development of the fibrillæ from albumoid masses which are ejected from the cells. The albumoid masses form in vacuoles in the cells, and are ejected from the cell together with the portion of the cell-substance forming the wall of the vacuole. As they lie in the matrix they then become centres for the formation of fibrillæ. The author also finds that in the cartilage of different animals there are true extracellular centres for fibrillar formation, showing that the matrix possesses formative activity apart from its enclosed cells. Generally, the author considers that the distinction between "ground-substance" and "protoplasm" is somewhat arbitrary, the two being so intimately connected that he is disposed to regard hyalin cartilage as a syncytium, the ectoplasm (= ground-substance) of the elements being united, the endoplasm (= the "cells") being distinct.

Phagocytosis.†—Prof. E. Metchnikoff finds that the macrophagous cells of the rabbit will take up living spermatozoa. The head is first taken up by the cell, and the protruding tail displays movements during the process. The red blood-corpuscles of the goose were also taken up, the phagocytes putting out pseudopodia in the same way as that in which a *Vampyrella* takes up its prey, and speedily devouring the corpuscles.

Peritoneal Epithelium of Cat.‡—Prof. W. S. Miller has examined the central tendon, suspensory ligament, great omentum, and mesentery of the cat, in order especially to study the so-called stigmata or stomata. His results lead him to deny that pre-formed natural openings exist, the appearances usually described as stomata being, as he believes, artifacts, produced during the preparation of the structures for examination.

Blood of Fishes.§—Herr Bernhard Rawitz has continued his observations on this subject, the present investigations being confined to Ganoids and Teleosts. They confirm in all respects the previous results as to the variability of the constituent elements, as contrasted with the constancy found in the case of mammalian blood. In *Crenilabrus pavo* there are two distinct forms of erythrocytes not connected by intermediate forms. In *Sargus vulgaris*, as in *Scyllium catulus*, there is marked erythrocytolysis without the formation of blood-plates. In Teleosts as a whole there is complete absence of eosinophilous granulations, and generally it would appear that conclusions drawn from the conditions

* Anat. Anzeig., xvi. (1899) pp. 417–38 (13 figs.).
† Ann. Inst. Pasteur, xiii. (1899) pp. 737–69 (2 pls.). See also Bot. Centralbl., lxxxii. (1900) pp. 206–7.
‡ Bull. Univ. Wisconsin (Sci. Ser.), ii. (1900) pp. 235–46 (2 pls.).
§ Arch. Mikr. Anat., lvi. (1900) pp. 149–68 (1 pl.).

seen in mammalian blood cannot be applied to fishes. An explanation cannot be looked for until the blood-forming organs have been studied.

Cerebellum of Petromyzon.*—Prof. Alfred Schaper points out that the slightly developed cerebellum of the lamprey has always been regarded as of the nature of a commissure only, and therefore has been tacitly supposed to consist only of nerve-fibrils. He has however found that not only are numerous cellular elements present, but that they are arranged in layers generally corresponding to those of other vertebrates, especially amphibians. The superficial layer shows the general characters of the molecular layer. Beneath lies a layer of cells corresponding to Purkinje's cells, and a well-defined granular layer. As in amphibians the medullary layer is absent. Generally there is clear evidence that the cerebellum of *Petromyzon*, though much reduced, is the homologue of that of other vertebrates—a point of some importance in connection with the phylogeny of the vertebrate brain.

c. General.

Animal Mechanics.†—Dr. Otto Thilo further elaborates his previous statements as to the part played by check action in the mechanics of organisms. Where any part of the body has to be long maintained in one position, the muscular strain would be very severe, were it not lightened by the construction of the hard parts, which are so arranged as to prevent reversal of the action. Thus the spines of the dorsal fin of *Zeus faber* exemplify the mechanical construction known as a ratchet. In the dorsal spine of *Monacanthus*, a contact check is well illustrated, while the adjustments of the fangs of a viper show another form of the same mechanism. In general, the author is of opinion that check action plays as important a part in animal mechanics as it does in the machines constructed by man.

Origin of Life.‡—Ludwig Zehnder, as a continuation of his volume on 'The Mechanics of the Universe,' has published a book whose object is to explain the organic world on mechanical principles. Beginning with the atoms, the author evolves the phenomena of aggregation and the forces of magnetism and electricity, and derives also his mechanical bases. From the constitution of molecules, the author deduces his first fundamental biogenetic law, which reads, "Substance struggles to reproduce itself." Each molecule seeks to generate new similar molecules, and the new formed molecules are subjected to a process of selection, a struggle for existence, which is identical for aggregates of molecules, simple molecular structures, protists, plants, and animals. In consequence the second fundamental biogenetic law may be formulated as follows, "Substance seeks to adapt itself to the conditions of existence." Organisms are conceived of as consisting of fistellæ, or circular aggregates of molecules. Spontaneous generation of such aggregates is theoretically possible, but improbable, and the improbability increases with

* Anat. Anzeig., xvi. (1899) pp. 439–46 (4 figs.).

† Biol. Centralbl., xx. (1900) pp. 452–61 (7 figs.). Cf. this Journal, 1899, p. 583.

‡ 'Die Entstehung des Lebens, aus mechanischen Grundlagen entwickelt,' 1st part, Freiburg, Leipzig, and Tübingen, 1899, 8vo, viii. and 256 pp. and 123 figs. See Bot. Centralbl., lxxxii. (1900) p. 375.

the complexity of the aggregate, wherefore organisms as we know them arise only from like organisms.

Study of Domestic Animals.*—Prof. S. H. Gage sums up an interesting address on 'The importance and the promise in the study of the domestic animals' in the following sentences. "However necessary and desirable it may have been in the past that the main energy of zoologists should be employed in the description of new species, and in the making of fragmentary observations upon the habits, structure, and embryology of a multitude of forms, I firmly believe that necessity or even desirability has long since passed away, and that for the advancement of zoological science the work of surpassing importance confronting us is the thorough investigation of a few forms from the ovum to youth, maturity, and old age. And I also firmly believe that, whenever available, the greatest good to science, and thus to mankind, will result from a selection of domesticated forms for these thorough investigations."

Use of Otoliths.†—Herr J. Laudenbach has some experimental data to offer in regard to the problem of the function of otoliths. In *Siredon pisciforme*, with extirpation of the labyrinth on one side there were rolling movements; when the extirpation was effected on both sides there were circling and whirling movements. But these disturbances of equilibration did not occur when the otoliths were removed without destruction of the whole labyrinth.

Morphology of the Vertebrate Brain.‡—Prof. B. Haller, as a continuation of his study of the brain of fishes, has made a detailed investigation of the brain of *Emys*, with a special view to determining the relation between the Reptilian and Mammalian arrangement of parts. The third part of the memoir is to be devoted to a detailed comparison of the Reptilian and the Mammalian brain, but the present part discusses to some extent the vexed question of the homology of the commissures. The author denies the suggestion that the commissura fornicata of Reptiles can be homologised with the commissura superior of Ziehen in Monotremes, or the secondary commissura anterior of the former with the large ventral commissura anterior of the latter; for the commissura anterior of Reptiles corresponds with that of Placentalia, and the commissura fornicata of the former contains true transverse elements and the first rudiment of a psalterium. If the transverse elements be indicated by a, the psalterium elements by b, the elements of the commissura anterior of Reptiles and Placentals by c, then the relations can be indicated in the following formulæ:—The commissura fornicata of Reptiles $= a + b$, the commissura superior of Monotremes $= b$, the secondary commissura anterior of Reptiles $= c$, the ventral commissura anterior of Monotremes $= a + c$. It thus cannot be said that the reptilian condition, as at present existing, is a stage in the development of the placental condition, and we must look to an extinct reptilian stock for the common starting point of the brains of existing reptiles and mammals.

* Proc. Amer. Ass. Adv. Sci., 48th Meeting, 1899, pp. 235–52.

† Pflüger's Arch. Ges. Physiol., lxxvii. (1899) pp. 311–20. See Zool. Centralbl., vii. (1900) p. 569.

‡ Morph. Jahrb., xxviii. (1900) pp. 252–346 (5 pls.). Cf. this Journal, 1899, p. 21.

In another paper * the author discusses the structure of the brain of *Mus*, with some observations on that of *Echidna*, and in regard to the phylogeny of the brain of Vertebrates comes to the following conclusions. The primitive basal part of the brain in Selachians underwent in the ancestors of Reptiles a differentiation into a median and a lateral half, which became attached respectively to the median and lateral parts of the pallium, and formed the primary gyrus fornicatus and the striatum. A further differentiation of the lateral region produced the epistriatum. An invagination and differentiation of the pallium above the primary gyrus fornicatus produced a reptilian condition of parts, the differentiated pallium having olfactory significance. A further specialisation of the olfactory sense produced the gyrus ammonis which grows downward over the primary gyrus fornicatus, so that the basal olfactory region of the brain contains a purely pallial element. At the same time the non-olfactory region of the pallium underwent further differentiation. The development of the superior commissure—a connection between the gyri ammonis of the two sides—produced the Monotreme condition. Then the anterior part of the gyrus ammonis underwent degeneration, while simultaneously the non-olfactory region of the pallium and its system of cross fibres underwent further development. This system of cross fibres becomes differentiated from the large inferior anterior commissure of Monotremes, which gradually diminishes in importance. As the cortex of the brain increases in importance and the number of association centres becomes greater, a strong system of transverse fibres appears, and forms the corpus callosum. The result of this is the development of the true gyrus fornicatus, which becomes differentiated out of the primary gyrus fornicatus, and replaces the anterior part of the gyrus ammonis, while its posterior part becomes degenerate. Thus the gyrus fornicatus cannot be included as part of the rhinencephalon. The importance of the corpus callosum is that it contains crossed association tracts, which, when combined with association centres, mean increased intelligence. In *Echidna* there is a differentiation of the cortex without any great increase of intelligence, and here the crossed association tracts are not numerous.

Sensory Canals of Polypterus bichir.†—Mr. E. P. Allis, jun., finds that the lateral canals of this fish present a condition that represents a perfectly normal development, excepting only in the fusion, in one specimen, of the fifth and sixth primary pores of the mandibular line to form a single pore. No primary pore in the entire lateral system of the fish has undergone secondary subdivision, *Polypterus* presenting in this a much lower stage of development than either *Amia* or *Lepidosteus*. The author describes the mandibular canals (which unite at the symphysis), the main infra-orbital canals (which unite on the top of the snout), the supra-orbital canal, the supra-temporal commissure, the pre-opercular canal, the pit-organs, and the three sensory lines on the body of the fish, the more important one having the most ventral position, and corresponding, apparently, to the main lateral line of other fishes.

Kidney of Lepadogaster gouanii.‡—M. Frédéric Guitel finds that in the male of this fish the kidney consists of a posterior lobed region,

* Morph. Jahrb., xxviii. (1900) pp. 347–477 (7 pls. and 4 figs.).
† Anat. Anzeig., xvii. (1900) pp. 433–51 (3 figs.).
‡ Comptes Rendus, cxxx. (1900) pp. 1773–7 (2 figs.).

and an anterior region containing a Malpighian corpuscle which is the persistent corpuscle of the pronephros. The mesonephros has no Malpighian corpuscles, and consists of a number of branched tubules, while the pronephros retains throughout life the condition which is embryonic for other Teleosts. In the female the tubules of the kidney have a smaller diameter, and the lobes are therefore less well developed than in the male. In both sexes the Malpighian corpuscles of the pronephros are the only ones which are present.

Pneumaticity of Mammalian Skull.* — Dr. Simon Paulli, in the course of his investigations on this subject, has studied the skull of Ungulates and of the elephant. He finds that in the Ungulates the air-chambers of the skull are well developed, especially in the larger forms. In some, as in the rhinoceros and in cattle, the air-spaces are distributed over the whole skull, but the pneumaticity rapidly diminishes with the size of the species, so that in *Tragulus* it is very slightly developed. To this rule the hippopotamus forms an exception; for in it the slight development of the air-spaces is in marked contrast to the size of the skull. In regard to the development of the air-spaces, the elephant shows well-marked analogies with the Ungulates.

Moles' Burrows.†—D. Rossinsky has published a number of plans and sections of moles' burrows. These do not corroborate the geometrically regular arrangement displayed in some of the older figures, but they show considerable complexity, with numerous individual variations. It is difficult, however, to discuss the matter without figures.

Attaching Organs of Geckotidæ.‡—Anton Haase has studied the structure and development of the organs of attachment found on the feet of geckos. His material included adults of numerous genera and embryos of *Hemidactylus mabounia*. The author agrees with Cartier that the lamellæ of the organ are to be regarded as modified-scales, and finds that the ventral or palmar surface and the dorsal surface differ in structure from one another, the ventral epidermis being thicker and more complicated in structure than the dorsal. But in most details the results appear simply to confirm those of previous investigators. As to development, the conditions seen in the embryo show clearly that the lamellæ are merely modified scales, and develope as scales. The author considers that the exact way in which attachment occurs has not yet been adequately explained.

Position of Myxinoids.§—Dr. M. Fürbringer has a brief note on this subject, and on the question of the existence of an old and a new mouth in *Myxine*. He is of opinion that recent work confirms his view that the Myxinoids have no close relationship to the Petromyzontes, and should be separated from them. On the other hand, he now abandons the term Distoma as applied to the Myxinoids, as the work of Price and of von Kupffer on *Bdellostoma* shows that in the first place the nasal canal cannot be regarded as the primitive mouth, and secondly, von Kupffer's observations show that mouth and nasal canal are both differ-

* Morph. Jahrb., xxviii. (1900) pp. 179–251 (7 pls. and 44 figs.).
† Zool. Jahrb. (Abt. Syst.), xiii. (1900) pp. 287–98 (2 pls. and 4 figs.).
‡ Arch. Naturgesch., lxvi. (1900) pp. 321–46 (2 pls.).
§ Morph. Jahrb., xxviii. (1900) pp. 478–82.

entiated from a primitive cavity. Fürbringer is of opinion that the position of Myxinoids, and their relation to the lampreys and the other Craniota, would be best expressed by a classification based on the number of semicircular canals, but as yet is hardly prepared to formulate a new classification.

Position of Palæospondylus.—Dr. Bashford Dean * discusses the literature of *Palæospondylus* and its discrepancies, the known and questionable structures of the fossil, its developmental characters, and views as to its probable kinships. He leads up to conclusions as to the affinities and systematic position of the fossil and the arrangement of lower Vertebrates.

He thinks that the single feature in *Palæospondylus* which forcibly suggests a Marsipobranch, is the anterior "unpaired narial opening" with its surrounding "cirri." But it is not certain that the opening is narial.

Bashford Dean tabulates the evidence showing that the animal undergoes a striking change in the form of its body and head, as it increases in size. "From the condition in the earliest specimen the head decreases steadily in size (both length and width) in proportion as the length of the vertebral column increases. Thus the head, from measuring in the earliest stage about fifty per cent. of the entire length of the animal, becomes reduced to but fifteen per cent. of this length in the largest specimen—a result which becomes convincing in view of the transitional stages measured. The post-occipital plates are found to decrease in size as the length of the animal increases; their absence in the largest specimen, however, by no means proves that these structures have been normally lost, although it is remarkable that they have not been preserved in a specimen whose anterior vertebral column is so perfectly preserved as in the present case. The modification in the vertebral column is a very striking one. From the earliest condition the column decreases in relative thickness until the individual measures 24 mm. or thereabouts in length. In the largest specimen, however, its proportionate thickness is half again as great as in the specimen of 24 mm." The author thinks it fair to conclude that *Palæospondylus* can hardly be looked upon as having attained its definite form, and that it is a larval form, perhaps of an Arthrodire, e.g. *Coccosteus*.

Mr. J. Graham Kerr † points out some resemblances between this form and a young Dipnoan, as suggested by a study of the *Lepidosiren* larva. The post-occipital plates of the former suggest the so-called cranial ribs of the latter, and some resemblances between the skull of *Ceratodus* and that of *Palæospondylus* are also indicated. It is to be noted that Dipnoans were abundant about the times in which *Palæospondylus* lived. A point apparently against the Dipnoan nature of *Palæospondylus* lies in the highly developed vertebræ, but this objection tells equally against its being a Cyclostome. But if the tubular centra are really, as Dr. Traquair suggests, formed in the sheath of the notochord, it is interesting to note that the Dipnoi are potentially chordo-centrous, and the Cyclostomes essentially arco-centrous.

* Mem. New York Acad. Sci., ii. (1899) pp. 1–31 (1 pl.).
† Proc. Cambridge Phil. Soc., x. (1900) pp. 298–9.

INVERTEBRATA.

Notes on the Fauna of the Caspian Sea.* — Dr. Einar Lönnberg has had opportunity to collect and dredge in the northern part of the Caspian Sea and at Baku. He gives some account of the temperatures and bottom materials at various stations, and a list of the Invertebrates collected, e.g. the light coloured *Astacus leptodactylus*, the abundant *Metamysis strauchi*, *Gmelina pusilla* and *Gammarus andrussovi* (both hitherto known from one specimen), *Cardiophilus baeri*, *Micromelania spica*, *Amphicteis invalida*, and the remarkable leech *Archæobdella esmonti*.

Of forms which are regarded as relicts from a former connection with the Arctic Sea, he found only *Cardium edule*. Although the water had (in April and May) a relatively high temperature (13°–16° C.), the plankton was very sparse. Thus there were no fully developed plankton Crustacea. One diatom and perhaps a dinoflagellate represented the endemic plankton forms.

Mollusca.

α. Cephalopoda.

Development of Cephalopoda.†—Victor Faussek publishes a German translation of his work on the development of Cephalopoda which appeared in Russian in 1897, together with an additional article on the cœlom question. The material for the research was chiefly furnished by species of *Loligo*, notably *L. vulgaris*, and the aim was to complete the observations of Bobretzky by the use of modern technical methods. As to the origin of the embryonic layers, the author finds that the endoderm is represented by the "blastocones" which are the homologues of the macromeres of other Molluscs, while the mesoderm arises from the ectoderm. The endoderm is entirely converted into the "envelope of the yolk-organ" (= perivitelline membrane of Vialleton) which is purely an embryonic organ, so that no one of the permanent organs or tissues is of endodermic origin. The mesenteron with all its derivatives arises from the mesoderm, and generally the whole of the adult *Loligo* is formed from mesoderm and ectoderm, the great development of yolk producing total degeneration of the endoderm. The author quotes numerous observations of other authors in various groups of Invertebrates, to show that this is not a phenomenon *sui generis*, but has its analogues elsewhere. It can be brought into line with current embryological teaching by regarding the mesodermic cells which produce the mid-gut as *regenerated* endoderm, for the younger the embryo the greater the regenerative capacity of its elements.

In regard to the cœlom, the author considers that the view of Hatschek and Ed. Meyer, that it is to be regarded as having originated from the cavity of the gonads in Turbellaria, finds no support in the embryology of either Mollusca or Arthropoda. He believes that the cœlom of the higher Metazoa is, especially in embryonic life, of great importance in excretion, and that it was primitively an excretory organ, to be homologised with the excretory system of Platodes and Nemertines.

* Ofversigt k. Vetensk. Akad. Förhandl., lvii. (1900) pp. 13–29.
† MT. Zool. Stat. Neapel, xiv. (1900) pp. 83–237 (5 pls. and 11 figs.).

So far the original paper:—in the new appendix the author endeavours to show that the excretory organs of Vertebrates and Invertebrates have developed along parallel lines, and fall into the following scheme:—(1) The decentralised method, exemplified best in Platodes where there is neither blood-circulation nor body-cavity, and excretion is effected by canalisation of the organism. To this group, where the excretory organs are protonephridia, belong also Endoproctous Bryozoa, Rotatoria, and Annelid and Molluscan larvæ. (2) Organisms with a circulatory system and a space or spaces in which excretory products accumulate, have metanephridia, or open tubes communicating on the one hand with the exterior, and the other with the cœlom. Such are Annelids, Molluscs, and the embryos of Vertebrates. (3) Finally the nephridial tubes themselves take part in the excretory process, and as their walls become specialised and vascularised, the cœlom loses its excretory significance and diminishes in importance, though portions of it may become shut off with the nephridia. Suggested in Annelids and Molluscs, this is most distinct in Arthropods and Vertebrates, though accomplished according to different plans in the two groups. This scheme is not supposed to have phylogenetic value, the author believing that cœlom and nephridia may have originated independently in the different groups of the Metazoa.

γ. Gastropoda.

Pacific Opisthobranchs.*—Dr. R. Bergh gives an account of the collection made by Prof. Schauinsland (1896–7), including *Pleurobranchæa novæ-zelandiæ*, *Pleurobranchus aurantiacus*, *Chelidonura hirundinina* (A. and G.) var. *elegans* Bgh. sp. n.?, *Archidoris nyctea* sp. n., *Æolidiella drusilla* sp. n., *Æo. faustina* sp. n., and *Samla annuligera* g. et sp. n.

The last-named has the elongated lank form of all the Flabellinids, beautiful perfoliate rhinophoria, a rounded anterior margin to the foot, a triseriate radula, with a denticulate anterior margin to the lateral teeth, and an unarmed penis.

Arthropoda.

α. Insecta.

Development of Hydrophilus.†—Paul Deegener has investigated the development of the mouth appendages and of the alimentary canal in this form, the former especially with the view of determining the accuracy of Meinert's views as to the differences between the appendages of Coleoptera, Neuroptera, Hymenoptera, and Lepidoptera on the one hand, and those of the Orthoptera on the other. He finds that the sequence of the appendages in Coleoptera is identical with that in Orthoptera, and that the labrum is completely homologous in the two orders. The labrum in Coleoptera is not an appendage belonging to an intercalary segment, as Meinert supposed. In regard to the origin of the epithelium of the mid-gut, he finds that it arises from two anterior and two posterior ventro-lateral ectodermal lamellæ, which grow out from fore- and hind-gut respectively, and, meeting in the mid-ventral and mid-dorsal lines, constitute the mid-gut. The mid-gut is re-formed

* Zool. Jahrb. (Abth. Syst.), xiii. (1900) pp. 207–46 (3 pls.).
† Zeitschr. wiss. Zool., lxviii. (1900) pp. 113–68 (3 pls.).

during the metamorphosis by "regeneration-crypts," which are formed during embryonic life, and in the larva take on a characteristic flask shape. The author is not able to throw any new light on the question of the origin of the musculature of the gut of the imago.

Fungus-collecting Ants.* — Prof. G. v. Lagerheim has studied the habits of *Lasius fuliginosus* Latr. which occurs in Sweden and cultivates *Septosporium myrmecophilum.* The point of interest is that the motive appears to be different from that in the other known cases, for there is little evidence that the fungus is used to any extent as food. The ants build their nests usually of rotten wood, at times also of particles of earth, sand, &c. The particles are fastened together by means of a secretion, but the walls so formed are also interpenetrated by fungoid hyphæ, which ramify through their substance and appear to give stability to the whole. In addition to these "intramural" hyphæ, the fungus also appears as a down-like coating on the surface of the wall. The evidence as to intention on the part of the ants is based on the fact that the fungus occurs as a pure culture, unmixed with other genera, and that it always occurs in the nests. The purpose would appear to be to give stability to the walls, but this applies only to the intramural hyphæ; the object of the extramural coating may be to serve to some extent as food, perhaps it also roughens the walls and so affords the ants foothold. The fungus must depend for food chiefly upon the mortar-like secretion by means of which the particles of the walls are fastened together.

Life-history of Plant-lice.†—R. Thiele notes that in July Aphides sometimes appear suddenly on trees previously free from them, a fact which he explains in the following way. In June, or the beginning of July, in the colonies of wingless forms winged females may appear, which on perfectly calm days may be seen in the air as white specks. These produce viviparously fifteen to twenty females which are fertilised when born, and are capable of giving rise to new colonies. These fertilised females are furnished with a suctorial proboscis.

Parthenogenetic Origin of Drones.‡—Wilhelm Paulcke has re-investigated this much debated question. He has examined newly deposited eggs from worker-cells and from drone-cells, and also the eggs laid by workers (substitute-queens) in *Apis mellifica.* In 800 drone eggs he found what appeared to be a sperm nucleus in three cases only, and never found the characteristic sperm radii which regularly occurred in the worker eggs. In the eggs laid by workers there was neither sperm nor sperm radii. In the drone eggs he found four chromatin groups; of these two seem to be the result of the division of the first polar body, one represents the second polar body, the fourth is the egg nucleus. The results therefore generally confirm those of Blochmann. A more detailed account of the research is promised.

"Cuckoo-spit." §—Max Gruner has investigated the function, origin, and composition of the frothy secretion with which the larvæ of *Aphrophora* and *Philænus* invest themselves. Experiments convinced him

* Ent. Tidskrift, 1900, 13 pp. See also Bot. Centralbl., lxxxii. (1900) pp. 334–6.
† Zeitschr. Pflanzenkrank., ix. (1899) pp. 260–2 (1 pl.). See also Bot. Centralbl., lxxxii. (1900) pp. 345–6.
‡ Anat. Anzeig., xvi. (1899) pp. 474–6 (2 figs.).
§ Zool. Anzeig., xxiii. (1900) pp. 431–6.

that its function is to protect the larvæ from ants and other enemies. It is formed by the mingling of the fluid contents of the gut as they leave the anus with bubbles of air from the last pair of stigmata. Breathing appears to be carried on by the protrusion of the posterior end of the abdomen from the froth, and the last pair of stigmata appear also to be covered with a fatty substance which perhaps prevents the foam from adhering to them. The secretion is slightly alkaline; it appears to consist of the sap of the food-plants after passing through the body, together with secretion from the salivary glands, as is shown by the presence of a trace of ptyalin.

Mosquitos and Malaria.*—Dr. J. W. W. Stephens and Mr. S. R. Christophers have investigated the distribution, habits, and breeding places of *Anopheles* in Sierra Leone, in relation to the distribution of malaria. They find that rock-pools, drains, and streams in Freetown contain larvæ at all seasons. Such larvæ originate from parent *Anopheles* found even during the dry season in dirty overcrowded houses and among vegetation and refuse. Native houses, especially when crowded and dirty, swarm with *Anopheles*, and form everywhere dangerous sources of malarial infection. The immunity of natives from malaria is not absolute, and natives attract mosquitos much more strongly than Europeans. In the prevention of malaria, the important points are to prevent the formation of stagnant pools by careful drainage, to exercise strict personal precautions, and to destroy rank vegetation and dirty huts. The source of greatest danger to travellers is the proximity of huts in which native servants sleep.

Alimentary Tract in Brachytrupes achatinus.†—L. Bordas shows once again that there is great diversity in the alimentary tract in Orthoptera; for the details in the species named above differ from those of *Br. membranaceus*, which the author has also studied. It is interesting to notice that the alimentary canal in *Br. achatinus* is more than twelve times the length of the animal. Two facts are especially noteworthy:—(1) The gizzard is provided with a strong internal chitinous armature of six rows of pointed teeth ("a masticatory apparatus of the first order, surpassing in efficiency that of all the other Orthoptera," or, rather, that of all those carefully investigated). (2) The Malpighian tubes open into a tubular bifid receptacle or bladder, which leads, by an unpaired excretory duct or ureter, into the anterior portion of the hind-gut. Histological details are summarised.

Parental Care in a Beetle.‡—Dr. J. E. V. Boas gives an interesting account of the way in which *Saperda populnea* operates upon the sound bark of *Salix viminalis* and *Populus tremula*, so that pathological conditions are induced which afford sappy food for the young larvæ.

Plumules of Lycæna.§—Dr. F. Koehler notes that the structures called "plumules," "battledoor scales," or *Duftschuppen*, which occur as secondary sexual characters in various Lepidoptera, have always aroused much interest since their discovery in 1825, but that the question

* Roy. Soc. Lond. Reports to Malaria Committee, 1899–1900, pp. 42–75 (3 maps).
† Comptes Rendus, cxxxi. (1900) pp. 66–9.
‡ Zool. Jahrb. (Abt. Syst.), xiii. (1900) pp. 247–58 (1 pl. and 6 figs.).
§ Tom. cit., pp. 105–24 (3 pls. and 6 figs.).

of their phylogenetic origin has not been adequately treated hitherto. He has investigated the scales in 110 different species of the genus *Lycæna*. His careful comparison of these shows, in the first place, that the scales are progressive and not degenerating structures, a conclusion directly opposite to that put forward by Kennel, who regards them as disappearing organs. Further, the author believes that the evidence shows that in the genus they have been independently acquired by the species in which they occur, and that they are modifications of primitive long hair-like scales. As to function, the author agrees with Fritz Müller and Weismann in regarding the scales as true "scent-scales," exhaling the characteristic odour which is probably a means of sexual attraction.

Blepharocera capitata Loew.* — Mr. Vernon L. Kellogg has been able to make some observations on the structure and life-history of this member of the Nematocera. The eggs have not been found, but larvæ and pupæ occur in swift-running streams near Ithaca, New York. The larvæ have ventral suckers, by which they cling to the rock-bottom, and are social, forming patches numbering at times several hundred individuals. The pupæ are submerged, and the emergence of the imago takes place under water. In the imago the mouth shows an extremely generalised structure, and the eyes are peculiar in being divided into two parts, one part with large and one with small facets. Too little is known of the habits of the adults to determine the exact function of these divided eyes, but the fact that they are present in both sexes is of interest.

New Maritime Fly.†—Mr. Vernon L. Kellogg obtained in 1898 a large number of small flies from the surface of tidal pools near Monterey, California, but has not since been successful in finding the form, either as larvæ or imagines, during subsequent visits, so that the life-history remains unknown. The animal is described as *Eretmoptera browni* g. et sp. n., and is apparently not referable to any existing family, although allied to the simpler families of Nematocera. The special peculiarities are the reduction of the wings in both sexes to narrow somewhat thickened strap-shaped structures, and the condition of the halteres, which are not of the usual shape, but rather present the appearance of simple rudimentary wings. The antennæ are six-jointed in the male, four-jointed in the female; the *empodium* is "curving, filiform, and pectinate for its whole length."

Sperm Destruction in Hemiptera.‡—Herr A. Handlirsch discusses the interesting discovery made by Berlese § that in the tree-bug, *Graphosoma lineatum*, the spermotheca consists of two parts, one storing the spermatozoa necessary for fertilisation, the other receiving the superfluous spermatozoa and the secretions of the accessory male glands. By the secretions the superfluous spermatozoa seem to be destroyed, and the products are probably absorbed by the organism. In the bed-bug (*Cimex lectularius*) the same occurs, but it is interesting to notice that the organ

* Entomol. News, xi. (1900) pp. 305–18 (5 figs.).
† Biolog. Bull., i. (1900) pp. 81–7 (3 figs.).
‡ Verh. Zool. Bot. Ges. Wien, l. (1900) pp. 105–12 (3 figs.).
§ Rev. Patol. Vegetal., vi. (1898) pp. 353–68 (3 pls.); vii. (1899) pp. 1–18 (3 pls.).

in which the destruction takes place is not like that in *Graphosoma*, either structurally or developmentally.

Collembola from Caves.*—Prof. K. Absolon finds that the Poduridæ are well represented in the caves of Moravia. In addition to forms known from other regions, there are certain peculiar cave forms, of which two are described as constituting new genera. In the one—*Schäfferia emucronata* g. et sp. n.—the ocelli are six in number; there is a remarkable postantennal organ, and the springing organs are short and degenerate. The other—*Mesachorutes 4-ocellatus* g. et sp. n.—appears to be intermediate in character between the genera *Schötella* and *Achorutes*.

Arctic Collembola.†—Einar Wahlgren, in the course of a description of the Collembola of the Swedish Expedition of 1899, makes some remarks on the distribution of northern forms. Previously two species only were known from Jan Mayen, but the Swedish collection includes thirteen species, in spite of the brevity of the time at the disposal of the collectors. On the other hand, although there have been many expeditions to Spitzbergen, only sixteen species have been described from it, and only eight from Beeren Island, in spite of careful search. All the Jan Mayen forms belong to the so-called lower Collembola (Aphoruridæ, Poduridæ, and Isotomidæ), but the author believes that this is largely accounted for by the fact that it is less easy for the higher forms (Smithuridæ, Tomocerinæ, and Entomobryinæ) to cross the polar seas, and is not due to the incapacity of these forms to tolerate low temperatures. Of the thirteen Jan Mayen forms, eight are white in colour, perhaps because the concealed habitat of white forms enables them to withstand the cold more readily.

New Collembola.‡—Prof. Karl Absolon describes as *Typhlopodura longicornis* g. et sp. n., an interesting cave form found in Herzegovina, and remarkable for its large size, long antennæ, and glistening silvery colour. The length of the antennæ is due to the great size of the fourth segment, which is larger than all the others put together. Another form from the same district is *Verhoeffiella cavicola* subgen. et sp. n., which is apparently allied to *Heteromurus margaritarius* Wkl.

Structure and Development of Collembola.§—S. Prowazek has obtained abundant material of *Isotoma grisea* Lubb., and has been able to make a series of observations on its development. The egg is surrounded by a very resistant coat, the chorion of authors, and is yellowish-green in colour; polar bodies were not clearly made out. The segmentation is interesting and apparently primitive; it is total and subequal, but later passes into the superficial type. As this change progresses a thin membrane, the cuticula blastodermatica, appears between embryo and chorion, and forms a protective investment. This is to be regarded as an embryonic ecdysis, and is an adaptive peculiarity. The so-called dorsal organ makes its appearance very early, and the author is disposed to regard it as the last remnant of the ordinary

* Zool. Anzeig., xxiii. (1900) pp. 265–9 (4 figs.).
† Öfvers. k. Vetensk. Akad. Förhandl., lvii. (1900) pp. 353–75.
‡ Zool. Anzeig., xxiii. (1900) pp. 427–31 (2 figs.).
§ Arbeit. Zool. Inst. Wien, xii. (1900) pp. 335–70 (2 pls.).

embryonic investment. The antennæ are primitively postoral, and at first consist of three segments; after the rudiments of the limbs have appeared, a second embryonic ecdysis occurs. The development of the different organs and the habits of the adults are described in some detail. The interesting ecdysis of the mid-gut was studied with great care; the author regards it as a forecast of the complicated changes which occur during the metamorphosis in the Holometabola. As a whole it may be said that the development, like the anatomy of larva and adult, displays an extraordinary mingling of primitive and adaptive characters.

β. Myriopoda.

The Ascospermophora.* — Dr. Carl Verhoeff, in the course of his researches on Palæarctic Myriopods, has come to this sub-order, whose structure, phylogeny, and classification are fully discussed in the present paper. The sub-order is held to consist of two families, the Chordeumidæ and the Craspedosomidæ, each containing sub-families of which full definitions are given. The paper includes descriptions of two new genera and a number of new species.

Coloration of Glomeridæ.—Dr. Carl Graf Attems † draws attention to the fact that in the genus *Glomeris* there is much variety of colouring, combined with much structural constancy. The differences in coloration show a certain regularity which makes it possible to indicate the course of colour evolution. In *Glomeris conspersa* black spots are present on the light ground-colour. In others the spots coalesce to form longitudinal stripes, separated by pale bands. The dark bands are four in number, and show a gradual increase in breadth combined with a gradual diminution of the pale ground-colour, which takes place after a different fashion in the different species and sub-species. The author arranges the species according to the colour scheme which they display.

In an independent paper on the Glomeridæ, Dr. Carl Verhoeff ‡ discusses the same phenomenon along similar lines, and draws up the following list of the stages in colour evolution in the family. In subterranean forms pigment is absent, in others the colouring is uniformly pale, this pale ground-colour becomes flecked by dark spots arranged in a median line; regular longitudinal bands of dark colour then make their appearance, and increase so that the primary pale colour is confined to longitudinal rows of spots; these longitudinal rows become transverse bands, which later diminish or disappear. In the case of the forms displaying the more specialised forms of colouring, the young stages may resemble more primitive forms, and display recapitulation in development. The author believes that in other Diplopoda the same colour evolution is discernible, and regards black as being always a specialised colour in the group, red, brown, and yellow as primitive tints.

Diplopoda of Siebenbürgen.§—Dr. Carl Verhoeff has continued his previous observations on this fauna. He classifies the forms found in

* Arch. Naturgesch., lxvi. (1900) pp. 347–402 (4 pls.). Cf. this Journal, *ante*, p. 322.

† Arch. Naturgesch., lxvi. (1900) pp. 297–320 (2 pls.).

‡ Tom. cit., pp. 403–13.

§ Tom. cit., pp. 205–30. Cf. this Journal, 1897, pp. 202, 379.

the first place in biological groups according to the habitat, as Alpine forms, plain forms, &c., and also groups them in sub-regions according to the distribution, with notes as to locality, &c. The district proves to be very rich in Diplopoda.

δ. Arachnida.

Mange in Animals.*—Dr. B. Galli-Valerio and P. Narbel discuss *Sarcoptes mutans* from the feet of fowls, *S. lævis* var. *gallinæ* which causes the feathers to fall off, *S. minor* var. *cuniculi* from the rabbit, *Psoroptes communis* var. *cuniculi* from the rabbit's ear, *S. scabiei* var. *furonis* from the ferret, *S. minor* from the cat, *Psorergatus simplex* from the field-mouse, and *Myocoptes musculinus* (?) from the mouse.

New Linguatulid.†—Prof. H. B. Ward has some notes on *Reighardia* g. n., found in 1894 in the air-sacs of Bonaparte's Gull, and in 1898 in the common tern. One of the three vermiform parasites contained well-developed embryos with the characteristic hooks. The body was elongated, cylindrical, transparent, devoid of annulations, with thin cuticle, and round the mouth-opening was a chitinous framework recalling that of the Sarcoptidæ.

ε. Crustacea.

Schizopods from Irish Waters.‡—Messrs. E. W. L. Holt and W. J. Beaumont report on the Irish members of this group, especially on the collection made in the 1890–1 survey of fishing-grounds on the west coast of Ireland. They compare their results with what is known of British Schizopods generally, but the points of difference are not striking. They are able to add two species to the British list, viz. *Parerythrops obesa* G. O. Sars, and *Mysidella typica* G. O. Sars.

African Ostracods.§ — Herr G. W. Müller describes from Massai Nyeke *Eurycypris neumanni* sp. n., *Cypris bicornis* sp. n,, and *Stenocypris cultrata* sp. n.

Distribution of Atlantic Copepoda.‖—P. T. Cleve gives tables of the distribution of the Copepoda as shown by observations conducted in the years 1898–99, noting the mean temperature and salinity, and the northern and southern limits. The wide distribution of *Acartia bifilosa* is interesting, no distinction being observed in specimens from the mouth of the Congo and from the Baltic.

Notes on Copepoda.¶ — Dr. W. Giesbrecht gives a list of the littoral species of Copepoda found in the Gulf of Naples, with descriptions of the species of *Pterinopsyllus*, *Cyclopina*, and *Euryte*, and an account of the synonymy. He also notes the occurrence of a single male specimen of *Cervinia bradyi* Norman in the Gulf of Naples; hitherto the species has been described from British coasts only. The paper further contains an account of *Enterognathus comatulæ*, a new intestinal parasite found in the alimentary canal of *Antedon rosaceus*. The new form certainly belongs to the Ascidicolidæ, in spite of the novel host. It differs from

* Bull. Soc. Vaudoise, xxxvi. (1900) pp. 198–202.
† Proc. Amer. Ass. Adv. Sci., 48th Meeting, 1899, p. 254.
‡ Sci. Trans. R. Dublin Soc., vii. (1900) pp. 221–51 (1 pl. and 9 figs.).
§ Zool. Jahrb. (Abt. Syst.), xiii. (1900) pp. 259–68 (3 pls.).
‖ Öfvers. k. Vetensk. Ak. Förhandl., lvii. (1900) pp. 139–44.
¶ MT. Zool. Stat. Neapel, xiv. (1900) pp. 39–82 (4 pls.).

the other members of the family in that both sexes undergo development within the gut of the host, the male not becoming free until maturity. The author is of opinion that *Enterognathus* must have originated, not from a free-swimming form, but from a degenerate ascidicolous type. The post-embryonic life of the male may be divided into three stages: (1) the free-swimming Copepodid stage; (2) the later entozoic Copepodid stage; (3) the free-swimming ripe stage when the organs of nutrition are aborted. The way in which copulation occurs was not observed, but the author regards it as probable that the female becomes temporarily external, and is fertilised perhaps on the anal tube of the host.

Life-History of Sacculina.*—Prof. Yves Delage notes that his classical account on this subject has been recently disputed as regards two points: first, the presence of a truly endoparasitic stage, as contrasted with the pseudo-endoparasitism of some other Crustacean parasites; and second, the remarkable process of inoculation, which has been questioned on the ground that it was observed only in captive, and therefore possibly abnormal specimens. Delage is enabled to confirm his previous account as to the endoparasitism, by means of Schimkevitsh's observations on the nearly allied *Peltogaster*, which closely agree with the earlier statements of Delage. As to the second point, Delage obtained at Roscoff a young crab with a *Sacculina* in the kentrogonous Cyprid stage on one of the legs, and has been enabled to rear the crab in captivity until the time of the appearance of the adult *Sacculina* on the tail, thus affording ample confirmation of his previous conclusions.

Notes on Crustaceans.†—Prof. G. S. Brady gives a list of littoral forms collected at Alnmouth, e. g. *Paratylus uncinatus*, *Apherusa borealis*, *Siriella norvegica*, and *S. armata*. Some new forms are described:—*Cyclops salinus*, *Stenhelia limicola*, and *Cyclopicera berniciensis*. The author notes that *Acartia clausii* is infested with what is probably an immature fluke, of which the dab, for instance, may be the final host.

A new description is given of *Ilyopsyllus coriaceus*, notable for its bright red colour, eel-like movements, and peculiar mouth-parts. The almost obsolete mandibles, and the reduction of all the other mouth-apparatus—maxillæ and maxillipedes—to a few very minute filaments or setæ, preclude its coming into line with any of the three divisions established by Thorell. The author therefore proposes, for the reception of *Ilyopsyllus*, a new section under the name Leptostomata. The divisions of Copepoda, based upon the structure of the mouth organs, would then stand as follows:—Gnathostomata, Pœcilostomata, Leptostomata, and Siphonostomata.

Annulata.

Terricola of Columbia.‡ — Dr. W. Michaelsen describes a collection of worms made by Prof. Otto Bürger in Columbia. The collection consists of two main groups of worms: (1) the purely endemic forms; (2) introduced forms. In regard to the first group, it would appear from the nature of its members that the Terricola of Columbia are an offshoot of the Terricola of the West Indies and of tropical South

* Bull. Soc. Zool. France, xxv. (1900) pp. 72–3.

† Nat. Hist. Trans. Northumberland, Durham, and Newcastle-upon-Tyne, xiii. (1900) pp. 429–41 (3 pls.)

‡ Arch. Naturges., lxvi. (1900) pp. 230–66 (1 fig.).

America, but possess well marked characters of their own. There is little trace of affinity with the Terricola fauna of Eastern South America, and the slight development of the species of *Geoscolex* and *Fimoscolex* without sperm-pockets, as well as of species of *Anteus* with less than seven pairs of chyle-pockets, affords a marked contrast with the Eastern fauna, in which such species are dominant. The absence of Megascolecidæ is also remarkable, for the family Acanthodrilinæ to which they belong is numerously represented both to the north and the south of the area. The introduced forms fall into two groups: European species, e.g. *Allolobophora fœtida*; and tropical forms, e.g. *Amyntas* (?) *indicus* (Horst) and *Benhamia affinis* Mchlsn. The occurrence of the latter East African species the author regards as a confirmation of his view that all the species of *Benhamia* found outside Africa have been introduced into the localities in which they are found; and that the genus originated in Africa.

North American Oligochætes.* — Mr. Frank Smith describes as *Premnodrilus palustris* g. et sp. n. a new form found in Florida. The new form appears to be allied to *Eclipidrilus* and *Mesoporodrilus*; and as these latter genera are represented by only one species each, the author suggests that it may be found necessary to unite the three forms in one genus, though he is not as yet prepared to do this. The most notable point of resemblance is the presence of sperm-reservoirs in all three; the differences are chiefly in regard to the number and position of the nephridia and the characters of the reproductive organs. Of the three, *Mesoporodrilus* and *Premnodrilus* are most closely related. The distribution is interesting, in that *Eclipidrilus* has only been found in California, *Mesoporodrilus* in Illinois, and the new genus in Florida; but the anomaly is doubtless to be explained as the result of the imperfect investigation of the intervening areas. Apart from the three genera named, the Lumbriculidæ are represented in North America by two species of *Sutroa* and one of *Thinodrilus*. Of these, *Thinodrilus* appears to be related to *Lumbriculus*, while *Sutroa* seems to connect the group formed by *Eclipidrilus*, *Mesoporodrilus*, and *Premnodrilus* to the European genus *Rhynchelmis*.

Maclovia iricolor (Montagu).† — Dr. Arthur Willey has a useful note on the synonymy of this species, one of the longest Chætopods of Plymouth Sound, and also gives a brief diagnosis. Part of the confusion has arisen from the fact that *Maclovia* cohabits with a *Lumbriconereis* (probably *L. latreilli*), which though smaller has a strong superficial resemblance to it, and has been often confused with it.

Variation in Number of Genital Pouches in Thalassema neptuni.‡ — Mr. F. H. Stewart describes a case of five instead of four genital pouches. An unpaired pouch seemed to be interpolated between the two normal pairs. "If this be granted, it would have to be assumed either that a segment which does not normally bear pouches intervenes between the two which normally do, or that a partial duplication of the nephridia of

* Bull. Illinois Lab. Nat. Hist., v. (1900) pp. 459–78 (1 pl.).
† Journ. Mar. Biol. Ass., vi. (1900) pp. 98–100.
‡ Ann. Nat. Hist., vi. (1900) pp. 218–9.

one segment has occurred—a phenomenon which we find in its complete form in the family of Capitellidæ."

New Leech.* — Mr. J. Percy Moore describes as *Microbdella biannulata* g. et sp. n., a leech obtained in North Carolina, U.S.A., on the salamander, *Desmognathus nigra*. The leech is specially interesting on account of the structure of the somites, which consist of two annuli only. The new form belongs to the Glossiphonidæ, but is apparently the smallest species of the family yet described, being only 4–5 mm. in length in the half-expanded condition. The special interest is the light it appears to shed on the difficult problems connected with the segmentation of leeches. Nineteen segments are clearly indicated externally; they are biannulate except in the extreme anterior and extreme posterior regions, and correspond to well-developed internal partitions, as well as to the arrangement of the segmentally repeated internal organs. If this leech is to be regarded as a primitive form, then Whitman's views as to the typical number of annuli in a leech somite, and the relation of the nerves to the annuli, must undergo considerable modfication. The author discusses the point in some detail, and concludes that the triannulate condition has been derived from the biannulate. Therefore the fact that in leeches in general the anterior and posterior somites have fewer annuli than the median, shows that these segments are "type somites," rather than "abbreviated somites" as they are regarded by Whitman.

Cocoon of Piscicola and Herpobdella.†—E. Brumpt has made many observations on copulation and oviposition in *Piscicola geometra*, *Herpobdella atomaria*, and *H. vulgaris*. In the first the egg-laying occurs in March and April on aquatic plants, stones, &c. The leech presses the secretion of the turgescent clitellum against the object, it waits till adhesion has occurred, and then creeps backwards out of the annular cocoon. But the movements, which last for about 5 minutes, are such that an invagination of the cocoon is effected, and this seems to be of importance for the securing the purity and preservation of the contents.

In *Herpobdella* the oviposition lasts about 20–25 minutes; the clitellum having been fixed, the leech rolls round and round, liberates a number of eggs and some liquid into the cocoon, and slowly disengages itself. There is the same invagination of the cocoon, the leech solving the problem of creeping through an albuminous mass without introducing any impurities into its interior!

Neuroglia in Invertebrates.‡—Dr. H. Joseph, in a brief note upon Müller's § recent paper on the neuroglia of Chordata, states that he has made a somewhat similar series of preparations of the neuroglia of Invertebrates, especially worms, and finds that conditions practically identical with those described by Müller for Vertebrates also occur there. That is, he finds that the neuroglia has a fibrillar structure, and the fibrillæ are to be regarded as differentiated cell-prolongations. Glia fibrillæ not in connection with cells probably do not exist. Generally it

* Proc. Acad. Nat. Sci. Philadelphia, 1900, pp. 50–73 (1 pl.).
† Bull. Soc. Zool. France, xxv. (1900) pp. 47–51 (4 figs.). Cf. this Journal, *ante*, p. 327.
‡ Anat. Anzeig., xvii. (1900) pp. 354–7.
§ Cf. this Journal, *ante*, p. 22.

may be said that the neuroglia in Vertebrates and Invertebrates has the same minute histological structure. There is also much to be said for the position that the fibrillæ of the neuroglia are comparable to the fibrillar modification of the protoplasm of other cells, e.g. of epidermal cells.

Platyhelminthes.

Exotic Ectoparasitic Trematodes.*—Prof. S. Goto has notes on a number of interesting forms, e. g. *Phyllonella hippoglossi* O. F. Müller (= *Epibdella hippoglossi* of P. J. van Beneden and Monticelli); *Epibdella sciænæ* P. J. van Beneden; several new species of *Microcotyle* and *Acanthocotyle*, *Dionchus agassizi* g. et sp. n. from the gill of *Remora brachyptera*. This new genus seems to combine several of the characters of the Gyrodactylidæ and the Monocotylidæ. The diagnosis runs:—Body flat and elongated; with a single posterior sucker, the inner surface of which is divided by radial ridges into ten areas, with one pair of chitinous hooks; mouth at a short distance from the front end; intestine bifurcated, simple; with four eye-spots; porus genitalis communis submarginal; testes two, one in front of the other; no vagina.

Avian Cestodes.†—Herr Walter Volz gives a list of the Cestoda found in the Corvidæ and in the diurnal birds of prey, with hosts, localities, synonymy, references, tables for identification, and in the case of the less well known species, anatomical descriptions.

Genera of Bothriocephalidæ.‡—Herr M. Lühe publishes a series of observations on those Bothriocephalidæ which have marginal genital openings. He describes the single form known to be found in reptiles, discusses the general characters of the genital organs of the sub-family, and on the basis of these and the external characters, re-arranges the species afresh into genera. In the genus *Abothrium* are placed *Bothriocephalus rugosus* (Gze.), *B. infundibuliformis* Rud. (= *Tænia crassa* Bloch.), and *B. fragilis* Rud.; in the genus *Ancistrocephalus*, *B. microcephalus* Rud. and *B. imbricatus* (Dies.); in *Fistulicola*, *B. plicatus* Rud.; and in *Triænophorus*, in addition to *T. nodulosus*, two uncertain species *T. robustus* and *T. anguillæ*. All these genera receive new definitions. In connection with the same subject should be noted a brief communication by Dr. V. Ariola § on some points at issue between himself and Lühe in regard to the Bothriocephalidæ.

New Planarian.‖—Dr. R. F. Scharff describes what proves to be a new species of *Rhynchodemus* (*R. Howesi*) which he found in the Pyrenees under a stone near Eaux Chaudes. The worm was 130 mm. long, and therefore twice as long as any species of *Rhynchodemus* hitherto known. It differs from the other known species in that marginal glands are present in the anterior region, but appears to be most nearly related to *R. terrestris*.

Rhabdocœle Turbellaria.¶—Dr. Adolf Dörler finds that the parasitic forms described by Calandruccio as *Hypotrichina tergestina* and

* Journ. Coll. Sci. Univ. Tokyo, xii. (1900) pp. 263–95 (2 pls.).
† Arch. Naturgesch., lxvi. (1900) pp. 115–74 (3 pls. and 4 figs.).
‡ Zeitschr. wiss. Zool., lxviii. (1900) pp. 43–112 (5 pls.).
§ Zool. Anzeig., xxiii. (1900) pp. 417–9.
‖ Journ. Linn. Soc. (Zool.), xxviii. (1900) pp. 33–42 (1 pl. and 2 figs.).
¶ Zeitschr. wiss. Zool., lxviii. (1900) pp. 1–42 (3 pls.).

H. marsiliensis differ so strikingly from the other members of that genus, that it is necessary to place them in the new genus *Genostoma*. The diagnosis of the new genus is as follows:—Cilia confined to the ventral surface, mouth-opening ventral at or near the posterior extremity, ovary and yolk-gland united, male and female ducts opening into the anterior end of the pharyngeal pocket. The genus must be placed in a sub-family (Vorticina parasitica) of the family Vorticida; and to the same sub-family belongs a new form found in the mantle-cavity of *Mytilus edulis*. This form is described as *Urastoma fausseki* g. et sp. n., the generic characters being as follows:—Cilia equally distributed over the whole surface, mouth opening at the posterior end of the body, "yolk"-gland and ovary distinct, male and female ducts opening into the proximal part of the pharyngeal pocket. Another new form was found in the gut of *Phascolosoma vulgare*, and is described as *Collastoma monorchis*, g. et sp. n. In it the pharynx is doliiform, the testes are compact and unpaired, paired ovaries and yolk-glands are present, and there is a large bursa seminalis communicating with the oviduct. The oviduct represents only a part of the atrium genitale. Full descriptions of all these forms are given.

Maturation of Oocyte in Thysanozoon brocchi.*—R. Schockaert has discovered a new structure—"*un organite nouveau*"—in the oocyte of the first order in the Planarian named above. It is a delicate filament, pointed at both ends, and quite distinct from the chromatin-coil. But what gives it particular interest is that the author believes he has succeeded in showing that it gives origin to the centrosome.

Peculiar Northern Nemerteans.†—Prof. Bergendal describes, from the Swedish west coast, *Callinera bürgeri* g. et sp. n., related to the Carmellidæ, but differing widely in external appearance, absence of cerebral organs, structure of brain and gut, and above all, as regards proboscis and rhynchocœlom; and *Gononemertes parasitica* g. et sp. n., found parasitic on *Phallusia*, and showing direct or indirect adaptations to parasitism in the absence of eyes, the weak development of cephalic slits and cerebral organ, and the great development of gonads. The shortness of the posterior proboscis region, the occurrence of an atrium into which proboscis and fore-gut open, and finally, the slight development of the cæcum, are further peculiarities which make the position of *Gononemertes* among the Metanemertines very uncertain.

New Nemertines.‡—Herr E. Isler describes a number of new species of *Amphiporus*, *Eupolia*, *Lineus*, and *Cerebratulus*.

Incertæ Sedis.

Arctic Polyzoa.§—Mr. A. W. Waters has been entrusted with the Polyzoa collected by the Jackson-Harmsworth Expedition in Franz-Josef Land during 1896–97, and publishes descriptions of the Chilostomata, with some notes on distribution. The collection includes 59 species, and of these *Hippothoa hyalina* is cosmopolitan, *Porella concinna*, *Escharoides sarsii*, and *Cribrilina punctata* are only very doubtfully found in

* Anat. Anzeig., xviii. (1900) pp. 30–3 (6 figs.).
† Zool. Anzeig., xxiii. (1900) pp. 313–28 (6 figs.). ‡ Tom. cit., pp. 177–80.
§ Journ. Linn. Soc. (Zool.), xxviii. (1900) pp. 43–105 (6 pls.).

the southern hemisphere, 20 species are common to the British coasts, 5 species only are known also from the Mediterranean. On the whole the Polyzoa do not lend support to Sir John Murray's bipolar hypothesis, and the author considers that a critical survey greatly reduces the number of species supposed to be common to the Arctic and Antarctic, and absent from the intervening areas.

Development of Phoronis.*—Prof. Louis Roule states that a complete account of this development based on his own researches is in the press, and that his results differ from those obtained by Masterman † in some respects. The special point of difference is in regard to the development of the mesoderm, which Masterman states has an enterocœlic origin. The point is of importance, as Masterman found a striking correspondence between Enteropneusta and *Phoronis* in regard to the origin of this layer. Roule's own observations on fresh material confirm Metschnikoff's previous statements that the mesoderm has a mesenchymatous origin. He further holds that, even apart from his own observations, Masterman's figures show that his preparations were not in good condition, and his conclusions not warranted by the evidence at his disposal. While denying the existence of any resemblance between the development of *Phoronis* and that of Enteropneusta, Roule agrees with Masterman in regard to the existence of a rudiment of a notochord in the Actinotrocha.

Echinoderma.

Rearing of Echinoid Larvæ.‡—Prof. E. W. Macbride has, after much experimenting, been able to rear *Echinus* larvæ in numbers through the metamorphosis. His method is detailed, but its general interest is the light which it throws upon the physiology of development. The first condition for a successful experiment is found to be the use of full-sized and perfectly ripe individuals of both sexes as sources of eggs and sperms. Next it was found that water must be obtained from the open sea, not inshore, and must be changed frequently throughout the course of development. The extent of change necessary varies for each season according to the amount of vegetable plankton present, and generally it would appear that the necessity for the frequent changes is due to want of food rather than to deficient oxygen. Finally, an interesting point is that in the most successful cultures only a proportion of the larvæ are sufficiently healthy to survive, and an important part of the method is "to allow natural selection to weed out the weaker," and after the selective process has taken place, to devote attention only to the healthy forms.

Hermaphroditism and Parthenogenesis in Echinoderms.§—C. Viguier makes an important note on this subject. Hermaphroditism is well known in Synaptids; it has also been proved in *Amphiura squamata* and *Asterina gibbosa*. But while the representatives of *Asterina* at Roscoff and Banyuls show a protandrous hermaphroditism, those at Naples do not. Cuénot found at Roscoff an *Asterias glacialis* which was hermaphrodite and capable of self-fertilisation. Viguier notes a similar

* Zool. Anzeig., xxiii. (1900) pp. 425–7. † Cf. this Journal, *ante*, p. 468.
‡ Journ. Mar. Biol. Ass., vi. (1900) pp. 94–7.
§ Comptes Rendus, cxxxi. (1900) pp. 63–6.

state in one specimen of *Sphærechinus granularis*; in these cases the larvæ were slow in developing.

More important, however, is the fact that the eggs of *Arbacia pustulosa*, *Strongylocentrotus lividus*, and *Sphærechinus granularis*, sometimes illustrate parthenogenetic development. This fact, the author says, disqualifies these animals from being used as subjects of experiments like those of Loeb.*

In a later paper,† Viguier indicates that although he has not been able to find out with what percentages, &c., Loeb worked, he finds that magnesium chloride inhibits rather than favours development.

Cœlentera.

Families of Stichodactylinæ.‡—Oskar Carlgren points out that these Actiniaria have hitherto been classified according to external characters only, and in consequence the current classification is artificial. After studying most of the genera, he suggests the following arrangement:—The family Discosomidæ should be taken as including the following genera, *Discosoma*, *Isaura*, *Orinia*, *Ricordea*, *Actinotryx*, and *Rhodactis*, and is defined as including Stichodactylinæ without basilar muscles, without a sphincter, or with only slightly developed sphincter without gullet grooves or ciliated bands, with smooth body-wall without suckers or appendages, and with slightly developed longitudinal muscles in the mesenteries. The stinging-cells are chiefly present in the endoderm, the tip of the tentacles is not globular, and more than one tentacle at times arises from each exocœle. In the new family Stoichactidæ the following genera are included, *Radianthus*, *Helianthopsis*, *Antheopsis*, and *Stoichactis*. The definition of the family is as follows:—Stichodactylinæ with basilar muscles and distinct though not very well developed sphincter, a fossa, gullet-grooves, and ciliated bands, body-wall smooth or with suckers, longitudinal muscles of the mesenteries well developed, stinging-cells chiefly in ectoderm, tentacles unbranched or only partially branched, not placed on special armlike prolongations of the mouth-disc, one tentacle only on each exocœle, no distinction between marginal and disc tentacles. A separate family, the Heteranthidæ, is erected for the genus *Heteranthus*, which differs from the foregoing genera only in the structure and position of the tentacles. Finally the author's observations confirm Andres' view of the close relation between *Aurelania* and *Actinoporus*, which are included in the family Aurelianidæ, defined as follows:—Stichodactylinæ with basilar muscles, a very strong sphincter, a distinct fossa, at least one gullet-groove, and ciliated bands. The body-wall is elongated and without suckers, and the longitudinal muscles of the mesenteries are very strongly developed. The stinging-cells occur chiefly in the ectoderm, and those of the tentacles are almost all thin-walled, and with distinct spiral threads. The tentacle arrangement is various, and there are two or more tentacles on each exocœle.

Cubomedusæ of Jamaica.§ — Dr. E. W. Berger has continued the late Dr. Conant's work on this subject, and publishes a paper on their

* Cf. this Journal, 1899, p. 492. † Comptes Rendus, cxxxi. (1900) pp. 118–21.
‡ Öfvers. k. Vetens. Ak. Förhandl., lvii. (1900) pp. 277–87.
§ Mem. Biol. Lab. Johns Hopkins Univ., iv. (1900) pp. 1–84 (3 pls.).

physiology and histology, in which certain physiological observations of the latter author are included. As to physiology, Berger finds that *Charybdea* is very sensitive to strong light, which, like total darkness, inhibits the pulsations, while moderate light acts as a stimulus. In this respect it resembles a Hydromedusan, but in the temporary paralysis and subsequent recovery after removal of the marginal bodies it resembles a Scyphomedusan. In regard to histology, the most important of the results obtained have reference to the structure of the retina of the eyes of the sensory clubs. The retina of the distal eye contains two kinds of sensory cells (the prism and pyramid cells), and long pigment-cells. The sensory cells contain an axial nerve-fibre which is probably continued into the sub-retinal nerve-tissue. In the proximal eye prism-cells only are present. In the simple eyes which occur in pairs at the sides of the sensory clubs the retina consists of flagellated cells whose flagella are continued into nerve-fibres. In both the simple and the complex eyes the nerve-fibres display a dumb-bell-shaped basal body at their point of entrance, least obvious in the case of the pyramid cells.

Nematophores in Plumularidæ.*—F. v. Pausinger has studied the structure and function of these organs in *Aglaophenia pluma* and *Plumularia halecioides*. He finds that in the former the nematophore is divided at its distal end into an outer portion bearing stinging-cells, the cnidostyle, and an inner freely movable portion, the sarcostyle. An endodermic axis is present in both regions. The sarcostyle is able to spread itself out freely over the colony, and can also put out pseudopodial prolongations. In *Plumularia* no distinction into cnidostyle and sarcostyle can be observed, the whole nematophore contains stinging-cells, and is freely movable, putting out pseudopodia and then retracting these again. Further, under certain conditions the nematophore displays a gastric cavity, which either disappears again or unites with the hydranth. As to morphological significance, the author believes that the nematophore is to be regarded as a reduced individual characterised by the great motility of the ectoderm; he further considers the condition in *Plumularia halecioides* to be the more primitive. In *Plumularia diaphana* he finds that there is a functional distinction into cnidostyle and sarcostyle, but not a morphological one, so that the condition may be regarded as intermediate between that of *Plumularia halecioides* and that of *Aglaophenia pluma*. As to function;—in branches full of vitality this appears to consist chiefly in keeping the colony free from parasites or noxious bodies, a function accomplished by means of the great motility. In degenerating parts of the colony the nematophores appear to assimilate the substance of the dying polype for the benefit of the remainder of the colony, and also close the channel of communication between the exterior and the cœnosarc which would otherwise be left at the death of the polype.

Neocomian Coral from King Charles Land.†—Herr G. Lindström describes *Thecocyathus nathorsti* sp. n., a Turbinolian coral from King Charles Land, situated east of Spitzbergen. No other corals but these were found there. He compares it with the other species, which can

* Arbeit. Zool. Inst. Wien, xii. (1900) pp. 301–34 (3 pls.).

† Öfvers. k. Vetensk. Ak. Förhandl., lvii. (1900) pp. 5–12 (8 figs.).

be followed from *T. mactra* of the Upper Lias to *T. cylindraceus* of present times. "The most remarkable feature in such *Thecocyathi* as *T. mactra* and *nathorsti* is the great change to which they have been subject; at an earlier stage resembling a *Deltocyathus* or *Brachycyathus*, and then assuming the calicular form characteristic of the genus. It may be that this is a phenomenon indicating the ancestry of these corals."

Stinging-cells in Siphonophora.* — Karl Camillo Schneider has made a very detailed study of the origin, development, and phenomena of discharge of these structures. His more important results may be concisely stated as follows:—The stinging-cells or cnidocytes contain a central cnidum and an apical discharge apparatus. The cnidum consists of a capsule or reservoir of poison, and a tube or injection apparatus. By means of the discharge apparatus the cell-operculum springs back, and allows the water to come into contact with the stinging-secretion, which takes up water and swells suddenly. The stinging-secretion is morphologically the most important part of the cells, which are to be regarded as modified gland-cells (Lendenfeld). The cnidocyte has also certain accessory structures which attach it to the epithelial cells. The cnidum has a complicated life-history, which may be studied under the following headings:—(1) A growth period, lasting until the tube is invaginated into the capsule; (2) the invagination period; (3) the preliminary maturation period; (4) the wandering period, during which the organs reach the spot where they are used later; (5) the final maturation period. A resting period then follows, which is closed by the instantaneous discharge of the cells. The structure of the various parts during the different stages, and the mechanism of discharge, are described in much detail.

Development of Aurelia.† — Dr. W. Hein has re-investigated this much-disputed development, and sums up his observations as follows. The blastula is composed of similar cells throughout, and has a central blastocœle. Into this cavity certain cells wander from the blastoderm, and undergo speedy degeneration. Gastrulation occurs by a typical process of invagination, but the blastopore is small, and persists as a fine canal until the formation of the mouth. Rarely certain endoderm-cells wander into the archenteron and there undergo degeneration; but there is no evidence that the cells which wandered earlier into the segmentation cavity take any part in the formation of the endoderm. While the rounded gastrula is gradually becoming transformed into the oval planula, the oral endoderm, by its more rapid division and the small size of the cells, becomes differentiated from the atrial endoderm. After fixation, this mass of proliferating oral cells increases in size, and the prostoma is converted into the definitive mouth; gullet-tube and gastric pockets were not observed. The four primary mouth-tentacles originate simultaneously, soon after the formation of the mouth. At this stage four small interradial ingrowths arise from the upper part of the endoderm, grow like folds into the archenteron, and form the gastric ridges. From the manner of their origin four perradial grooves arise between

* Arbeit. Zool. Inst. Wien, xii. (1900) pp. 133–242 (7 pls.).
† Zeitschr. wiss. Zool., lxvii. (1900) pp. 401–38 (2 pls. and 4 figs.).

the folds, but these are to be regarded as originating merely as a result of the formation of the ridges. Four interradial insinkings of ectoderm arise in the peristome, and give rise to muscle-fibres which lie at either side of the supporting lamellæ of the gastric ridges. Thus, therefore, in regard to the most keenly disputed points, the research confirms the older authors rather than Goette.

Protozoa.

Studies on Protozoa.*—S. Prowazek has continued his observations on this subject, the present paper including discussions on certain general topics. In regard to the reproduction of Rhizopods, a prolonged series of observations on many different forms yielded very few instances of conjugation as distinct from ordinary plastogamy. In consequence the latter phenomenon must be regarded as of great importance in testaceous Rhizopods. In *Euglypha alveolata* at least during the process a fragment of protoplasm is often left in the empty shell, which must be regarded as a reduction phenomenon. In general the reproductive phenomena of the Testacea may be summarised as follows:—Periods of very active division come to a close with a division into an abortive and an active individual. This division is followed by copulation, which has only been occasionally observed, and differs in its details in the different genera. It would appear that at times, especially in autumn, it may be followed by the formation of swarm-spores. Plastogamy is much more frequent than copulation, and has also been seen in the Foraminifera. In regard to the formation of pseudopodia, the author finds that the first movement occurs in the ectoplasm, the endoplasm becoming involved later. At first there is a sharp line of demarcation between the two layers, but later this disappears either suddenly or slowly, the endoplasm appearing to yield something to the ectoplasm. While the plasmic contents of pseudopodia closely resemble those of the ordinary cell-plasm, the cilia and flagella show striking differences from the cell-plasm. The paper includes a discussion of some other physiological characters of the Protozoa, and a description of two new forms.

Reactions of Protozoa.—Mr. Herbert S. Jennings† has had reprinted a lecture delivered at Woods Holl on the reactions of *Paramæcium* and other ciliated Protozoa. The lecture gives a general account of the various experiments made by the author,‡ but it merits special notice as a clear and concise statement of the author's researches, and the conclusions based upon them.

In another paper,§ the same author discusses the points at issue between himself and Mr. W. E. Garrey in regard to the reactions of the Protozoon *Chilomonas* to organic acids, and concludes that the differences are largely differences of nomenclature and of point of view. Thus the phenomenon described by Garrey as chemokinesis, that is the retreat of the organisms from an area containing weak acid, is similar to the motor reflex of *Paramæcium*, due weight being given to the difference in the activity of the organisms. Again, the phenomenon described by

* Arbeit. Zool. Inst. Wien, xii. (1900) pp. 243–300 (2 pls.).
† Biol. Lect. Woods Holl, 1899. Lecture VII., pp. 93–112.
‡ Cf, this Journal, 1899, p. 495.
§ Amer. Journ. Physiol., iii. (1900) pp. 397–403.

Garrey as "true chemotropism" is really due to the non-symmetrical nature of the organism. Generally, Jennings is of opinion that Garrey's results confirm and supplement his own.

Galvanotaxis in Infusorians.*—Boris Birukoff observes that specimens of *Paramæcium*, stimulated by induction currents, wander to the cathode (as do dead particles of carmine and starch), but dispose themselves in the parts of the water-drop where the strength of the current is least, and arrange themselves similarly on the surface of the electrode (which not-living particles do *not* do). Thus he contrasts the purely physical and the vital.

Nuclear Division in Noctiluca.†—Prof. C. Ishikawa has shown that the division of the nucleus in this Protozoon takes place much in the same way as in higher forms, the only difference consisting in the persistence of the nuclear wall and the consequent modification in the relative position of the spindle fibres and the chromosomes. He proceeds to describe the centrosome, centrosphere, and pole-plate, especially emphasising the remarkable resemblance of the archoplasm of *Noctiluca* to the centrosphere of Metazoa on the one hand, and to the pole-plate of less specialised Protozoa on the other. The relation of the archoplasm to the tentacle is next considered. In spore-forming individuals the flagellum is developed from the archoplasmic spindle-fibres, just as the tail of a spermatozoon is developed from the remains of the spindle-fibres of the last division of the sperm-cells. Ishikawa now adds the observation that a part of the centrosphere goes to form the tentacle. He calls attention to the great interest of the fact that similar processes are met with in the formation of the motile organ (cilia or flagella) of the cells in Flagellata, Algæ, Gymnosperms, and Vertebrates, wherein the centrosome or the centrosome-like body plays the most important part. Furthermore, the direct conversion of the central or archoplasmic spindle-fibres into the flagellum of spores in *Noctiluca* is probably to be looked upon as an interesting contribution to the knowledge of the archoplasm. The author then discusses the elongation of the fibres of the archoplasmic spindle, and, finally, abnormal multipolar division. The abnormality clearly demonstrates that the kinetic centres of the nuclear division in *Noctiluca* lie outside the nucleus and can form spindles quite independently of it.

Notes on Chrysomonads.‡—Herr L. Iwanoff discusses the species of *Mallomonas* (three being recognised as "good"), *Chrysopyxis bipes* (which he followed through several phases), *Uroglena volvox* (whose conjugation he regards as non-proven), *Chromulina nebulosa*, and *Dinobryon spiralis* sp. n. He regards all these as Algæ.

Röntgen Rays and Protozoa.§—Herr F. Schaudinn subjected members of twenty species to fourteen hours' exposure to these rays, and describes the very varied results. Those with the least substantial

* Pflüger's Arch. ges. Physiol., lxxvii. (1899) pp. 555–85. See Zool. Centralbl., vii. (1900) p. 548.

† Journ. Coll. Sci. Univ. Tokyo, xii. (1900) pp. 243–62 (1 pl.).

‡ Bull. Acad. Imp. St. Petersbourg, xi. (1899) pp. 247–62.

§ Pflüger's Arch., lxxvii. (1899) pp. 29–43. See Zool. Centralbl., vii. (1900) p. 543.

and least dense plasmic structure seem to be most influenced, but much also depends on the envelopes and skeleton.

Lake Plankton.*—Dr. Otto Zacharias records the occurrence of the Infusorian *Trichodina pediculus* in great numbers in a plankton gathering from Lake Hertha. The gathering consisted of the Infusorian and of a few Crustacea and Rotifers. The point of interest is that *Trichodina* usually occurs as a parasite on Planarians, *Hydra*, and young fishes; but this observation, together with one by Dr. A. Seligo on a lake near Marienburg, shows that it does also occur as a free-swimming form. A somewhat analogous fact is the occasional occurrence of the Rotifer *Actinurus neptunius* Ehrb. as a plankton form, while it is usually found in mud or in the plant zone near the shore.

Plankton of Gulf of Naples.†—Bruno Schröder publishes a paper on the phytoplankton of the Gulf of Naples, which not only includes such members of the Protista as the Peridiniaceæ, but also to some extent is concerned with the plankton as a whole. He finds that a line drawn approximately from Cap Miseno to Castellamare divides the Gulf into two regions so far as the plankton is concerned; but if the sirocco blow persistently the distinction becomes obliterated. In the inner region, owing apparently both to the temperature and to the condition of the water as influenced by surface drainage, Copepoda swarm in enormous numbers, and Peridinieæ and Diatoms are relatively less abundant. In the outer region the Copepods are less abundant, and *Sagittæ*, Radiolaria, Peridinieæ, and Diatoms occur freely. As regards the affinities of the Neapolitan plankton, the author's results confirm those of Schütt that not only do the species correspond to those of the warmer parts of the North Atlantic, but there is also strong resemblance in regard to the range of variation and the paucity of individuals, as contrasted with the great number of species. The occurrence of similar variations in the North Atlantic and the Gulf of Naples is especially striking in regard to the species of *Ceratium*, notably the very variable *C. tripos*. The reason is probably to be sought in the warm superficial current which enters the Mediterranean through the Straits of Gibraltar, and is produced by a branch of the Gulf Stream.

Malarial Parasites.‡—Dr. J. W. W. Stephens and Mr. S. R. Christophers find that the parasite of malaria may occur in fresh blood in one of two forms: it may be unpigmented throughout, or it may have one or several pigment spots from the earliest stages onwards. By the use of gentian-violet or hæmatin (modified Thin's formula) they succeeded in staining blood-films so that leucocytes, erythrocytes, and parasites showed up clearly. The very young parasites consist of a staining ring (chromatic substance) surrounding a central achromatic body. Later there are in addition a chromatic body on the periphery of the ring, and also one or more minute chromatic bodies. As the parasite grows the chromatic substance increases, usually unilaterally, and a differentiation takes place in the expanded region, whose significance is not understood, and which is not always identical in nature. When full-grown the

* Biol. Centralbl., xx. (1900) p. 463.
† MT. Zool. Stat. Neapel, xiv. (1900) pp. 1–38 (1 pl.).
‡ Roy. Soc. Lond. Reports to Malaria Committee, 1899–1900, pp. 12–42 (10 charts). Cf. *ante*, p. 578.

parasite often lies in a vacuole in a red blood-corpuscle. The time taken by the parasites to undergo full development would appear to be about fourteen hours, but quinine has an extraordinarily rapid effect in eliminating the parasites from the blood, without necessarily producing the abatement of the clinical symptoms, or preventing a fatal termination. The authors find, however, that malaria may be diagnosed, even after dosing with quinine has eliminated the parasites, by the characters of the leucocytes. In malarial cases, especially during apyrexia, characteristic pigmented leucocytes occur, and there is an increase in the large mononuclear elements, and a decrease in the small mononuclear and the polynuclear elements. They have always found this peculiarity in the case of blackwater fever, and believe that the quinine may, by its lethal effect on the parasites, free from them a sufficient quantity of toxin to produce the hæmoglobinuria of blackwater. In other words, so far they have always found malarial infection in blackwater cases, and have never found any specific blackwater parasites.

Proteosoma and Mosquito.*—Dr. C. W. Daniels reports on the result of a continuation of Major Ross's experiments on the infection of birds by *Proteosoma* through the agency of the mosquito. He was enabled to entirely confirm Ross's results in regard to the infection of mosquitos fed on proteosomal birds. Such mosquitos showed the cysts called by Ross "coccidia" on the walls of the stomach. Further the results confirmed Ross's statements that these "coccidia" contain "germinal threads," which are freed into the body-fluid of the mosquito by the rupture of the cysts, and ultimately find their way into the salivary glands. The attempt to infect birds by the direct agency of mosquitos was less successful than Ross's previous experiments, but this is probably explained by the lateness of the season, the colder months being apparently less favourable to the disease than the hot ones. In most infected mosquitos there were found, in addition to the cysts containing the germinal threads, others containing black spores. These are very resistant to injurious agents, and until their significance is understood, the life-history of *Proteosoma* cannot be said to be known.

Foraminifera from Funafuti.† — Mr. Frederick Chapman finds that the Foraminifera play no inconsiderable part in the formation of coral reefs in the Funafuti Atoll. In the rock material obtained by boring, the Foraminifer *Polytrema* was found growing in alternate concentric layers with a calcareous alga, and in the coral sand many other genera occurred. In the present paper the larger forms, many of which are true rock-builders, are dealt with. The most interesting form is *Cycloclypeus*, which is extraordinarily abundant, and appears in what were at first regarded as numerous varieties. Later it was found that these varieties are stages of one dimorphic species, the two forms having been described as *C. carpenteri* Brady and *C. guembelianus* Brady.

Polytrema miniaceum.‡—Herr Fr. Merkel has made a detailed study of this curious Rhizopod. He finds that the shell is dimorphic, as it is

* Roy. Soc. Lond. Reports to Malaria Committee, 1899–1900, pp. 1–11.
† Journ. Linn. Soc. (Zool.). xxviii. (1900) pp. 1–27 (4 pls.).
‡ Zeitschr. wiss. Zool., lxvii. (1900) pp. 291–322 (2 pls. and 2 figs.).

in *Orbitolites*, *Peneroplis*, &c.; a megalospheric and a microspheric form both occurring, the former with one and the latter with several nuclei. The minute details of structure are described and figured, but it does not appear that any very striking or novel points were made out.

Nomenclature of Dimorphic Protozoa.*—Prof. A. Silvestri discusses a question recently raised by E. van den Broeck † as to the most convenient way of naming dimorphic Foraminifera. The megalospheric forms may be labelled A, and the microspheric forms B; *Nummulites elegans* Sowerby and *N. planulata* Lamarck are respectively the forms A and B of the same species, and this should be registered as follows:—*Nummulites planulata* Lamarck, *N. planulata* B Lamarck, *N. planulata* A (*elegans*) Sowerby. Similarly, *Frondicularia alata* d'Orbigny is the form B to which corresponds *F. annularis* the form A; the B forms are most important for determining the species, and the A forms for the genus; the registration, in this case, should be *Frondicularia alata* d'Orbigny, *Fr. alata* B. d'Orbigny, *Fr. alata* A (*annularis*) d'Orbigny.

Radiolaria.‡—Mr. A. Earland publishes an interesting general paper on this subject, which, without containing anything very novel, is worthy of note as a useful summary of the present state of our knowledge of the group.

Flagellated Heliozoon.§—Mr. H. Crawley describes what he believes to be specimens of *Vampyrella lateritia*, some of which were provided with normal pseudopodia, while others bore flagella.

Intranuclear Parasite of the Kidney of Rats.‖—Dr. E. Giglio-Tos discovered in the renal epithelium of the sewer rat a parasite designated *Karyamœba renis* sp. n. It is strictly confined to the nucleus, and is composed of two parts, a central or nuclear and a peripheral or protoplasmic. In size the parasite varies from 2 to 9 μ, and the numbers present vary from 1 to 6. The sections were stained with Ziehl's phenol-fuchsin diluted with 5 per cent. carbolic acid (10 ccm. sat. alc. sol. fuchsin to 490 5 per cent. carbolic acid). The nuclear portion of the parasite was stained red, the peripheral was unstained.

* Atti Accad. Pontif. Nuovi Lincei, liii. (1900) pp. 77–86.
† Bull. Soc. Belge Geol., x. (1899); Ann. Soc. Malacol. Belg., xxxiv. (1899).
‡ Journ. Quekett Micr. Club, vii. (1900) pp. 257–84 (2 pls.).
§ Amer. Nat., xxxiv. (1900) pp. 255–8 (2 figs.).
‖ Atti R. Accad. Sci. Torino, xxxv. (1900) pp. 563–9 (1 pl.).

BOTANY.

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

α. Anatomy.

(1) Cell-Structure and Protoplasm.

Alleged Occurrence of living Protoplasm in the Air-passages of Water-plants.*—Observations made by Herr L. Kny on various water-plants throw considerable doubt on the statement made by several observers, especially Baranetzki and Sauvageau, that the air-passages in the tissues of water-plants are clothed with a layer of living protoplasm. He found no certain evidence of such a layer—whether containing nuclei and chromatophores or not—which could not have arisen from the flow of intracellular protoplasm from adjoining cells.

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

Chemistry of Chlorophyll.†—Dr. L. Marchlewski and Herr C. A. Schunk state that crude leaf-extracts contain two green colouring matters, chlorophyll proper and another, which is present only in small quantity and which exhibits a red fluorescence. They describe a method by which true chlorophyll can be obtained almost free from this green colouring matter. Hartley's "yellow chlorophyll" is a mixture of a green colouring matter, which is not chlorophyll, with members of the xanthophyll group. When isolated, its colour is green, and the term "yellow chlorophyll" is therefore not applicable to it.

Latex and its Functions.‡—Mr. J. Parkin notes the following points in the latex-producing trees and shrubs of Ceylon. The coagulation of the latex of *Hevea brasiliensis* suggests that the proteid is rather an albuminate than albumen. A proteid is also present in the latex of *Castilloa elastica* and *C. Markhamiana.* The latex of *Castilloa* and that of the capsule (but not of the trunk) of *Hevea* darkens on exposure to the air, indicating the presence of an oxydase. Although laticiferous tubes contain both starch and sugar, the starch (especially the starch-rods of the Euphorbiaceæ) appears to have no nutritive value, and to have nothing to do directly with carbon-assimilation. There is frequently a considerable difference in the properties of the latex from young and old organs of the same plant. The author suggests that one of the most important functions of a laticiferous system may be that of holding water in reserve.

Poisonous Property of Raphides.§—Herr L. Lewin points out that the general theory that crystals of calcium oxalate in the tissues of plants serve to protect them against the attacks of animals, is contradicted by the fact that some of these plants are edible by man, while many are eagerly eaten by animals of all kinds. The mechanical injury which has been attributed to them is also not supported by facts. The

* Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 43–7.
† Proc. Chem. Soc., xvi. (1900) pp. 148–9.
‡ Ann. of Bot., xiv. (1900) pp. 193–214 (1 pl.).
§ Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 53–72.

explanation offered by him is that, when present in plants not otherwise poisonous, they are not injurious; and that their chief toxic effect is indirect, as the carriers of poisonous substances characteristic of the species.

Reserve Carbohydrates of Hyacinth Bulbs.*—According to Mr. J. Parkin, the most abundant carbohydrate in the bulb-scales of the hyacinth is an inulin, i.e. is levorotary, and is converted by hydrolysis into fructose. There are three kinds of inulins in plants:—those found in Compositæ and the allied orders; those in the hyacinth, *Scilla*, *Yucca*, and *Phleum*; and those found in *Galanthus* and *Leucojum*.

Reserve Carbohydrate in the Seeds of Trifolium repens.†—Results analogous to those obtained in the lucerne and fenugrec have been reached by M. H. Hérissey in the case of the Dutch clover. He finds the reserve carbohydrate to be a mannogalactane which is hydrolysable by seminase, this substance transforming it, at least partially, into reducing sugars capable of being assimilated.

Endosperm of Gleditschia.‡—M. M. Goret finds that the carbohydrate which composes almost the whole of the endosperm of the seed of *Gleditschia triacanthos* is, like that of the carob, a mannogalactane or a mixture of mannane and galactane. Like the reserve-material of other seeds with horny endosperm, it is hydrolysed by seminase.

Distribution of Carotin in Plants.§—From a series of observations made on a great variety of different plants, Herr T. Tammes concludes that the pigment of the plastids from green and etiolated leaves and those which turn green in the autumn, from fruits and seeds, and from green, blue-green, brown, and red Algæ, agrees, in all its chemical and physical properties, with the carotin of the carrot. He states also that in the plastids of all plants or parts of plants which contain chlorophyll and which are capable of carbon dioxide assimilation, carotin is an invariable accompanier of chlorophyll; and that carotin shares with chlorophyll the capacity of engendering this assimilation.

Pathogenic Effects of Primula obconica and sinensis.‖—The well-known effect of these two species of *Primula* in producing dermatitis on the hands of those who handle them, is traced by Herr A. Nestler to a secretion formed in the glandular hairs on the stem and leaves. The intensity of the toxic effect is very different on different individuals.

Distribution of the Diastatic Enzyme in Plants.¶—In the potato Herr A. Meyer finds most diastase in old germinated tubers and in the ordinary leaves; sprouts from germinated tubers contained much less; and old potatoes from the field, young tubers attached to them, and the ordinary stems, scarcely any. It is the organs from which the carbohydrates are transmitted through the plant that are richest in the diastatic enzyme. In the sugar-beet none of the organs were found to contain

* Ann. of Bot., xiv. (1900) pp. 155–7.
† Comptes Rendus, cxxx. (1900) pp. 1719–21. Cf. this Journal, *ante*, p. 479.
‡ Op. cit., cxxxi. (1900) pp. 60–3. Cf. this Journal, *ante*, p. 479.
§ Flora, lxxxvii. (1900) pp. 205–47 (1 pl.).
‖ Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 189–202, 327–31 (2 pls.).
¶ Jahrb. Landwirth., xlviii. pp. 67–70. See Journ. Chem. Soc., 1900, Abstr. ii. p. 427.

any enzyme analogous to invertin. Experiments with oats showed that the ripe seed contains much larger quantities of the diastatic enzyme than the half-ripe ears.

Proteolytic Enzyme in Seeds after Germination.*—From experiments made on seedlings of *Lupinus luteus* and on ungerminated seeds of *L. angustifolius*, Herr W. Butkewitsch confirms Green's statement of the presence in germinated seeds of a proteolytic enzyme which decomposes the seed, with formation of amide-compounds, in a way similar to animal trypsin. The decomposition of the albuminoid becomes gradually slower and slower, and finally ceases.

Proteolytic Diastase of Malt.†—MM. A. Fernbach and L. Hubert claim to have empirically determined what has previously only been assumed, the presence in malt of a proteolytic diastase. It may be compared to the saccharifying diastase, substituting, in the description of its effects, the term peptone for dextrin, and amides for maltose.

Galactase.‡—Dr. E. von Freudenreich made experiments relative to galactase, an unorganised enzyme present in milk, which was discovered by Babcock and Russell.§ The results are altogether confirmatory of the existence of this lactic enzyme.

(3) Structure of Tissues.

Elastic Swelling of Tissue.‖—Herr C. Steinbrinck gives further experimental evidence in support of his view that in the anthers of flowering plants and the sporanges of ferns, neither the contraction of the valves when they burst, nor their swelling when again moistened, is influenced by the pressure of the external air.

Laticifers of Eucommia ulmoides.¶—M. G. J. Barthelat has investigated the nature of the laticiferous vessels in this tree, belonging to the Euphorbiaceæ or an allied order, the dried latex of which yields a substance of the nature of gutta-percha. The laticifers are unseptated, and do not anastomose; they differ from those of the typical Euphorbiaceæ in but rarely branching. They occur in abundance in all parts of the plant.

Passage from the Root to the Stem.**—From observation on a number of different species, Sig. L. Montemartini supports the view of Briosi and Tognini, rather than that of Dangeard, viz. that in the majority of cases, whether the root be diarch, triarch, or polyarch, its xylem-bundles are completely continuous with those of the stem, and that the passage from the centripetal to the centrifugal arrangement takes place without torsion. In seedlings there is an apparent torsion of the radial vascular bundles; the passage of the primary vascular bundles being uninterrupted from the primary root into the hypocotyl.

* Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 185–9.
† Comptes Rendus, cxxx. (1900) pp. 1783–5.
‡ Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 332–8.
§ Cf. this Journal, 1899, p. 525; 1900, p. 224.
‖ Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 48–53. Cf. this Journal, 1899, p. 500.
¶ Journ. de Bot. (Morot), xiv. (1900) pp. 55–9 (8 figs.).
** Atti Ist. Bot. Univ. Pavia, 1898, 1899. See Beih. z. Bot. Centralbl., ix. (1900) p. 271.

Connection of the outer and inner Leptome in the Solanaceæ.* — Herr M. Tswett contests the statement made by some previous observers that, in the stem of the Solanaceæ, the outer and inner (extra-xylar and intra-xylar) leptome are not connected with one another, the latter appearing quite independently in the pith of the young hypocotyl. He finds, on the contrary, that, in the genera examined (*Datura*, *Atropa*, *Solanum*, *Nicotiana*), the two leptomes are always connected with one another by transverse anastomoses.

Irregular Endoderm in Ruscus.†—Mr. T. J. Lewis finds, in the roots of a *Ruscus* sp., that the vascular cylinder is entirely enclosed by the endoderm, except that in one place a cell of the endoderm was joined by its uncuticularised tangential wall to a complete ring of endoderm external to the central cylinder. No vascular tissue was contained within this ring, the elements consisting entirely of crushed parenchyme. Further out in the cortex, on the opposite side of the root, was another small isolated ring of endoderm, also enclosing crushed parenchyme.

Anatomy of the Stem of the Dammar-tree.‡—Dr. W. Figdor gives a detailed description of the anatomy of the source of dammar resin, a tree belonging to the Dipterocarpeæ, probably a *Shorea* sp. The resin-passages are found in the perimedullary zone of the stem, but a short distance from the xylem, and are probably of schizo-lysigenous origin. The secreting cells have thick yellowish strongly refringent walls. The resin-passages result from the coalescence of a number of secreting cells.

Structure of Bowenia.§—Mr. W. C. Worsdell finds, in the stem of *Bowenia spectabilis*, strands of extrafascicular vascular tissue, corresponding to a similar structure in *Cycas*, *Macrozamia*, and *Encephalartos*, which support the view that these genera are derived from plants allied to the Medullosæ.

(4) Structure of Organs.

Origin of Variegated Varieties.‖—M. E. Laurent concludes, as the result of a series of observations, that variegation is brought about by a substance absorbed from the soil through the root, of the nature of a zymase, which causes modifications in the distribution of the chlorophyll.

Female Flower of Coniferæ.¶—Mr. W. C. Worsdell gives a detailed account of the views that have been entertained by various authorities as to the nature of the female "flower" in the Coniferæ, accompanied by a copious bibliography.

The writer himself adopts the "axillary bud" theory of Velenovsky and Celakovsky, which is supported by the continuous and gradual transition between the undivided seminiferous scale of the normal condition and the first transverse pair of foliar organs of the axillary bud, along with the anterior bud-leaf, as well as by the agreement, in the relative

* Ber. Deutsch. Bot. Ges., xvii. 1899 (1900) Gen.-Vers. Heft, pp. 231–5. Cf. this Journal, *ante*, p. 215. † Ann. of Bot., xiv. (1900) pp. 157–9 (2 figs.).

‡ Oesterr. Bot. Zeitschr., l. (1900) pp. 74–8.

§ Ann. of Bot., xiv. (1900) pp. 159–60.

‖ Bull. Soc. R. Bot. Belgique, xxxix. (1900) pp. 6–9.

¶ Ann. of Bot., xiv. (1900) pp. 39–82 (7 figs.).

position of the various appendages, between this abnormal axillary bud and an ordinary axillary vegetative bud. He agrees also with Celakovsky in maintaining that there is a uniform presence, throughout the order, of two integuments to the sporange, thus harmonising the structure of the female organ throughout the order. It may well be supposed that the outer integument has, in all conifers except *Podocarpus* (where it has long been recognised), become modified in the direction of vegetative development, in order to subserve the special adaptive function of a protective covering to the sporanges.

Staminodes of the Scrophulariaceæ.*—Dr. J. M. Polak has investigated the phenomena connected with the suppression of the fifth stamen in as many as 177 genera of Scrophulariaceæ. The suppression is most complete in the Rhinanthoideæ, throughout which suborder no trace survives of the fifth superior stamen. In the Pseudosolaneæ the structure varies between five fertile stamens (*Verbascum*) and a complete suppression of the fifth. In the third and largest suborder, the Antirrhinoideæ, the fifth stamen is either completely suppressed or is represented by a staminode. In the smaller groups of this suborder the structure is generally uniform.

Ovule of Cephalotaxus.†—In the ovule of *Cephalotaxus* Mr. W. C. Worsdell finds a well-developed centripetal xylem, the tracheids composing it extending along the whole tangential surface of the centrifugal xylem. From this and other points of structure he draws the conclusion that *Cephalotaxus* is the most primitive of the Coniferæ, and that it forms in some measure a connecting link between the Cycadeæ and the Coniferæ.

Pushing up of the Axillary Shoots in the Borragineæ.‡—Dr. L. J. Celakovsky returns to the controversy on this subject between Herren Kolkwitz and Schumann (*Symphytum officinale* and *Anchusa italica*), summing up in favour of the explanation offered by the latter authority. He lays down the general law that every production of new members—whether sporanges in the widest sense of the term (including anther-lobes and ovules), lateral shoots, or even trichomes—in Metaphytes, has its origin in the leaf, as in Characeæ; and that the caulome, in the narrower sense of the term, is simply the supporting organ for the leaves. The true leaf (in the narrower sense), with its two leaf-traces, is a morphological unity, like the pushed up axillary shoot with its leaf-trace coalescent with the stem.

Structure of Salisburia adiantifolia.§—Mr. A. C. Seward and Miss J. Gowan give a detailed synopsis of observations hitherto made on the structure and affinities of the maidenhair tree (*Gingko biloba* L., *Salisburia adiantifolia* Sm), together with results of their own investigations. The general conclusion is that the genus should be removed from the Coniferæ, and should constitute a separate order of Gymnosperms, the Gingkoaceæ. In many respects *Gingko* shows a marked affinity with the Cycads, viz. :—in the structure of the ovules and seeds, in the pro-

* Arb. bot. Inst. k. k. deutsch. Univ. Prag, 1899, No. 38. See Oesterr. Bot. Zeitschr., l. (1900) pp. 33–41, 87–90, 123–32, 164–7 (2 pls.).

† Ann. of Bot., xiv. (1900) pp. 317–8.

‡ Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 2–15 (7 figs.). Cf. this Journal, 1895, p. 652.

§ Ann. of Bot., xiv. (1900) pp. 109–54 (3 pls.).

duction of spermatozoids, and in certain anatomical characters of the reproductive and vegetative organs. Like the extinct Cycadofilices, it possesses both Filicinean and Cycadean characters; but, while exhibiting traces of the affinity of Cycads and Ferns, it represents, in all probability, a very ancient type which may have been merged in the Cordaitales in the Palæozoic era.

Cypress-Knees.*—Mr. T. Meehan has come to the conclusion that the so-called "knees" of *Taxodium distichum*, common in the swamps of Florida, are not, as has been supposed, organs containing aeriferous tissue which is useful to the plant; but that they are simply excrescences caused by the attacks of a fungus, the hollowness of the main trunk and of the excrescences being due to the same cause.

Root-nodules of Alnus and Elæagnus.†—Herr L. Hiltner states that, like the Leguminosæ, alders, when provided with root-nodules, grow normally in the absence of combined nitrogen. But, unlike leguminous plants, alders develope normally in water-cultures when the nodules remain covered with water. *Elæagnus*, when inoculated with the root-bacteria, will also grow normally without combined nitrogen. The organism which produces the nodules, *Frankia subtilis*, appears to be the same in all cases. The author regards it as a connecting link between bacteria and fungi.

β. Physiology.

(1) Reproduction and Embryology.

Impregnation in Dicotyledons.‡—Pursuing his investigations on this subject, Herr S. Nawaschin has devoted himself especially to two widely separated families, the Ranunculaceæ and the Compositæ. The general result has been a confirmation of his previous conclusion that the fusion of the male with the female nucleus is a true process of impregnation; and whether this takes place in the ovum-cell (oosphere) or in the endosperm-cell, the signification is the same. If (in the latter case) no such fusion takes place, no endosperm is formed.

In *Delphinium elatum* (Ranunculaceæ) a material deviation from the mode in Liliaceæ was established in the fact that the two polar nuclei fuse together before impregnation, and the ovum-nucleus passes through a long period of repose after its fusion with the male nucleus. Before impregnation the male generative cells were detected, not only within the pollen-tube as vermiform structures, but also during their fusion with the ovum-nucleus and the embryo-sac respectively in the form of a dense chromatin-knot.

In *Helianthus* (Compositæ) also the two polar nuclei fuse together long before impregnation. The pollen-tube empties its contents into the side of the embryo-sac, between the two synergids. The two spermatozoids free themselves from the coarse-grained contents of the pollen-tube; one of them forces itself into the side of the ovum-cell, the other attaches itself closely to the embryo-sac nucleus. The sperma-

* Proc. Acad. Nat. Sci. Philadelphia, 1900, pp. 349–51.

† Forstl. naturw. Zeit., vii. (1898) pp. 415–23. See Journ. Chem. Soc., 1900, Abstr. ii. p. 426.

‡ Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 224–30 (1 pl.) Cf. this Journal, *ante*, p. 81.

tozoids closely resemble those of many Gymnosperms; they consist of a long filament somewhat thickened in the middle and at its two ends, and exhibiting at these spots a delicately porous structure.

The author regards it as probable that a process similar in all essential points takes place in all Angiosperms, with the exception of a few abnormal cases, among which the Orchideæ may probably be ranged.

Embryology of the Araceæ.*—Prof. D. H. Campbell describes the structure of the flower and the development of the seeds in species belonging to the following genera of Araceæ,—*Dieffenbachia*, *Aglaonema*, *Anthurium*, *Philodendron*, and *Lysichiton*. The following is given as a summary of results.

In *Dieffenbachia* and *Aglaonema* there is no question as to the axial origin of the ovule; this is probably the case also in *Lysichiton*, but not so certainly in *Anthurium*. In all the species examined there is a large development of the base of the ovule, and in *Aglaonema* and *Lysichiton* of the integuments also. The endosperm forms very early a continuous tissue, completely filling the embryo-sac. In *Lysichiton* the antipodal cells become very large and undergo secondary divisions, so that a large group of cells results. In *Aglaonema* there is a similar group of cells. In the older embryo-sacs of *Anthurium* the antipodal cells could not be certainly distinguished. There are probably two types of segmentation of the young embryo; in the first two transverse divisions are formed before any longitudinal walls appear; in the second there is a quadrant formation suggestive of the early divisions in the fern-embryo; the differentiation of the organs takes place at a late period, and it is not possible to trace them back with certainty to the primary divisions of the embryo. The cotyledon is very large, the stem and root are much less conspicuous; in *Lysichiton* the root seems to be of lateral origin, as it is in *Pistia*. A suspensor is never developed.

The author regards the early development of a solid endosperm and the great development of the antipodal cells as evidences of the primitive nature of the Araceæ.

Embryology of Triglochin.†—Mr. T. G. Hill has carefully investigated the structure and development of *Triglochin maritimum*, the following being the more important results obtained.

The vascular bundles of the flowering stem are of the collateral type, and, when young, have a structure remarkably similar to that of the same organ in several plants belonging to the Ranunculaceæ. The ovule is basilar in origin. The embryo-sac often contains an increased number of antipodal cells, varying from 3 to 14. The polar nuclei do not appear to fuse until after fertilisation has taken place. The embryology follows a normal course strongly resembling that of other Monocotyledons; a basal cell is developed, and it appears that this does not undergo division. The embryo does not bend over, as in *Alisma*; the stem-apex is developed laterally. An endosperm is formed, the nuclei of which are not separated by cell-walls; they are very distinct, lining the inner wall of the embryo-sac.

* Ann. of Bot., xiv. (1900) pp. 1–25 (3 pls.). Cf. this Journal, 1899, p. 410.
† Tom. cit., pp. 83-107 (2 pls.).

Embryology of Balanophora globosa.*—M. J. P. Lotsy describes the remarkable phenomenon of autogamy in this plant. There is no true flower; but there appears on the axis of the inflorescence a few-celled protuberance, the hypodermal cell of which becomes an embryo-sac, the superjacent epiderm growing out into a long organ resembling a style. The embryo-sac curves; at each end 4 nuclei are separated in the ordinary way; but the oosphere and synergids abort, as also do the antipodal nuclei without developing into antipodal cells. There remains only a single nucleus, which divides into two endosperm-cells, of which the lower one gradually disappears, the whole of the endosperm being formed from the upper one. From a cell of this endosperm is developed the true few-celled embryo; the surrounding endosperm-cells become filled with oil, and the outermost layer, together with the epiderm, developes into a thick-walled testa.

Embryology of Vaillantia.†—In *Vaillantia hispida* (Rubiaceæ), according to Mr. F. E. Lloyd, the archespore consists of about 12 cells; but only one of the megaspores becomes normally an embryo-sac; this megaspore travelling from the nucellus into the micropylar canal. Fusion of the polar nuclei takes place at some distance from the ovum-cell, towards which the endosperm moves, and to which it ultimately becomes closely applied. There are three antipodals; one of them is very long, one end being plunged into the disintegrating archespore. The suspensor forms outgrowths into the endosperm, which act as food-absorbing organs. The endosperm enlarges at the expense of the integument, which has the appearance of a tissue undergoing digestion. A part of the integument persists as the integument of the seed.

Embryo-sac of Leucocrinum.‡—According to Mr. F. Ramaley, the embryo-sac of *Leucocrinum montanum* is usually nearly spherical; the polar nuclei fuse before the impregnation of the ovum-cell. The definitive nucleus moves from the centre of the sac towards the posterior end before any division takes place. The synergids are large; they persist for a short time after the fecundation of the ovum-cell. The antipodals do not increase in number, but a fragmentation of their nuclei sometimes occurs. They do not become completely disorganised for a long time. Nothing was observed to suggest a fusion between the definitive nucleus and a male cell.

Ovule of Stangeria.§—Mr. W. H. Lang finds a close correspondence in the development of the ovule in *Stangeria*, in the processes of pollination and fertilisation, and in the embryogeny, to those already described by him in *Ceratozamia*. Two ovules are developed on each sporophyll. The development of the ovule is similar in essential points to that in *Ceratozamia*. At the time of pollination the prothallus fills the megaspore; the sporogenous tissue is represented by a single persistent layer. The pollen-tubes penetrate the nucellus as in *Cycas* and *Zamia*; in the free end of each two spermatozoids are formed. The spermatozoid is of

* Ann. Jard. Bot. Buitenzorg, xvi. (1899) pp. 174–86 (4 pls.). Cf. this Journal, 1898, p. 555.
† Proc. Amer. Ass. Adv. Sci., xlviii. (1899) p. 229. Cf. this Journal, 1899, p. 411.
‡ Tom. cit., p. 289.
§ Ann. of Bot., xiv. (1900) pp. 281–306. Cf. this Journal, 1898, p. 94.

large size, and possesses cilia attached to a blepharoplast which forms a spiral of five turns. By the absorption of the intervening tissue of the nucellus, a free passage is formed between the pollen-chamber and the prothallus. The embryos, which are formed singly at the lower ends of the archegones, as in *Cycas*, possess long suspensors, and come to occupy a common cavity formed by the absorption of the tissue of the prothallus.

The author corrects his previous close comparison between the microsporange of *Stangeria* and the sporange of *Angiopteris*. He is now rather disposed to compare the ovule of Cycads to a sorus consisting of a single sporange, which developes on the whole in a manner similar to a microsporange.

Division of the Megaspore in Erythronium.*—Mr. J. H. Schaffner finds that, in *Erythronium albidum* and *americanum*, the megaspore arises from the archesporial cell directly, by differentiation and not by division. The cell in which the reduction takes place has a period of development extending over six months. While the nucleus is expanding in the autumn, the chromatin network begins to thicken until a continuous band is formed. In the spring the band twists itself up into twelve loops, which break apart and form twelve very large coiled chromosomes. The chromatin granules never appear very distinct, and they do not begin to divide until the chromatin band begins to form the loops. After the pseudo-reduction, the chromosomes are arranged on the spindle-threads with their closed ends turned outwards, and are then gradually untwisted and pulled apart at the middle. This results in the transverse division of each chromosome, one transverse half going to each daughter-nucleus. The division of the megaspore of *Erythronium* is, therefore, essentially the same as in *Lilium philadelphicum*. The writer regards a transverse qualitative division as the only possible interpretation.

Vermiform Sexual Nuclei in Caltha.†—Miss Ethel N. Thomas finds, in the embryo-sac of *Caltha palustris*, a much-coiled vermiform male nucleus wrapped round the polar nucleus. There is every reason to believe that a fertilisation of the polar nuclei by a vermiform nucleus actually takes place in *Caltha palustris* as in *Lilium Martagon*.

Germinal Vesicles of the Abietineæ.‡—Herr W. Arnoldi has investigated the nature of the structures called by Hofmeister "germinal vesicles" (*Keimbläschen*) in the Abietineæ, and has determined that they are not "proteid-vacuoles" (*Eiweissvacuolen*), but are the nuclei which have passed out from the cells of the "covering-layer" (*Deckschicht*). There are not, in the archegones of the Abietineæ, any simple or compound proteid-vacuoles; the nuclei of the covering cells pass from them into the ovum-cell (oosphere) itself. They then lose their nuclei and become the "germinal vesicles" of Hofmeister, "Hofmeister's corpuscles" of Goroschankin. The Abietineæ do not stand alone among the Coniferæ in possessing these bodies; they appear to be wanting only in the Cupressineæ and the Taxodineæ.

* Proc. Amer. Ass. Adv. Sci., xlviii. (1899) pp. 299–300.
† Ann. of Bot., xiv. (1900) pp. 318–9.
‡ Flora, lxxxvii. (1900) pp. 194–204 (1 pl.).

Pollen of Hybrids.* — Herr A. Jenčič has carried out a series of experiments with the view of settling the much disputed point of the relative fertility of hybrid plants, and especially of their capacity for producing fertile pollen. In 33 living and 10 dried species, he finds the law universal that the fertility of the pollen is diminished in hybrids, but the degree of reduction varies greatly. In some cases no pollen at all is produced, while Orchideæ exhibit but a very small reduction of fertility; and between these extremes there are all intermediate grades. Hybrids between nearly related species were always found to be more fertile than those between species less nearly related. Pollen-grains which did not swell up in water were regarded as sterile.

Descendants of Race-Hybrids.†—Commenting on De Vries's paper on the law of splitting of hybrids, Herr C. Correns points out that the same results were obtained by Mendel in 1866, and precisely the same explanation offered. The descendants of hybrids reproduce every possible combination of the distinguishing characters of the parent-forms; but these characters are not in any sense weakened.

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

Formation of Chlorophyll in the Seedlings of Gymnosperms.‡—From a series of experiments carried on by Herr A. Burgenstein on the formation of chlorophyll in the seedlings of Gymnosperms in the light and in the dark, he comes to the following general conclusions. Seedlings of Coniferæ (except *Salisburia*, and *Ephedra* among Gnetaceæ) become green when light is entirely excluded; but more intensely at a favourable temperature (15°–25° C.) than a lower one (5°–10°). *Cycas* and *Zamia*, and probably all Cycadeæ, do not develope chlorophyll in their seedlings, even at an optimum temperature, in the complete absence of light. The formation of chlorophyll takes place not only in the cotyledons, but (except in *Larix*) also in the hypocotyl. In the Araucarieæ a number of green leaves are developed on the stem which springs from the growing point, even when light has been excluded for weeks. The formation of chlorophyll is not confined, as it is in other Coniferæ, to the cotyledons. In many Coniferæ, especially species of *Abies* and *Cedrus*, the embryo contains chlorophyll even in the dormant seed. When this is not the case, the seedling begins to turn green even within the testa, before or after it is broken through by the radicle. The endosperm is absorbed more slowly, and the epinastic expansion of the cotyledons is less complete in the dark than in the light. Seedlings of Coniferæ and Gnetaceæ which have developed in the dark form shorter roots and cotyledons, but larger and thicker hypocotyls, than those which develope in the light, when the conditions are otherwise the same. The cells of the hypocotyl are absolutely longer and their transverse diameter shorter in the dark than when formed under the influence of light.

Chlorophyll Assimilation.§—Signor Pollacci states that the green organs of plants grown in sunlight restore the colour of magenta which

* Oesterr. Bot. Zeitschr., l. (1900) pp. 1–5, 41–6, 81–6.
† Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 158–68. Cf. this Journal, *ante*, p. 484.
‡ Tom. cit., pp. 168–84.
§ Atti Ist. Bot. Pavia, vii. 1899. See Journ. Chem. Soc., 1900, Abstr. ii. p. 426.

has been decolorised by sulphurous acid, while fungi, or plants which have been kept for a long time in the dark, or in an atmosphere free from carbon dioxide, do not give this reaction. The distillate obtained by boiling the liquid expressed from plants which have grown in sunlight shows all the reactions of formaldehyd.

Grafting the Potato on the Potato.* — Experiments made by M. E. Laurent confirm the statements of Darwin and Vöchting, rather than those of earlier observers, that there was no mingling of characters between graft and host when one variety was grafted on another very similar one, graft and host each preserving its own individual characters.

Green Hemi-parasites.†—Herr E. Heinricher's most recent observations on the parasitism, germination, and mode of growth of the Rhinantheæ relate chiefly to *Bartsia alpina* and *Tozzia alpina*. The seeds of *Bartsia* do not require for their germination the neighbourhood of a host-plant. Those of *Tozzia*, on the other hand, resemble in this respect more closely the seeds of *Orobanche* and *Lathræa* than those of the other Rhinantheæ. Their germination is dependent on the irritation resulting from the vicinity of a host-plant. The seedling carries on a parasitic existence for some years before it puts up a flowering branch, again in this respect resembling *Lathræa*. The author has succeeded also, for the first time, in germinating the seeds of *Thesium* (*alpinum*).

Germination of Orchideæ.‡—The minute seeds of the Orchideæ are notoriously difficult to germinate. From the results of experiments made chiefly on *Neottia nidus-avis*, M. N. Bernard believes the faculty of germination to be dependent on the presence of the mycorhiza or symbiotic fungus which is invariably present in the root-hairs or cells of the root. This fungus probably excretes a diastatic enzyme which assists in the germination. The results are compared with those obtained with the spores of Lycopodiaceæ and Ophioglossaceæ (see p. 611).

Corallorhiza and its Mycorhiza.§—Mr. A. V. Jennings and Mr. H. Hanna have studied the mycorhiza of *Corallorhiza innata*, which they identify as *Clitocybe infundibuliformis*, and its effect on the host-plant. They do not regard the relationship as true symbiosis, the fungus appearing to be captured and utilised by the orchid without any corresponding benefit to itself. The hyphæ in the cells of the host-plant are absorbed and made use of in forming food-materials for the host-plant. Starch is most abundant in cells in which the hyphæ are in a state of decomposition. In no case could any enlargement of the hyphæ be detected in the neighbourhood of the cell-nucleus, nor was the nucleus perceptibly enlarged. The hyphæ of the fungus pass down the root-hairs and through the outer layers of the root to the lower layers, where the absorption takes place.

Excretion of Water from Leaves.‖—In the case of *Phaseolus multiflorus*, Dr. A. Nestler states that the drops of water are not exuded

* Bull. Soc. R. Bot. Belgique, xxxix. (1900) pp. 9–16.
† Ber. Deutsch. Bot. Ges., xvii. 1899 (1900) pp. 244–7. Cf. this Journal, 1899, p. 175.
‡ Rev. Gén. de Bot. (Bonnier), xii. (1900) pp. 108–15.
§ Sci. Proc. R. Dublin Soc., ix. (1899) pp. 1–12 (2 pls. and 8 figs.).
‖ S.B. K. Akad. Wiss. Wien, Nov. 3, 1899. See Oesterr. Bot. Zeitschr., l. (1900) p. 26.

through the ordinary stomates, but through stomates of special construction which are found chiefly at the meeting-points of the veins. The residue obtained by the evaporation of the drops contains calcium carbonate and potassium carbonate, the latter of which salts attracts water eagerly. In *Boehmeria* the water escapes through fissures in a small papilla composed entirely of epidermal cells. It is a process of simple filtration.

(3) Irritability.

Geotropism of the Hypocotyl of Cucurbita.*—According to Mr. E. B. Copeland, *Cucurbita* displays the geotropic response without direct regard to the consequences, and without the power of adaptation to unusual conditions. The rapid growth of the under side of a prostrate hypocotyl carries the cotyledons upward; but if a young plant be placed horizontal with the cotyledons fast and the roots free, the same response bears the roots upwards, and is therefore likely to be immediately fatal.

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

First Organisation-Product of Phosphoric Acid.†—Dr. S. Posternak has found in seeds a phosphor-organic substance, which, from its constant presence, its relations with the reserve-albuminoids, and its chemical composition, must be the first organisation-product of phosphoric acid. This phosphor-organic acid has the composition PCH_5O_5; it is in fact a compound of formaldehyd and phosphoric acid. It is a bibasic acid, all the salts of which are amorphous. In combination with the reserve-albuminoids, potassium phosphor-organate forms the grains of aleurone, the combination being a very unstable one. The author concludes with remarks on the occurrence of inosite, a hexatomic alcohol, in the products of decomposition of phosphor-organic acid.

Formation and Decomposition of Albumen in Plants.‡—Herr E. Schulze gives experimental evidence (derived apparently from culture experiments on Leguminosæ only) in favour of his theory that the decomposition of the albuminoids in germinating seeds results in the production of a mixture of nitrogenous compounds which always consists partially of amido-acids of the fatty and aromatic series, as well as of hexon-bases (argidin, histidin, and lysin); these substances being also formed by the decomposition of albuminoids by acids or by trypsin. A portion of these primary products of decomposition is transformed, in the metastasis of seedlings, into asparagin or glutamin, which are therefore *secondary* products. The analysis of the substances contained in the seedlings showed that, while the amount of leucin, tyrosin, and arginin decreased with the growth of the plant, the proportion of asparagin rapidly increased.

Denitrification and Fermentation.§—Herr H. Wolff employed for these experiments four typhoid-like bacilli (including *B. coli com.* and *B. typhi murium*) and two hay bacilli. All the bacilli reduced nitrates

* Proc. Amer. Ass. Adv. Sci., xlviii. (1899) pp. 296–7.
† Rev. Gén. de Bot. (Bonnier), xii. (1900) pp. 5–24, 65–73.
‡ Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 36–42. Cf. this Journal, 1899, p. 56.
§ Hygien. Rundschau, ix. pp. 1169–72. See Journ. Chem. Soc., lxxvii. and lxxviii. (1900) p. 298.

to nitrites in 1 per cent. dextrose-broth containing 0·05–0·23 per cent. potassium nitrate. The extent of the reduction varied with the bacillus, the coli bacillus reducing least and the hay bacillus most nitrate. The strength of the sugar solution was without influence, but the amount of nitrate had a decided effect. An excess of nitrate checked fermentation. Complete disappearance of nitric nitrogen was simultaneous with cessation of fermentation. Denitrification is therefore not due to direct microbic action; but the products of fermentation reduce nitrates to nitrites and eventually convert them into carbonates. Any fermentation of sugar, by whatever microbe it is caused, will destroy nitrates when present, and denitrification can only take place in presence of substances which yield denitrifying products of metabolism.

Fermentation of Cellulose.* — According to M. V. Omeliansky, *Bacillus fermentationis cellulosæ* attacks cellulose in solutions which contain only mineral salts, the products of fermentation being fatty acids, acetic acid and butyric acid, and the gases carbon dioxide and hydrogen. The fermentation of cellulose described by Hoppe-Seyler is probably effected by some hitherto undescribed organism, and differs from the foregoing in that carbon dioxide and marsh gas are formed, but no solid or liquid products; it is not the amylo-bacterium.

Zymase Fermentation.†—In the process of the fermentation of cane-sugar, Herr E. Buchner states that it is not the whole of the protoplasm, but only a portion of it that acts as a transmitter of the fermenting activity. The idea of "living protoplasm" is not nearly so concrete a one as some writers have maintained.

γ. General.

Sudden Appearance of New Species.‡—M. H. de Vries records the appearance, in a culture of *Œnothera Lamarckiana*, of a single individual differing in several distinct points of structure from the parent-form, and possessing all the characters of a distinct species, which he names *Œnothera gigas* sp. n. These specific characters were renewed for three generations without exhibiting any tendency to return to the parent-form. In another communication § the author describes five other new "species," all derived from the same parent, which maintain their constancy.

Structure of Galls.‖—In a lengthy article on the structure of galls caused in various plants by different insects, Herr E. Küster gives the following summary of the most important conclusions.

Those galls which result from a superficial growth of the part of the plant attacked are always of simple structure; a great histological differentiation is found only in those which are the result of growth in thickness. Among normal kinds of tissue, the epiderm is that which offers the longest resistance to the action of the gall-irritant; the foci of formation of the gall are the mesophyll, the cortex, and the pith. The

* Arch. Sci. Biol. St. Petersburg, vii. pp. 411–34. See Journ. Chem. Soc., lxxviii. (1900) p. 493.

† Ber. Deutsch. Bot. Ges., xvii. 1899 (1900) Gen.-Vers. Heft, pp. 243–4.

‡ Comptes Rendus, cxxxi. (1900) pp. 124–6. § Op. cit., pp. 561–3.

‖ Flora, lxxxvii. (1900) pp. 117–93 (21 figs.).

most important change which the epiderm undergoes as the result of the action of the gall-irritant is the formation of hairs.

In the fully developed gall itself, the epidermal tissue is principally developed as epiderm; cork and bark are rare. The stomates of galls are often developed as air-fissures which remain permanently open; in some willow-galls true lenticels are formed. The assimilating tissue is usually but feebly developed; mechanical tissues are almost invariably present in those galls which are produced by growth in thickness. No stereids are present.

The cells of galls may resemble in form and arrangement those of the normal parts of the plant; or the arrangement may be changed; or forms of cells and tissues may occur which are not present in the normal parts of the plant. The gall-irritant is a compound of various sources of irritation.

Seasonal Dimorphism.*—Prof. R. v. Wettstein refers to the occurrence of this phenomenon in the vegetable, as in the animal kingdom, and regards it as a potent factor in the evolution of new species. As an instance he alludes to the changes introduced into meadow and pasture plants by the annual cutting of the grass; by which, in such genera as *Gentiana*, *Euphrasia*, *Rhinanthus*, *Galium*, *Campanula*, &c., the species are divided into two sections,—those which ripen their seeds before the mowing, and those which do not blossom till after the mowing.

Influence of Animals on Plant-life.†—Herr E. Ule records examples from the Tropics of various modes in which animals assist in the reproduction, the distribution, or the protection of plants under the following heads:—Bats as distributors of seeds (a species of *Cecropia*); Leaf-cutting ants as carriers of seeds (*Ipomæa pes capræ*); Small ants protecting plants against the attacks of leaf-cutting ants; Petals as food-materials for insects and birds; Extrafloral attractive organs as signals for fructivorous animals; Wholesale visiting by Insects with no result as to fertilisation (palms, &c.).

Embryo of "Mummy" Wheat and Barley.‡—M. E. Gain has examined the structure of the embryo of grains of wheat and barley obtained from Egyptian mummy-cases, and finds that, although the external appearance of the grain is unaltered and the reserve substances have maintained their chemical constitution, the embryo has undergone a great chemical change, and is no longer capable of development. The dormant life of the seed must have long ago expired. He concludes that the stories about the germination of these seeds after thousands of years are altogether apocryphal.

Percival's Agricultural Botany.§—This work is intended to aid in the removal of the deplorable ignorance too often displayed by agriculturists in the first principles of their craft. Its scope will be sufficiently shown by an enumeration of the headings of the chapters:—General External Morphology; Internal Morphology (Anatomy); Physiology of

* S.B. k. Akad. Wiss. Wien, Oct. 19, 1899. See Oesterr. Bot. Zeitschr., l. (1900) p. 25.
† Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 122–30.
‡ Comptes Rendus, cxxx. (1900) pp. 1643–6.
§ 'Agricultural Botany, Theoretical and Practical,' by John Percival. London, Duckworth, 1900, xii. and 798 pp. and 265 figs.

Plants; Classification and special botany of farm crops; Weeds of the farm; Farm Seeds; Fungi, considered chiefly in relation to some common Diseases of Plants; Bacteria. It is well and clearly written, and is the work of one well qualified to give valuable instruction in the various departments of Agricultural Botany.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Parthenogenesis in Marsilea.*—Herr A. Nathansohn states that, in several species of *Marsilea*, especially *M. Drummondii*, the tendency to parthenogenesis is greatly promoted by an increase of temperature; while a lowering of the temperature below that of an ordinary dwelling-room, exercises, when other conditions are favourable, but a slightly prejudicial effect on the process. He regards this as an illustration of the law that the effect of a high temperature on sexual cells is to deprive them of their sexual character and to impart to them vegetative properties.

Germination of the Spores of the Lycopodiaceæ and Ophioglossaceæ.† — M. N. Bernard finds the conditions of germination of the spores of species of *Lycopodium*, *Ophioglossum*, and *Botrychium* to be very similar to those of the seeds of Orchideæ (see p. 607), and to be in some way dependent on the assistance of the endophytic fungus which is constantly found in the cells of the prothallium of these plants.

Stem of Lycopodium.‡ — Mr. L. A. Boodle describes the arrangement of leaves in the dimorphic species of *Lycopodium*, *L. volubile* and *L. scariosum*, the resemblance to *Selaginella* being only apparent. *L. salakense* differs from other species of *Lycopodium* in the structure of the stem. The xylem of the stele does not form well-marked bands; the tracheids are arranged in small groups and curved uniseriate rows.

Regenerating Powers of Cystopteris.§—Pursuing his investigations on the development of the adventitious buds of *C. bulbifera* and other species of *Cystopteris*, Herr E. Heinricher has established the following points among others. In *C. bulbifera*, the buds are always produced on the basal region of the upper side of the fronds; if reversed they are not produced on the side exposed to light. Gravitation has also no effect on the part of the frond where they appear. In other species of *Cystopteris*—*C. montana*, *fragilis*, *alpina*—adventitious buds are formed on isolated basal portions of the frond, even when the frond has fallen off or is dead; but always on the upper side. The first fronds produced from these adventitious buds are of very simple structure, the lamina being often reduced to little but a mid-rib.

Algæ.

Assimilation, Metastasis, and Respiration of the Florideæ.‖—Herr R. Kolkwitz finds starch to be invariably present in the species of

* Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 99–109 (2 figs.).
† Rev. Gén. de Bot. (Bonnier), xii. (1900) pp. 115–20.
‡ Ann. of Bot., xiv. (1900) pp. 315–7.
§ Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 109–21 (1 pl.). Cf. this Journal, 1896, p. 654.
‖ Ber. Deutsch. Bot. Ges., xvii. (1899) 1900, Gen.-Vers. Heft, pp. 247–52.

Florideæ which he has examined (*Delesseria*, *Helminthocladia*, *Furcellaria*, *Polyides*), and to fulfil the same function as in the higher plants. The ripe spermatia (pollinoids) were, however, always found to be entirely destitute of starch. In *Delesseria sanguinea* the mid-rib is an organ for the storing up of reserve-substances. Where any part of the plant was uncoloured by the red pigment, this part was always found to contain more starch than the coloured portion. The process of respiration is also somewhat more active in the green than in the red portion, but is very feeble throughout the Florideæ.

Nuclear and Cell-division in Dictyota.*—Prof. D. M. Mottier notes the following specialities in the division of the nucleus and of the cell in *Dictyota dichotoma*.

The nuclear spindle originates in two systems of kinoplastic radiations or asters that lie close to the nuclear membrane and some distance from each other on opposite sides of the nucleus. The radiations of each system are centered upon a very distinct rod-shaped body, the centrosome; these together constituting the centrosphere. The centrosome is present during the two nuclear divisions which take place in the tetraspore mother-cell, in the germinating tetraspores, and in all the vegetative cells of the thallus.

The development of the spindle corresponds closely with that in *Stypocaulon*. During the prophase of both divisions of the tetraspore mother-cell, the behaviour of the chromatin differs strikingly from that of the higher plants. There is not developed here a regular and continuous chromatin-spirem which segments into the chromosomes, but these arise as isolated masses, often differing much in size. The reduced number of chromosomes, 16, appears in the first nuclear division in the tetraspore mother-cell. The development of the cell-plate or plasma-membrane belongs to the same type as in *Stypocaulon*, differing both from that in the higher plants, and from those in other families of Cryptogams. No differentiated connecting fibres of any sort can be recognised.

The author regards the centrosome rather as a special individualised part of the kinoplasm than as a distinct organ like the nucleus.

Plankton Algæ.—Herr E. Lemmermann † gives further results of a series of observations on Plankton-Algæ (and Protophyta). In the neighbourhood of Berlin he finds the following new species:—*Lagerheimia octacantha*, *Peridinium Marssonii*, *P. aciculiferum*. *Cyclotella chætoceras*, *Synedra actinastroides*, *S. berolinensis*, *Merismopedium Marssonii*, *Nostoc Kihlmani*. The mode of formation of the colonies of *Richteriella botryoides* is described, and he identifies with this species *Golenkinia fenestrata* and *G. botryoides*. A synopsis is given of the genus *Pteromonas*, including the form known as *Cryptoglena angulosa* or *Phacotus angulosus*, and 5 new species. An account is given of the brackish water phytoplankton of the neighbourhood of the Baltic, including 2 new species, *Chodatella Drœscheri* and *Cœlosphærium minutissimum*. The genera *Dinobryon*, *Mallomonas*, *Synura*, *Uroglena*, and *Ceratium* are wanting. The author

* Ann. of Bot., xiv. (1900) pp. 163–92 (1 pl.).
† Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 24–32, 90–8, 135–43 (1 pl. and 4 figs.).

does not agree with the proposed identification of the sterile filaments of *Aphanizomenon* with *Oscillatoria Agardhii*; regarding the latter as an entirely independent species.

Herr W. Schmidle * adds to the list 3 new species, *Lauterborniella elegantissima* g. et sp. n., *Schrœderia belonophora*, and *Rhabdoderma lineare* g. et sp. n. The following are the diagnoses of the new genera.

Lauterborniella. Cœnobes minute, flat, square, consisting of 4 cells arranged in a cross and imbedded in mucilage; cells round or subcuneiform on a vertical view and furnished with a thick spine; semilunate and with two spines on a lateral view; chlorophyllous contents parietal, with a single pyrenoid; propagation by cell-division in two directions.

Rhabdoderma. Cells 8–10 μ long, 2 μ broad; contents æruginous, homogeneous; enclosed in a very delicate membrane and a scarcely visible mucilage, formed by transverse division; rarely forming a few-celled filament, more often membranaceous families, which are ultimately curved.

Cosmocladium saxonicum.† — Herr B. Schroeder has studied the structure and development of this colonial desmid, especially in reference to the fine threads which connect the individual cells with one another. He regards these as having their origin in extra-cellular cytoplasm, being, in fact, analogous to the protoplasmic threads which so commonly connect the cells of a tissue with one another. He has been able to trace their origin to the sieve-like perforations in the cell-walls, near the base of the cells. The investing gelatinous envelope has at first a radial structure, and serves as a protection to the colony against unfavourable external influences. The statement that it consists of a double layer was not confirmed.

Formation of Auxospores in Diatoms.‡—Herr G. Karsten has studied the formation of auxospores, especially in the genera *Cocconeis*, *Surirella*, and *Cymatopleura*. In relation to the four types already established by the author,‖ he still regards *Rhabdonema arcuatum* as probably the primary form. The process in Type I. shows the genetic connection between the formation of auxospores and ordinary cell-division, as also the entire absence of sexuality in the archaic forms. A passage to more complicated phenomena is seen in *Achnanthes subsessilis*, where there is undoubted sexuality, though of a low order. A more fully developed sexuality is exhibited by the majority of ground-diatoms. Of the second type, characterised by the formation of two auxospores, the author regards *Synedra affinis* and *Bacillaria paradoxa* as reversions. In Type III. there is also a distinct sexuality. In *Cocconeis* the sexual nucleus is the result of a single, in *Surirella* of a double nuclear division. In the Tabellarieæ and in the entire mass of centric species, forms may be recognised which have descended in direct lines from the original form.

Pores of Diatoms.§—Herr F. Schütt regards the present position of the question of the perforation of the diatom-valve to be somewhat as

* Tom. cit., p. 144–58 (1 pl.). † Tom. cit., pp. 15–23 (1 pl.).
‡ Flora, lxxvii. (1900) pp. 253–83 (3 pls.) Cf. this Journal, *ante*, p. 491.
§ Cf. this Journal, 1899, p. 514.
‖ Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 202–16. Cf. this Journal, *ante*, p. 360.

follows:—In a small number of species there can be no question of the existence of pores; while in a very large number of species their existence is very probable. In some species of *Pinnularia* the non-existence of pores has been made very probable by Müller and Lauterborn; and the same is regarded by Müller as also probable in a small number of species belonging to other genera. In a somewhat larger number of species, especially in those with imperfect raphe, observations have not at present been sufficiently exact to determine the question. Negative evidence on the question cannot at present be regarded as conclusive.

The author regards it as probable that perforation of the valve was characteristic of the archaic type of diatoms. One of the most highly developed types is probably that of the Pinnularieæ, in which the numerous small pores of the original type have been replaced by a highly developed raphe.

If these conclusions are correct, they are regarded by Schütt as to a large extent negativing the supposed isolation of diatoms from all other forms of vegetable life. From the diatom genus *Melosira* it is but a step to *Hyalotheca* among Desmidiaceæ, and to *Exuviella* among Peridinieæ; and these three families may be grouped together as constituting the class Placophyta or Placophyceæ.

Synedra hyalina sp. n., a new non-chlorophyllous Diatom.*—Dr. S. Provasek has found, on decaying masses of *Ulva* at Trieste, an addition to the very few recorded instances of a diatom destitute of chlorophyll. *Synedra hyalina* sp. n. is a minute organism, about $0 \cdot 04 \times 0 \cdot 0034$ mm., endowed with rapid motion; the valves have no fine sculpture. The hyaline protoplasm forms, in the middle of the cell, a biconvex bridge, from which a delicate layer of protoplasm runs along the two valves towards the poles; in the poles is a mass of protoplasm; the intermediate cavity may, or may not, be traversed by lamellæ of protoplasm; it has a roundish nucleus; there are no leucoplasts. The discovery is of interest in connection with a possible derivation of the Diatomaceæ from the Flagellata.

Fungi.

Rhizomucor parasiticus, a new pathogenous Fungus.†—In the bronchial tubes of a woman about thirty years of age, living in the country, MM. Lucet and Costantin found a fungus which was distinctly parasitic and pathogenous, causing cough and other morbid conditions. It belonged to the Mucorini, and is named by its discoverers *Rhizomucor parasiticus* sp. n. It constitutes a new section of the genus, characterised by irregular stolons and rhizoids and branched sporangiophores; the columel is surrounded at the base by the *débris* of the membrane of the sporange. It was found to be pathogenous to rabbits and guinea-pigs; but with dogs the results were negative.

Structure of the Protoplasm of Mortierella.‡—By the use of the pigment (violacein) derived from chromogenous bacteria (see p. 647) M. L. Matruchot has detected what he terms a "canalicular" structure in the protoplasm of the unseptated hyphæ of *Mortierella reticulata*. At

* Oesterr. Bot. Zeitschr., l. (1900) pp. 69-73 (2 figs.).
† Rev. Gén. de Bot. (Bonnier), xii. (1900) pp. 82-98 (2 pls.).
‡ Tom. cit., pp. 33-60.

a certain phase the cytoplasm is differentiated into a transparent hyaloplasm which is not stained, and a stainable granular enchylema. This latter takes the form of cylindrical cords, varying in number, imbedded in the general mass of hyaloplasm. The enchylema alone contains bodies which can be compared to nuclei; and it appears to be only within the cords that circulation of protoplasm takes place. Subsequently the enchylema undergoes an oily degeneration.

Fertilisation of Peronospora parasitica.*—A detailed study of this process has led Mr. H. Wager to the following general conclusions.

The protoplasm of the oogone becomes differentiated into a central vacuolate ooplasm and a granular homogeneous periplasm. Immediately before this takes place, a receptive papilla is formed on the oogone at the place where the antherid is in contact with it. At this spot the wall of the oogone becomes very thin, and it is here that the fertilising tube of the antherid penetrates the oogone. The nuclei of the oogone and antherid undergo mitosis previous to fertilisation. A central body becomes differentiated within the oosphere which appears to play some part in bringing the sexual nuclei together, but disappears before the fusion of a single nucleus which travels from the periplasm of the oosphere and a single nucleus from the antherid which passes through the fertilising tube. This fusion does not take place until the zygote is nearly mature. The mature zygote is uninucleate. Of all the nuclei in the oogone, one only is set apart for the purpose of reproduction, the others remain in the periplasm, and are used up to form the protective layer or layers of the oospore. No difference is observable between the sexual nucleus and those which remain in the periplasm. They have the same size and structure, and stain in a similar manner. Hence it is probable that all the nuclei of the oogone are potentially sexual.

There appear to be three distinct modes of fertilisation in the Peronosporaceæ:—(1) Uninucleate oosphere, binuclear fusion, and uninucleate oospore (*P. parasitica*). (2) Uninucleate oosphere, binuclear fusion, and multinucleate oospore (*Cystopus candidus*, *C. Portulacæ*, *Peronospora Ficariæ*). (3) Multinucleate oosphere, multinuclear fusion, and multinucleate oospore (*C. Bliti*).

Starch-corroding Fungi.†—Herr F. H. Billings dissents from the opinion of Roze ‡ that *Amylotrogus*, of which he describes five species as having the property of corroding starch, is a reduced Myxomycete. He finds no evidence of the existence of a plasmode; the corrosion being caused by hyphæ belonging to an undoubted fungus. Other starch-corroding fungi are *Stysanus stemonitis*, *Trichocladium* sp., *Chætomium* sp., *Fusarium* sp., and *Coremium* sp.

New Genera of Fungi.—In a collection made by Ule in Brazil, Dr. H. Rehm § finds the following new genera:—

Lindanella (Stictidearum). Apothecia innata, primitus globoso-clausa, dein poro rotundo aperta et discum rotundum denudantia; asci cylindrici, 8-spori; sporidia globosa, glabra, hyalina, 1-sticha; paraphyses filiformes.

* Ann. of Bot., xiv. (1900) pp. 263–79 (1 pl.).
† Flora, lxxxvii. (1900) pp. 288–98 (2 pls.). ‡ Cf. this Journal, 1897, p. 154.
§ Hedwigia, xxxix. (1900) pp. 82 and 90 (3 figs.).

Mellitosporiopsis (nearly allied to *Goniothecium*). Apothecia sessilia, in mycelio tenuissimo, primitus globoso-clausa, dein urceolata, demum disco rotundo, plano, tenuissime marginato, excipulo parenchymatice contexto, extus glabra, ceracea; asci subclavati, crasse tunicati, 1-4-spori; sporidia oblonga, obtusa, plerumque tecta, hyalina, pluri-septata-muriformia, mucore obducta; paraphyses apice ramosæ, conglutinatæ, epithecium formantes; hypothecium hyalinum.

Coccoidea quercicola g. et sp. n. forms, according to P. Hennings,* small black disks on the underside of the leaves of an evergreen oak in Japan. It belongs to the Dothidiaceæ.

Parasitic Fungi.—Herr P. Magnus † describes a new species of *Phleospora*, *P. Eryngii*, parasitic on *Eryngium maritimum*.

Rossellinia radiciperda Mass.‡ sp. n. is the name given to a parasitic fungus which attacks the roots of apple trees in New Zealand, the mycele of which closely resembles that of *Dematophora necatrix*.

Mr. A. Howard § traces a disease very destructive to two different species of *Tradescantia* to a species of *Botryosporium*, apparently identical with *B. diffusum*, accompanied by a species of *Hormodendron* (*Cladosporium*).

Herr P. Magnus ‖ gives a full description of the rare *Neovossia* (*Vossia*) *Moliniæ*, belonging to the Ustilagineæ, parasitic on the ovary of *Molinia cœrulea*.

Stroma of the Sphæriales.¶—From an exhaustive examination of the stroma of the Pyrenomycetes, especially of the Sphæriales, Herr W. Ruhland distinguishes the following types:—(1) In its primitive development the stroma is nothing but a massing of mycele caused by the increased nutritive requirements of the crowded peritheces. For this type he proposes the term *protostroma*. In a higher stage, the *diplostromatic* type, a differentiation is established into two layers, an *ectostroma* and an *entostroma*. The former is developed immediately beneath the periderm of the branch of the host on which the fungus grows; the latter occupies the cortical parenchyme. The chief purpose of the former is to burst the periderm; it frequently also forms conids. In some cases it is partially or entirely thrown off. The entostroma is the origin of the peritheces; their tubes reaching either only to the inner surface of the ectostroma or growing completely through it. Hence the tissue which surrounds the tubes of the perithece, called by the author the *placodium*, is derived either from the entostroma or from the ectostroma. The ectostroma is in some cases greatly reduced in size. (2) The highest forms of the Sphæriales, represented by *Pseudovalsa*, *Botryosphæria*, and the Xylariaceæ, have again a uniform (undifferentiated) stroma, the *haplostromatic* type, in which the entostroma is greatly reduced, and serves only as a mycele for the nutriment of the ectostroma. The formation of peritheces then takes place in the ectostroma. The morphological differentiation of the stroma appears to be the result of the direct influence of the substratum.

* Engler's Bot. Jahrb., xxviii. (1900) pp. 259–80.
† Hedwigia, xxxix. (1900) pp. 111–4 (1 pl.).
‡ Journ. Board of Agriculture, vii. (1900) pp. 10–6 (1 pl.).
§ Ann. of Bot., xiv. (1900) pp. 27–38 (2 pls.).
‖ Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 73–8 (1 pl.).
¶ Hedwigia, xxxix. (1900) pp. 1–79 (3 pls.).

Biology of Poronia punctata.*—Miss Maria Dawson has followed out the life-history of this ascomycetous genus of Fungi, which she places between *Polystigma* and *Xylaria*. The trichogyne-like processes are treated as a degenerate organ, homologous to the trichogynes of the Florideæ and of the Collemaceæ. Associated with this degenerate process is a coiled hypha comparable to the archicarp of *Polystigma*. The spermogones and pollinoids (spermatia) are not developed, so that there can be no question of the sexual function of the trichogyne.

New Genera of Laboulbeniaceæ.†—Mr. R. Thaxter now adds 68 more to the known species of this family of Fungi, parasitic on living insects, together with the following seven new genera:—

Polyascomyces. Receptacle consisting of two superposed cells, the upper bearing a perithece laterally and an appendage terminally; appendage consisting of a series of superposed flattened cells, surmounted by a dome-shaped portion which is not persistent; perithece with a distinct stalk-cell and well-developed basal cells, the supporting cell and the lower wall-cells forming a broad base, the upper surface of which constitutes a broad ascigerous area, the asci arising from great numbers of ascigerous cells.

Monoicomyces. Receptacle consisting of a basal and sub-basal cell, above which it terminates in a small 2-celled sterile portion; the fertile branches consisting of from one to several cells in different species, the terminal cell of each branch normally giving rise to a stalked perithece and a stalked antherid; antherid of the compound type, consisting of a stalk composed of two cells, the antherid proper consisting of certain basal cells, two tiers of peripheral cells which surround numerous antheridial cells and a cavity above them, and three or four terminal cells, surrounding an opening through which the antherozoids are discharged.

Limnaiomyces. Receptacle consisting of two portions, a basal part below the perithece and a distal part united to its posterior margin; the basal portion consisting of a single basal cell surmounted by two tiers of cells, the anterior cell of the upper tier giving rise to a compound antherid; the distal portion consisting of an inner and an outer elongated cell, the inner one terminating in a bell-shaped appendiculate cell, the outer one forming a series of cells from which a small secondary appendiculate cell is separated off. Intermediate between *Peyritschiella* and *Chitonomyces*.

Eucorethromyces. General form as in *Rhadinomyces*; the receptacle consisting of two superposed cells, the upper giving rise to the perithece and appendage; perithece as in *Rhadinomyces*, stalked; appendage consisting of several superposed cells, the distal one bearing terminally a series of branches which produce free flask-shaped antherids laterally, borne on short lateral branches or sessile.

Clematomyces. Receptacle consisting of a basal and a sub-basal cell, from which arises distally a main axis bearing a terminal perithece and formed by a double row of cells; the cells of the external row producing sterile appendages; antherids simple.

* Ann. of Bot., xiv. (1900) pp. 245-62 (2 pls.).
† Proc. Amer. Acad. Arts and Sci., xxxv. (1900) pp. 409-50. Cf. this Journal, *ante*, p. 366.

Misgomyces. Receptacle consisting of numerous cells superposed singly or in tiers of two or three cells each, terminating in a more or less irregularly cellular base bearing appendages singly or in groups; peritheco solitary.

Euzodiomyces. Receptacle elongate, multicellular, consisting of a large and indefinite number of cells superposed above the single basal cell, and distally becoming divided by a few or many longitudinal septa, the distal portion bearing a unilateral series of peritheces and appendages; peritheces with from nine to ten wall-cells in each row, borne on a 3-celled stalk. Closely allied to *Zodiomyces*.

Saccharomyces anomalus Group.*—Herr L. Steuber examined four varieties of the *Saccharomyces anomalus* group:—(i.), distinguished by the acetic-etherlike aromatic odour of the cultures, was isolated from yeast water; (ii.), obtained from fermenting cherries, was characterised by the pinkiness of old cultures; (iii.) and (iv.) were derived from Munich beer. On wort all four forms were thermophilous. Their spore-formation was marked by special characteristics:—(i.) ferments 10 per cent. solution of saccharose, dextrose, and levulose, but not maltose, lactose, or galactose; in the sugar solutions were formed acetic ether and acetic acid, and some butyric acid, and in lactose and galactose there were traces of free alcohol. (ii.) inverts and ferments 10 per cent. cane-sugar solution, but not levulose, dextrose, lactose, galactose, or maltose; acetic ether and fatty acids were not formed, and only traces of acetic and butyric acids. (iii.) and (iv.) do not ferment sugars, and form only traces of alcohol. Neither acetic ether nor fatty acids were produced; and while at first traces of acetic and butyric acids were present, they were oxidised later on. All four forms decolorise beer-wort after long cultivation. None of the four forms affected the taste of low-fermented beer.

Yeast-Fungus as a Symbion in Beetle's Gut.†—Dr. K. Escherich notes that, just as *Saccharomyces guttulatus* has, according to Casagrandi and Buscalioni, its normal habitat in the rabbit's stomach and intestine (and other cases are known), so in the gut of *Anobium paniceum* there is a normal occurrence of a budding chain-forming yeast-like fungus. In the larva and adult it is always present in the cells of the wall of the mid-gut, and is localised in quite definite areas. In the pupa it almost disappears, but reappears in abundance when the imago begins to feed.

Fragrant "Mycoderma" Yeast.‡—Mr. B. T. P. Barker describes a yeast with a pleasant fruity odour, which was obtained when commercial ginger was added to saccharose-Mayer solution, beer-wort, and other nutrient media. The growth has a white floury appearance. In hanging drops a single cell budded off another in about two hours at 19°–19·5° C., and after about eight cells had been produced, the gelatin in the immediate neighbourhood was liquefied so that the colony became broken up.

The individual cells of this yeast, *Saccharomyces anomalus*, vary in

* Zeitschr. f. d. gesammt. Brauwesen, xxiii. pp. 3–10, 17–25, 33–6. See Bot. Centralbl., lxxxii. (1900) pp. 204–5.

† Biol. Centralbl., xx. (1900) pp. 340–8 (6 figs.).

‡ Ann. of Bot., xiv. (1900) pp. 215–44 (1 pl.).

shape according to environment and age. When young they are mostly ellipsoidal, are filled with a colourless protoplasm, are devoid of granules and vacuoles, and the cell-wall is not clearly differentiated. Spores, one to four in number, are formed in a single cell. In size they average from $3 \cdot 5\ \mu$–$4 \cdot 5\ \mu$ and resemble a bowler hat in shape. The spores germinate in about 24 hours; they first double their size, and then protrude a bud which in turn reproduces others when they attain the size of an ordinary cell, 5–7 μ. Growth takes place between 15° and 32° C., the optimum being 28°. *S. anomalus* is strongly aerobic; liquefies gelatin; excites fermentation, the products being mostly carbon dioxide, but also ethyl and other alcohols, organic acids, and fruit ethers. After alluding to the history of the species, the author discusses the relationship between *S. anomalus* and *Endomyces decipiens.*

Experiments with Wine Ferments.*—Prof. R. Chodat and Dr. A. Lendner have carried out experiments with different kinds of yeast for the purpose of testing their value in wine-making from Swiss grapes. The intention was not so much to turn Swiss wines into French, as to render the wine-grower independent of chance by furnishing him with a means of directing the fermentation, and of preventing foreign organisms, fungi, and bacteria from developing.

A red wine, Jussy, was tried with six yeasts, and a white wine, Carre, with seventeen. With one yeast the Jussy grape furnished a wine with a fair amount of alcohol and agreeable flavour; with the rest the results were unfavourable. The average results with the white wine were, on the whole, less unfavourable.

Specific Value of Enzyme Formation.†—M. A. Klöcker contests the statement of Dubourg that yeast fungi naturally devoid of fermenting power can by artificial means be endowed with this function. The author's experiments gave quite contrary results, and consequently the conclusions drawn by Duclaux from Dubourg's premisses are untenable. Duclaux inferred that the behaviour of alcohol-fungi to sugars could not be used as a specific criterion, while the author on the contrary holds that the enzyme formation of alcohol fermentation fungi is one of the most constant specific characters we possess.

Significance of Mycorhiza.‡—Prof. D. T. Macdougal enumerates all the species of fungi which have been determined as constituting the mycorhiza of different plants. They belong to the Oomycetes, Pyrenomycetes, Hymenomycetes, and Gasteromycetes; while the families especially infested by them are the conifers, orchids, heaths, oaks, poplars, and beeches, as well as Vascular Cryptogams and Hepaticæ. The Monotropaceæ and *Wullschlaegelia aphylla* (Orchideæ) have entirely lost the power of forming chlorophyll, and depend upon the fungi symbiotic with their roots for organic nutriment. The author regards the widespread occurrence and distribution of mycorhizas as indicating the great importance of these structures in the nutrition of the greater number of perennial seed-plants.

* Arch. Sci. Phys. et Nat., ix. (1900) pp. 365–90.
† Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 241–5.
‡ Biol. Lectures from Mar. Biol. Lab. Woods Holl, 1899 (1900) pp. 49–56.

Cytology of the Hymenomycetes.*—A series of observations on several species of Hymenomycetes has led M. R. Maire to conclusions in some respects different from those of Wager. The cells of the young carpophore contain normally two nuclei; these conjugate in the same manner as in the Uredineæ; each of the conjugated nuclei possesses four chromosomes. The young basid possesses normally two nuclei. The prophase, metaphase, and anaphase stages of mitotic division are described in detail. In the formation of the basidiospores there arises in the cytoplasm of the basid a kinoplasmic differentiation characterised by the production of longitudinal filaments. The apices of the sterigmas swell up into spores, into which the centrosomes pass. All the cytoplasm of the basid passes into the spores. The mitosis of the spore presents the same features as that of the basids; each daughter-nucleus receives four chromosomes. The mitotic figures resemble those of the Uredineæ; at the prophase stage they have four chromosomes. The conids have only a single nucleus, the chromatin of which is concentrated into a nucleole.

Rabenhorst's Cryptogamic Flora of Germany (Fungi Imperfecti).† Herr A. Allescher's last three parts of this important work include the completion of the Hyalodidymæ with the genera *Tiarospora* (1 sp.), *Actinonema* (8 sp.), *Cystotricha* (2 sp.), *Rhynchophoma* (3 sp.), and *Cytodiplospora* (8 sp.). The third section of the Sphærioideæ, the Scolecosporæ, are distinguished as having the spores rod-shaped, filiform, or elongated-fusiform, unicellular or septate, hyaline or greenish-yellow; and comprise 14 genera: *Septoria*, *Rhabdospora*, *Collonema*, *Trichoseptoria*, *Phleospora*, *Phlyctæna*, *Sphærographium*, *Cornularia*, *Eriospora*, *Dilophospora*, *Septoriella*, *Cytosporina*, *Micula*, and *Micropera*. The greater part of these three parts is taken up by the huge genus *Septoria*, of which no less than 494 species are described, besides a few doubtful ones. *Rhabdospora* is then commenced, and 35 species described.

Protophyta.

β. Schizomycetes.

Reducing Power of Bacteria.‡—Herr A. Wolff mentions in a preliminary communication the principal results of experiments bearing on the reducing power of bacteria. The anaerobes, especially malignant œdema, possess very great reducing power; coli and typhoid bacilli are strongly reducing; while anthrax and cholera bacilli are but faintly reducing, and tubercle-bacilli not at all.

Unnucleated Bacteria.§—Herr G. Marpmann remarks that bacteria are of different degrees of complexity of structure, some exhibiting a sheath with processes and internal contents, which latter have been regarded as cytoplasm and nucleus or as wholly nuclear. It seems, however, very probable that some bacteria cells are devoid of nucleus and exist as cytodes. The difficulty of staining the cells properly is the real crux. In the course of his remarks the author recommends Erika

* Comptes Rendus, cxxxi. (1900) pp. 121–4. Cf. this Journal, *ante*, p. 231.
† Lief. 70–72 (1900). Cf. this Journal, *ante*, p. 236.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 849–52.
§ Zeitschr. f. angew. Mikr., vi. (1900) pp. 101–3.

B and thiochromogen in aqueous solution and used successively for staining bacteria.

Production of Acetic Acid in Milk by Lactic Acid Bacteria.*—Herr Chr. Barthel made experiments to ascertain the quantity of acetic acid produced in one and the same milk by the same species of bacterium, but under different external conditions. The bacterium used was obtained from spontaneously coagulated milk, and from its morphological and biological aspect was identified as *Bact. lactis acidi.* The first problem attacked was the difference between the amount of acetic acid produced (1) in the presence of a copious supply of air, and (2) in the total absence of air. The relation was found to be as 3 to 2, a considerable difference. The second problem was to ascertain whether different temperatures exert any influence on the formation of acetic acid by lactic acid bacteria. The experiments showed that the amount of acetic acid produced decreased with the increase of temperature, the differences in the amount however being slight.

The inference from the foregoing facts is, that acetic acid is to a certain extent a pathological product of the cell-life of the lactic acid bacteria.

Oxalic Acid Formation by Bacteria.†—Herr W. Zopf makes a preliminary communication on the formation of oxalic acid from grape-sugars by the following bacteria,—*B. aceti* Hansen; *acetogenum* Henneberg; *acetosum* Henneberg; *ascendens* Henneberg; *kützingianum* Hansen; *pasteurianum* Hansen; *xylinum* J. Brown. All of these were found capable of oxidising grape-sugar into oxalic acid. The nutrient medium used contained gelatin 10 p.c., grape sugar 2–3 p.c., pepton 1 p.c., extract of meat 1 p.c. The oxalic acid was deposited in the substratum in the form of minute crystals of calcium oxalate. Control experiments with sugar-free media gave negative results, so that the possibility of the formation of oxalic acid from the carbon compounds of meat extract used for making the nutrient substratum appears to be excluded.

Inoculation of Beans with the Nodule Bacteria of Peas.‡—Herren F. Nobbe and L. Hiltner record a series of experiments made with root-bacteria of peas and beans. They found that each plant, if inoculated with the bacterium of the other, produced root-nodules, but that these are usually incapable of assimilating nitrogen and of promoting growth. The nodules caused by pea-bacteria on bean roots produce a vaccine-material, which not only leads to nodule formation on bean rootlets, but is approximately as effective; the dried substance of beans inoculated with these "cross" bacteria amounting to 80·74 per cent., and the nitrogenous to 74·8 per cent. of the quantity produced by pure bean-bacteria. On the other hand pea-bacteria, according as they become more and more acclimatised to the bean, become alienated in the same proportion from their original host-plant. Their infectivity to the pea becomes diminished; the dried substance of peas formed by the action of cross bacteria being only 69·83 per cent., and the nitrogen 49·26 per cent. of the plants inoculated with pure pea-bacteria. The experiments

* Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 417–20.
† Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 32–4 (2 figs.).
‡ Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 449–57 (1 pl.).

are held to afford positive proof of the adaptability of nodule bacteria to other genera of Leguminosæ. The illustrations are extremely effective, and show *Phaseolus vulgaris* (1) uninoculated, (2) with bean-bacteria, (3) with pea-bacteria, (4) with cross bacteria.

New Pigment-forming Bacillus.*—Dr. H. Marx and Herr F. Woithe found in the discharge from an operation wound and also in the air of the ward, a pigment-forming bacterium which is designated *Bacillus brunificans Berolinensis.* It is a motionless rodlet $0 \cdot 5\ \mu$ broad and $0 \cdot 75$–$1\ \mu$ long. It grows well on the usual media, and forms a brown to blackish-brown pigment which spreads from the surface to the depth of the medium and becomes darker with time. Gelatin is liquefied. It does not form spores, and is not pathogenic to animals. The optimum temperature is 30°. The pigment formation is not influenced by sunlight. The pigment is not soluble in chloroform.

Black-rot of Cabbage.†—Mr. H. A. Harding records important observations as to the existence of the black-rot of cabbage in North-western Europe. The disease is well known in the United States, and the cultural characteristics of the causative microbe, *Bacillus* vel *Pseudomonas campestris* Pammel, have been thoroughly described by American observers.‡

Bacteriosis of Dactylis glomerata.§—Herr E. Ráthay describes a bacterium disease which attacks this grass. It forms a yellow slime, the pigment of which is insoluble both in water and in alcohol. The microbes are ellipsoidal, and apparently destitute of vibratile cilia.

Tuberculosis in the Frog due to Fish Tubercle Bacillus.‖—Dr. Ledoux-Lebard records some more observations as to the action of *Bacillus tuberculosis piscium* on the frog. These bacilli are grouped in filaments, and exhibit false branchings; they are resistant to acids, and the appearance of cultures bears some resemblance to those of avian and human tubercle. The optimum temperature is however lower. Piscian tuberculin was found to give a much less marked reaction in guinea-pigs than Koch's tuberculin. Injections into the dorsal lymph-sac were followed by emaciation and death in a few weeks to months. In these cases the liver was chiefly affected, bacillary tubercles being disseminated throughout the organ. Though tubercles were found elsewhere, their presence was less marked than in the liver. The site of a tubercle was marked by necrosis, caseation, and cell-proliferations. In animals killed 10 minutes after infection, the presence of bacilli in leucocytes was observed in the liver and kidneys. The numbers increased as time went on. The activity of certain pigmented cells in the liver is described as being a special form of defence. These cells are apparently of endothelial origin, and have definite phagocytic functions. The effect of temperature is very marked; 22° C. is practically the optimum; below 20° the progress of the tuberculosis is slower, while above 34° it is arrested.

* Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 862–8.

† Proc. Amer. Ass. Adv. Sci., xlviii. (1899) p. 294. Also Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 305–13 (2 pls., 1 fig., 1 map).

‡ Cf. this Journal, 1897, p. 574; 1898, p. 462.

§ S.B. Akad. Wiss. Wien, cviii. (1899) pp. 597–602.

‖ Ann. Inst. Pasteur, xiv. (1900) pp. 535–54 (1 pl.).

Influence of Human Tubercle Bacilli on Frogs.* — Herr V. Sion contests the views of Bataillon, Terre, and others as to the influence of human tubercle bacilli on frogs. The author finds that it does not excite any characteristic lesions, nor does it become generalised in the body of this animal. It does not undergo any fundamental changes of shape, staining reaction, &c.; its virulence remains unaltered; and it does not endow the frog with any soluble substance which can impart immunity to guinea-pigs or increase their resistance.

Growth of Tubercle Bacilli on Mucus.†—Dr. P. Römer finds that tubercle bacilli grow with extreme facility in mucus obtained from healthy persons. As a medium mucus suffers from contamination with numerous microbes which may obscure the growth of the tubercle bacilli, and all attempts to sterilise it failed. The favourable growth of the tubercle bacilli in mucus is presumed to be due partly to its physical characters and partly to nutrient substances dissolved in it.

Bacillus pyocyaneus.‡—Dr. P. Krause found that currents of high tension (Tesla) have no direct action on cultures of *Bacillus pyocyaneus* and other bacteria, but that, owing to the heat developed, the cultures are killed or much damaged. When placed within a solenoid no diminution of growth was observed, but the green pigment of *B. pyocyaneus* was altered to yellow, and the red of *B. prodigiosum* became pale rose.

When existing in symbiosis with *Streptococcus pyogenes*, it was noticed that the pigment formation of *B. pyocyaneus* might be greatly diminished or even suppressed, so that colourless pus might contain *B. pyocyaneus* without its presence being recognised by the naked eye.

Under anaerobic conditions the vitality and chromogenic function were impaired or lost.

B. pyocyaneus produces two pigments: the blue, pyocyanin, is specific, and when dissolved by chloroform can be used to distinguish it from other fluorescing bacteria; while the green fluorescing pigment is soluble in water, and is formed by numerous other bacteria.

Effect of Pyocyanase on Anthrax.§ — Prof. R. Emmerich and Dr. Saida describe the morphological changes in anthrax bacilli under the influence of pyocyanase. The bacterium swells up, becomes granular and finally almost transparent. The dissolution takes place even more quickly *in vivo* than *in vitro*, if directly after artificial infection pyocyanase solution be injected intravenously or subcutaneously. The changes observed are ascribed to the action of a proteolytic enzyme, pyocyanase, which was obtained by filtering a fluid culture, then dialysing, and precipitating with absolute alcohol. The pyocyanase thus obtained was dried *in vacuo* over sulphuric acid. When used it was dissolved in distilled water. Its reaction should be alkaline, as acid solutions have no effect. The preparations were stained by Nakanishi's method. The authors claim that their observations have a direct bearing on the cure of infectious disease and artificial immunity.

Bacteria in the Stomach of the Cat.‖ — Dr. J. Weiss made an investigation of the bacteria in the stomach of the cat; among the more

* Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 710–20.
† Tom. cit., pp. 705–9. ‡ Tom. cit., pp. 769–75. § Tom. cit., pp. 776–87 (1 pl.).
‖ Journ. Applied Microscopy, iii. (1900) pp. 827–35.

important results may be mentioned the following. A large percentage of species produce indol, acidify and coagulate milk, ferment glucose, lactose, and saccharose with or without the production of gas, but do not produce peptones. The presence of bacteria in the proteids during peptic digestion was found to cause a marked reduction in the amount of peptones formed.

Bacteriology of Leprosy.* — Dr. J. Barannikow supplements a previous note on the bacteriology of leprosy by a communication in which he remarks that the microbe is distinguished by a very complicated developmental cycle, and that the forms of the different evolution stages are unequally sensitive for animals. In some stages the bacillus is very easily decolorised, and it is very difficult to avoid overlooking it; in this condition it appears to be more active than when easily demonstrable.

From lepra nodules, which have been dried for ten days, cultures are obtainable, and these do not differ in any material respect from those obtained from fresh tissue. In the latest stages of development cladothrix-like forms appear, while the earliest closely resemble the tubercle bacillus.

Elimination of Bacteria by the Kidneys and Liver.†—Dr. Métin, who has been working at the elimination of bacteria by the glands of the body, finds that the kidneys and liver are impermeable to bacteria introduced subcutaneously or intravenously. When however the cultivation tubes contain growths of the microbe injected, it is because the inoculated fluid contains some blood, and this is evidence of a vascular or epithelial lesion of mechanical or chemical origin.

Infectious Disease of Ostriches.‡—Dr. Marx isolated from ostriches a microbe belonging to the group of bacteria of hæmorrhagic septicæmia. The chief symptoms were weakness and palsy of the limbs and neck; death in 2–3 weeks. In size and appearance the bacterium resembled the plague bacillus, though in the body of animals the size varied, being thin in mice, and large and plump in birds. It was devoid of movement, was easily stained, but not by Gram's method. Spore-formation was not observed. It grew well on the usual media. Milk was coagulated in 72 hours; grape-sugar was fermented, indol was not formed. The reaction of the medium was always strongly acid. The microbe was pathogenic to mice and small birds.

Bacteriology of Suppurative Meningitis.§ — Dr. Scheib isolated from a case of suppurative meningitis a bacterium which presented itself as a short rodlet, constricted in the middle, and having rounded ends. In length it measured from 1·4 to 2 μ and its breadth was 0·5 μ. It occurs usually singly, sometimes in pairs, and as a rule inside cells. The bacterium was devoid of movement, grew luxuriantly in most nutrient media, fermented sugars, and was highly pathogenic to laboratory animals. The author identifies the microbe with *Bacillus lactis aerogenes* Escherich.

* Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 709–10. Cf. this Journal, 1899, p. 544.

† Ann. Inst. Pasteur, xiv. (1900) pp. 415–9.

‡ Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 822–4.

§ Wiener Klin. Wochenschr., xiii. (1900) p. 590.

Elective Staining of Sporiferous Filaments of Spirobacillus gigas.*—M. A. Certes records some observations made on living *Spirobacillus gigas* when placed in weak solutions of methylen-blue. During the vegetative period the living motile bacilli are as completely and uniformly stained as those which have ceased to move.

Directly, however, spore-formation commences, numerous individuals are observed to be only partially stained. Further observations showed that the colouring matter had been absorbed by the spores, thus leaving the rest of the filament more or less unstained.

Short and Asporogenous Variety of Anthrax.†—M. C. Phisalix succeeded in producing a short and non-sporing variety of anthrax which he designates *Bacillus anthracis brevigemmans.* Collodion bags filled with bouillon inoculated with virulent anthrax were introduced into the peritoneal sac of an adult dog. When examined three months after, the fluid was turbid. The contents under the Microscope showed neither bacilli nor spores, but collections and chains of cocci. These were stainable by Gram's method, were asporogenous and devoid of virulence. Re-sown in bouillon they maintained their shape and properties. The alterations in the anatomy and physiology of the microbe are due to substances dialysing from the blood; but whether the new form is to be regarded as variety or species, the author leaves for future experiments to determine.

Foul Brood of Bees. ‡ — Mr. F. C. Harrison makes an interesting communication on the foul brood of bees, the cause of which was first demonstrated by Cheshire and Cheyne.§ After a short historical *resumé*, the geographical distribution, the symptoms of the disease, and its diagnosis from chilled brood are first described. The morphological and biological characters of *Bacillus alvei* are then dealt with very thoroughly, after which the author passes on to a consideration and analysis of the remedies which have been proposed and applied to the treatment of the disease. The most effective of these appear to have been salicylic acid, creolin, eucalyptus, and formic acid. With regard to the last it is interesting to note that the bees use it themselves as a preservative, for "when honey is not destined for immediate use, the bee deposits in each cell a drop of formic acid, secreted by the venom-glands, and then seals the cell," and also that "the amount of formic acid recommended by Bertrand for the cure of the disease is almost identical with the amount found in buckwheat honey."

The paper concludes with some details as to legislative measures adopted in some countries for the suppression of foul brood. Eighty references to the literature of the subject are appended.

* Comptes Rendus, cxxxi. (1900) pp. 75–7. † Tom. cit., pp. 424–7.
‡ Centralbl. f. Bakt. u. Par., 2te Abt., vi. (1900) pp. 421–7, 457–69, 481–96, 513–7 (4 figs.). § Cf. this Journal, 1885, p. 581.

MICROSCOPY.

A. Instruments. Accessories, &c.*

(1) Stands.

Deschamps' Simplified and Improved Solar Microscope.† — The simplification depends primarily on the working of the movable mirror, which is moved without pinions or engaging gear by means of a vane and a wire. The vane produces the left-to-right (or contrary) motion; the wire attached to the top of the mirror raises or lowers it, and, being set in a caoutchouc disc, enclosed in a small copper cylinder, can be regulated with extreme nicety. By the help of this system the most inexperienced operator is, after a few minutes' practice, a perfect master of the direction of the solar beam which he easily controls and directs upon any desired point of the screen. The objective is, moreover, adjusted without a micrometric screw, and the diaphragm is fixed to the objective without forming a separate piece. All the movable parts are carried on a single guide-bar on which they slide, or are fixed by means of clamp screws.

The improvement secures the elimination of injurious heat, and this elimination is secured by a simple arrangement of lenses, and without a trough of water or alum.

The condenser is first selected of diameter sufficient for light, without accumulating a harmful excess of heat. The focus is replaced by a system of two non-achromatic lenses of equal focal length and separated from each other by the same distance. This system is situated in relation to the condenser at a point such that there is formed, in the first place, not an exact focus to which the rays converge, but an elongated focus at no point of which the luminous beams entirely converge. In the second place there is produced (and this is the chief cause of elimination) an effect of dispersion and of partial recomposition; the aggregation of lenses doing the work of a prism, and, as the rays of the infra-red (heat rays) are the less refrangible, they are kept in the periphery, and therefore removed from the line of the object, which is placed outside the violet cone in a spot where white light is recomposed slightly tinted with blue, green, or yellow, colours which diminish neither the intensity nor the brilliancy.

A living animalcule can be examined and studied at leisure without losing life or sensibly suffering. The magnification exceeds 1500 diameters without loss of clearness, so perfectly achromatic are the lenses of the objectives.

The results obtained by this instrument are inferior in no respect, from the point of view of perfection of the images, to those given by the best apparatus hitherto in use.

Deschamps' Telemicroscope.‡—The telemicroscope is so called because, whilst loupes magnify three or four times at 1 cm. distance, and it

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

† Comptes Rendus, cxxx. (1900) pp. 1175–6. ‡ Tom. cit., pp. 1176–7.

is necessary, in order to obtain a greater magnification, to still further diminish this small distance, this instrument gives at 25 cm. an amplification more than 12 diameters. Hence it offers facilities for observing insects without frightening them or forcing them to quit their natural habits. Thanks to its large field, and to its property of seeing several planes at once, the instrument is equally suitable for observing a large plant. An extraordinary effect of relief is also produced, comparable to that of a stereoscope.

In reality the telemicroscope is only a telescope of a special kind. Its objective is composed of two achromatic lenses separated by a distance less than the principal focal distance of the most convergent; therefore they act as one. Achromatism is increased by this arrangement, whence results the clearness of the images. The objective is Dollond's with four plano-convex glasses. The eye-piece has been chosen as convergent as possible, in order to increase the enlargement and the extent of the field without affecting the clearness.

Amici's Microscope.—The following interesting holograph letter from Prof. Amici, together with a description of his Microscope, has been recently found among the papers belonging to the Society.

Mr. John B. Carruthers, F.L.S., has most kindly translated the letter, together with the description of the Microscope. The cuts are photographic reproductions of Prof. Amici's own drawings. It will be recollected that Amici was the first to demonstrate the part played by the pollen-tube in the fertilisation of flowering plants.

"Most Honoured Sir,

"I send you the description of the Microscope which you have obtained, and the flat glasses necessary for the observations. I add also the ground glass which is mentioned in describing the use of the instrument. When the objects are prepared, I shall make it my duty to send you some which will serve as specimens, and will show the comparative power of the Microscope. With high esteem, I am your obedient servant,

"G. Batta Amici. At home. 18 Dec. 1841."

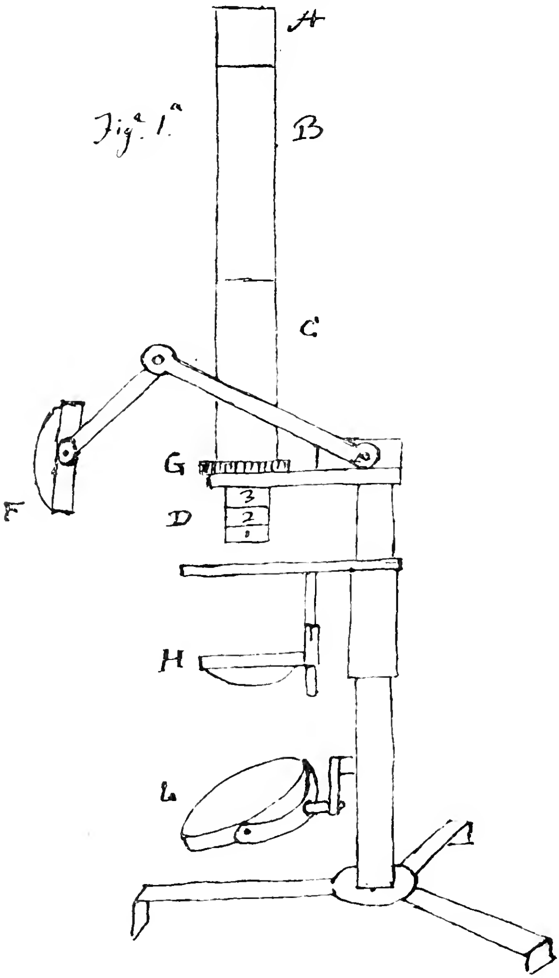
"Amici's upright Microscope, acquired by Mr. Sebright, contains ten achromatic objectives, variously marked, which are used combined in series of two, three, or even four, united together. Figs. 2^a, 3^a, 4^a, and 5^a [fig. 155] show the series as they ought to be fixed below the tube of the Microscope to obtain different magnifying powers.

"The four objectives marked with dots form the strongest combination; their focal distance being very short, only permits their use with minute transparent bodies, which bodies, if immersed in a fluid, should be observed by covering them with a very thin plate of mica, so as not to wet the last, that is to say the lowest, lens, which is brought almost into contact with them.

"The combination of objectives marked 3, 2, 1, in the order shown in fig. 3^a, serves only for transparent objects, but has been constructed so that, in order to see these objects clearly and distinctly, they must be enclosed between two flat glasses of which the upper one (i.e. the one which covers the object) must be 1 mm. in thickness. For this purpose the instrument is provided with a good number of cover-glasses of the needed thickness of 1 mm. *N.B.*—If it is desired, with the same combination as fig. 3^a, to work with uncovered objects, and not objects under glass, it is sufficient to separate No. 1 by two turns of the screw from No. 2.

"If No. 1 is removed and the other two are left, as in Fig. 4^a, the

Fig. 154.



magnification is lessened, but there is an increase of focal distance, whereby bodies of larger size, and even opaque ones, can be observed, and it matters not whether they be covered with glass or mica, or be uncovered.

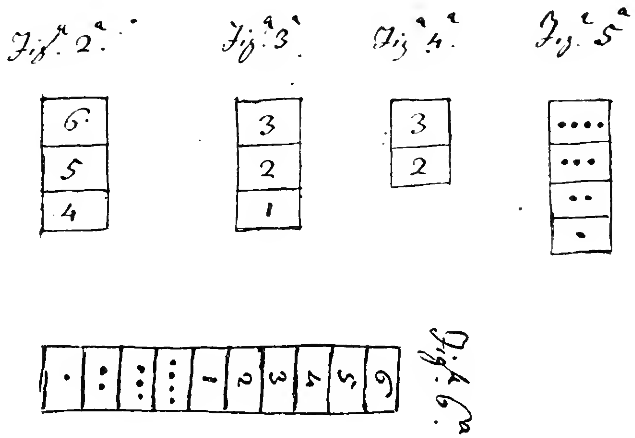
"The three objectives marked 6, 5, 4, as in fig. 2^a, are the series of smallest power, and, possessing a long focal distance, are of use for all kinds of objects, transparent or opaque.

"There are two eye-pieces, each with two lenses, which can be successively placed at A at the end of the tube [fig. 154] made up of the two parts B and C, or simply at the end of C. Thus with the four series of objectives, figs. 2, 3, 4, and 5 applied separately at D, sixteen different magnifying powers are obtained.

"Taking away next the tubes B and C and the eye-piece A, leaving only the milled head G, with one or more objectives, these latter act as common lenses (or "loupes"), and the Microscope—in that case equivalent to a simple Microscope—may be used in observing large bodies and for their preparation and dissection.

"Opaque bodies are illuminated by means of the lens F, which is so

FIG. 155.



inclined as to throw the light from a lamp or the daylight upon the object.

"Transparent bodies are illuminated by the reflection from the mirror L underneath, through the lens H. This lens slides along a vertical arm, and can be approximated to or removed from the object and placed more or less obliquely to it. Clearness of vision depends chiefly on the satisfactory placing of the illuminating lens, and it is well to get considerable practice, so as to ascertain the most favourable position for illumination, according to the nature of the object and the particular series of objectives which is in use. For the weaker objectives the lens H is usually covered by the black diaphragm placed above it.

"There is a flat ground glass which is introduced between the little springs under the stage only when it is desired to use direct sunlight as an illuminant, so as to increase the brilliance of the bodies without burning them.

"All the glasses, eye-pieces, and objectives alike, are kept bright by cleaning with the reverse side of a thin piece of glove-leather. This preliminary operation is recommended whenever it is desired to compare this instrument with other Microscopes.

"The objectives are enclosed in a little box, inserting them all together, as they are in fig. 6[a]. If they are inserted in a different order, there is a risk of breaking the glass of one against the other.

"Florence, 17 Dec. 1841."

KNIPE, O.—**The Projection Microscope.**
[An elementary description of method of use.]
Micr. Bull., Febr. and April, 1900, pp. 1 and 2.

DISNEY, A. N.—**Modern Microscopes.**
[The author reviews the most notable instruments which have been noticed in the Journal of the R.M.S. during last three years.]
Nature, lxii. (1900) pp. 154–6 (2 figs.).

(2) Eye-pieces and Objectives.

Eye-piece Diaphragms.* — M. Malassez has communicated to the Société de Biologie several inventions of his own for obtaining certain cheap accessory apparatus. One of these is an *Ocular Diaphragm with movable index.* In the eye-piece at the position of the ordinary diaphragm he inserts a disc of blackened cork with a kind of watch-hand pointer; one extremity (ring-shaped) is pivoted by a pin-head near the periphery of the disc, the other extremity (finely pointed) projects into the field. A rotation of the eye-pieces exerts sufficient friction to make the hand appear or disappear at will. Thus the position of any point in the Microscope image can be indicated.

M. Malassez also describes several simple contrivances for procuring effective home-made micrometer eye-pieces; also a new form of lens-carrier.

(3) Illuminating and other Apparatus.

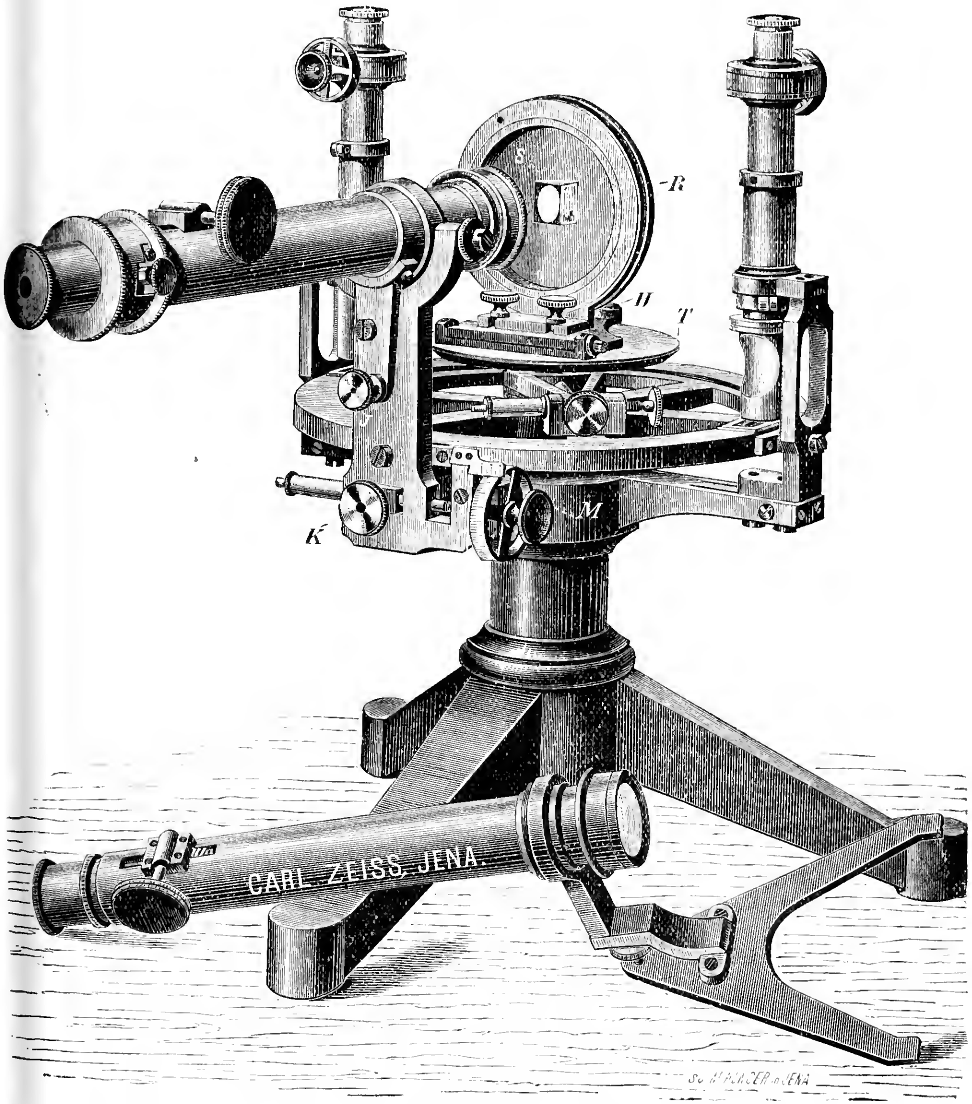
Abbe's Spectrometer.—This apparatus, originally designed by Prof. Abbe as far back as 1874, has undergone various improvements, and is now made by the Zeiss firm in the form shown in fig. 156. The principle is that known as "autocollimation," whereby the incident ray, after suffering normal reflection at the back face of the prism, issues in the same direction as it entered (fig. 158). In the adjustment of the ocular head (fig. 157) the width of the slit S is regulated from the under side by a screw. The course of the light is from the left through the illuminating prism P. The lower half of the field of view is free for the observation of the spectrum. The adjustment point (the intersection of two threads crossing at a sharp angle) is applicable both for dark lines on a bright ground and for light lines on a dark one. The focusing of the telescope is by rack-and-pinion: and its normal position with regard to the rotation axis of the graduated circle is obtained by the adjustment screw.

For determining the refractive index, Abbe's method has all the advantages of Fraunhofer's without its disadvantages. For the ray-path (fig. 158) is exactly identical with the path of a ray in the minimum of deviation through a prism of twice the refractive angle. But the mode of measurement is essentially simpler. It is only necessary to rotate the prism just so far round the vertical axis of the spectrometer

* C.R. Soc. de Biol., lii. (1900) pp. 629–33, 724–7.

that the spectrum line to be measured coincides with the adjustment mark. The minimum of deviation is thus automatically given; whilst

Fig. 156.



with Fraunhofer's there is required the repeated adjustment and the simultaneous testing of the adjustment of the telescope obtained by the rotation of the prism about its vertical axis. Abbe's method also possesses the advantage that, under otherwise similar conditions, only half of the material is used.

Fig. 157.

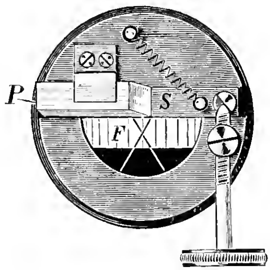


Fig. 158.

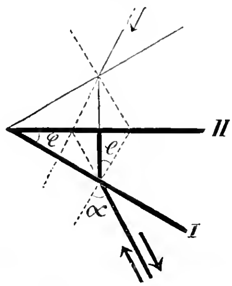
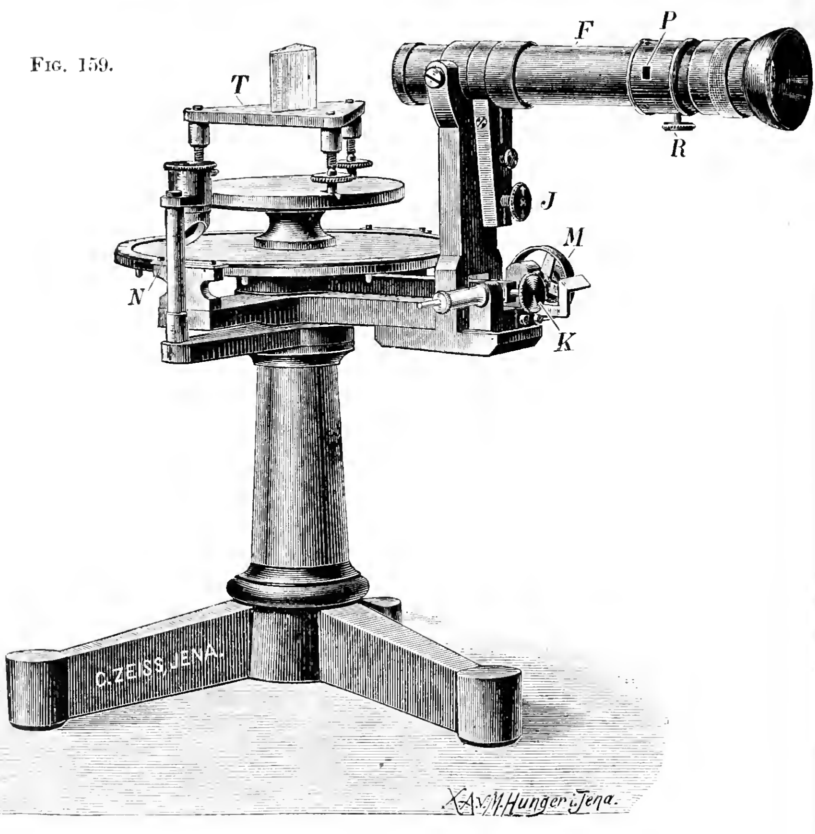


Fig. 159.



The determination of the dispersion follows independently from the graduated circle as the difference measurement by help of a special micrometer arrangement (M, fig. 156). The advantage of this determination method, in contrast with the direct determination of the refractive index, consists in a considerable simplification of the measurement and in, under otherwise similar conditions, great increase of accuracy. The limits of attainable accuracy for the refractive index affect the fourth decimal place to the extent of one unit, and for the dispersion (difference of the refractive indices) one or two units in the fifth decimal place.

The second telescope shown in the figure is only occasionally essential.

Fig. 159 is a simpler form of the same instrument adapted for students' use in physical laboratories.

Zeiss' High Temperature Spectrometer. — Figs. 161, 162, show this instrument, which is specially adapted for the examination of the influence of temperature on the refraction of solid bodies (glasses, &c.). It is applicable to temperatures of 400° C. and upwards.

The tube A (fig. 162) fastened on the rotation axis of the spectrometer, carries a small table T fitted with adjustable screws, on which is a glass tube G with a lid, and upon it the prism to be examined. The coarse rotation is by hand movement, and the fine by micrometer screw. The warming of the object is attained by heating a kind of copper jacket, weighing about 50 kilos., with vertical cylindrical perforations; within this jacket the prism-carrier freely rotates. The flame-gases from the Bunsen burners pass up

Fig. 160.

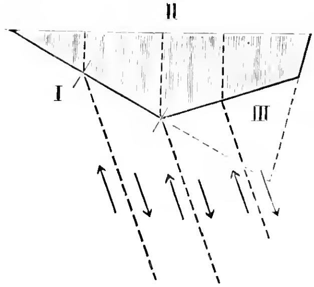
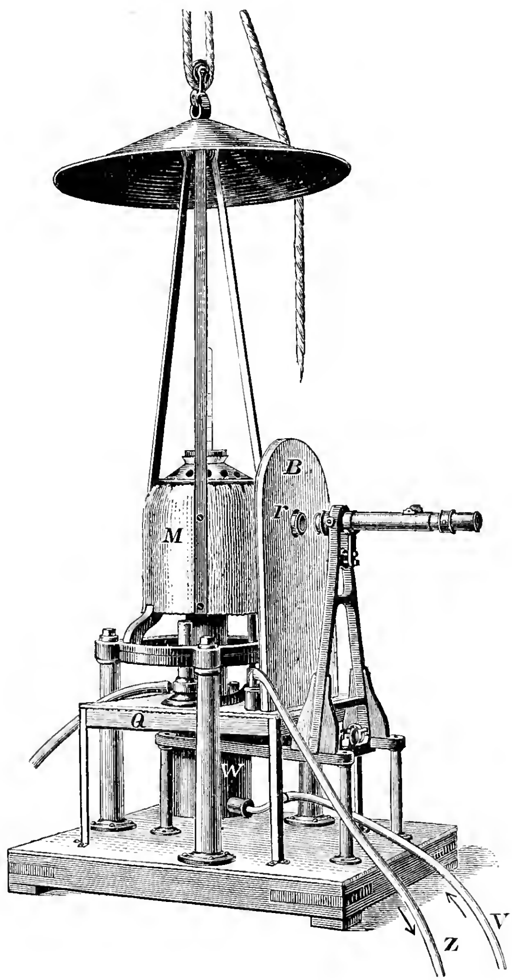
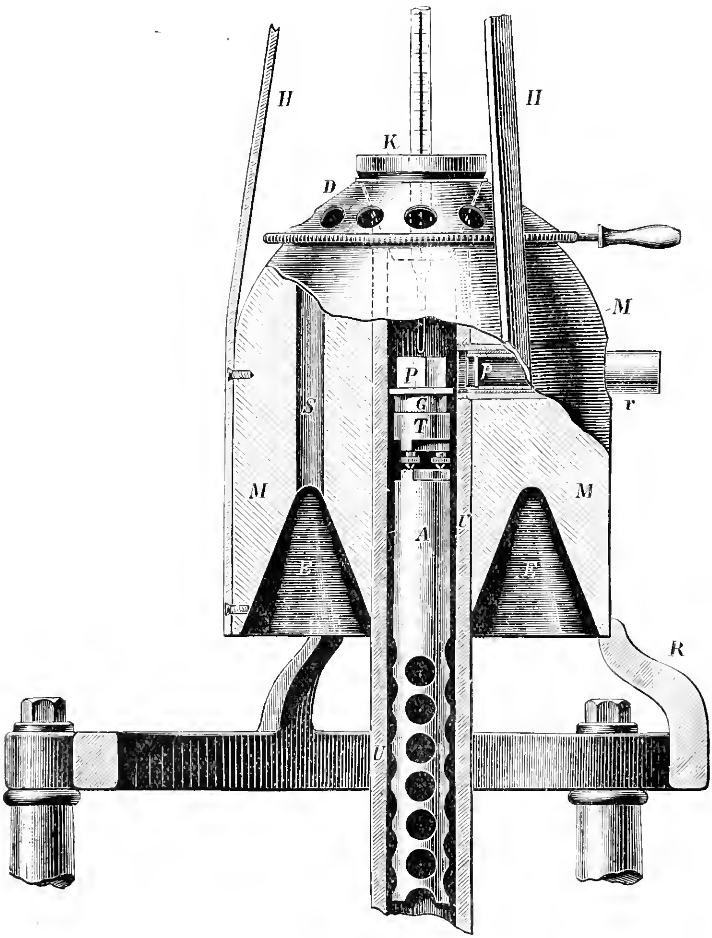


Fig. 161.



through the conical openings E, and escape through ten flues S, whose orifices can be closed or not at pleasure. The inner tube is closed at the top with a cone into which is fitted a thermometer. Inspection of the interior is by the metal tube *r*, which has two glass plates with parallel faces at *p*. The rotation axis and micrometer movement are

Fig. 162.



shielded from the influence of the heat by a constant stream of water through the iron troughs Q and W (fig. 161). A metal shield B protects the telescope. The whole copper jacket is wrapped in asbestos cloth.

For the convenient raising and lowering of the copper jacket, it is suspended on pulleys fastened to the ceiling of the room and counterpoised. The form of the glass prism and the autocollimation of the rays are shown in fig. 160.

Modification of Rousselet's Compressor. — At the meeting of the Society held on June 20th, Mr. G. H. J. Rogers, of Maidstone, exhibited a modification of the Rousselet compressor, the chief feature of which

Fig. 163.

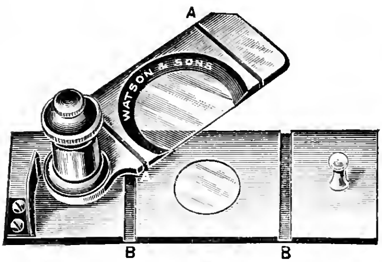
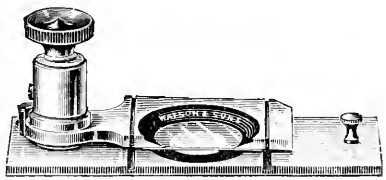


Fig. 164.



consisted in the employment of two indiarubber bands in suitable grooves to keep the glass in position, instead of having it cemented. It was claimed that this saved tronble and time in the event of the glass being broken. Fig. 163 shows the instrument open; A A are the indiarubber bands; B B the grooves to receive the bands; in fig. 164 the instrument is shown closed.

MARKTANNER-TURNERETSCHER, G., F.R.M.S.—**Bemerkungen über Lichtquellen für Projectionsapparate und mikrophotographische Zwecke.** (Observations on Light Sources for Projection Apparatus and Photomicrographic Purposes.)
[The author reviews the various kinds of available artificial light and especially Liesegang's ether jet.]
Laterna Magica, xvi. (1900) April, pp. 17–26 (1 fig.).

(4) **Photomicrography.**

CHEYNEY, J. S.—**Photomicrography.**
[A practical treatment of the subject.] *Micro. Bull.*, June 1900, pp. 17–9.

MARKTANNER-TURNERETSCHER, G.—**Fortschritte auf dem Gebiete der Mikrophotographie und des Projectionswesens.** (Progress in the Department of Photomicrography and Projection.)
[A descriptive catalogue of the chief novelties pertaining to the subject collected from international scientific journals for past year.]
J. M. Eder's Jahrb. f. Photog. u. Reproductionstechnik f. 1900.
(Also as a separate pamphlet, 18 pp. and 8 figs.)

(5) **Microscopical Optics and Manipulation.**

Abbe's Refractometer.—This instrument, first designed by Prof. Abbe in 1874, has lately undergone some improvements by Dr. Pulfrich.* The optical improvement consists in removing the polish from the plane of the under part of the double prism and replacing it by a frosted surface. It is found that the effect is to obliterate the troublesome images of adjacent objects which were apt to obtrude themselves into the field of view and distract the observer. The Zeiss firm recommend the

* See Zeitschr. f. Instrumentenkunde, 1898, pp. 107–12 (5 figs.).

improved instrument as one of most convenient manipulation. It can be used with any kind of light, and is self-reading, i.e. the refractive index (1·3 to 1·7) can be read off on the divided circle without calculation. A very few drops of fluid suffice for observation, and therefore the instrument can be used in the most delicate investigations. Its excellence for liquid observations with transmitted light has long been admitted, but the new form of prism permits of the application of reflected and obliquely incident light (figs. 165–167), by means of which observations can be made on solid bodies. For this latter purpose the telescope is placed approximately vertically, and the frosted surface illuminated by the mirror R (fig. 168).

FIG. 165.

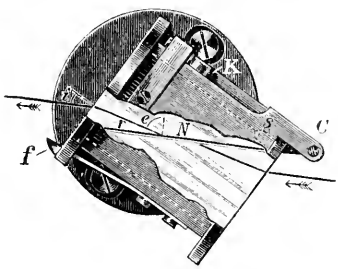


FIG. 166.

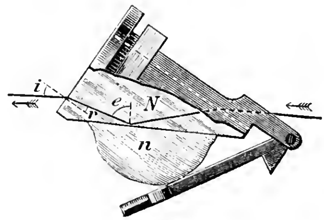
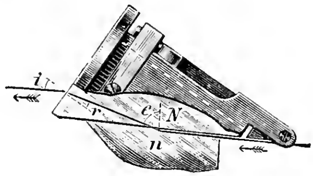


FIG. 167.

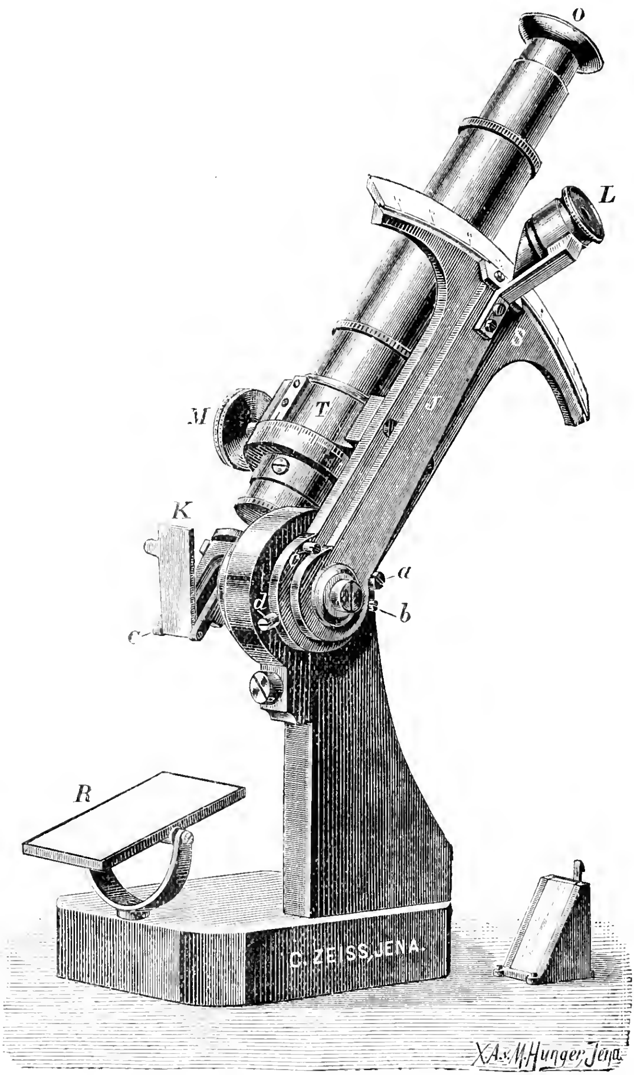


Another improvement consists in the addition of a so-called compensator placed in the ray-path between the double prism and the telescope. This renders possible the use of white light, and consists of two Amici prisms (exactly adjusted for the D line) of equal dispersion, which by rotation at M can be equally turned about the telescope axis. The dispersions at the two prisms coalesce, and form a resultant dispersion which causes a colourless ray exactly incident on the same spot as the ray from a sodium light. Fig. 168 shows the earlier form of the refractometer fitted with the new compensator.

The instrument can also be procured fitted with a heating apparatus.

Zeiss' Educational Refractometer.—This form of instrument is intended for use in physical and chemical laboratories, and depends on the properties of a flint glass prism ($\mu = 1 \cdot 72$) of 61° refractive angle. Its claim to its title is justified by the fact that all the necessary optical constants (the prism angle and the refractive index of the prism) can be determined on the instrument itself. Also the apparatus is provided with adjustments by assistance of which the whole of the various illuminating methods (reflected light, obliquely incident light, and transmitted light, figs. 169–171) can be brought into play and their appropriate effects in defining the boundary lines demonstrated. The

FIG. 168.



suitability of the instrument to solid and fluid bodies ranges between refractive indices of 1·0 and of about 1·7 (the index of the flint-glass prism).

The adjustment of the apparatus (fig. 172) is by free hand motion. The observer's right hand grips the telescope with its divided circle

Fig. 169.

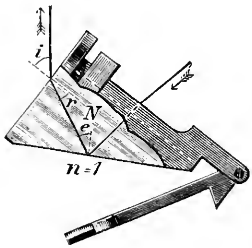


Fig. 170.

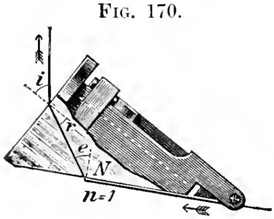


Fig. 171.

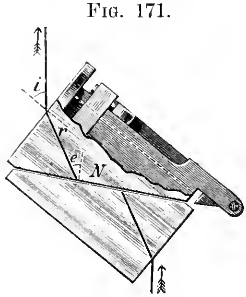
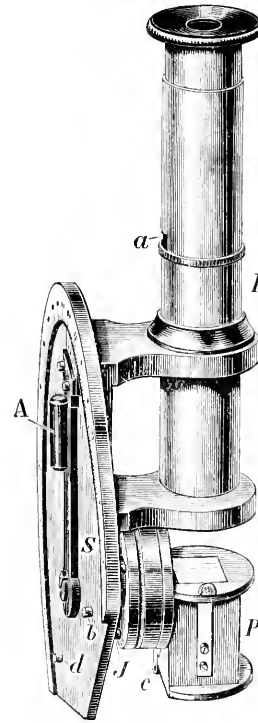


Fig. 172.



(0°–180°) while his left hand guides the arm A attached to the vernier and to the prism. The vernier reads to 1′. The prism is provided with a movable stop for changing the illumination.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

New Medium for Cultivating Diphtheria and other Organisms.†—Herr P. Glaessner, in a dissertation on the value of some new albuminous

* 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., xxvii. (1900) pp. 724–32.

preparations for culture purposes, describes his experiences with pepton, asparagin, somatose, nutrose, and Heyden's medium. To the last are ascribed numerous cultivation virtues, and the following procedure is recommended for making a mixture suitable for most purposes. One gramme of Heyden's medium is stirred up in a little water; 0·5 grm. salt, 0·1 grm. meat extract, 1·5 grm. agar, and 100 ccm. distilled water are added. The mixture is well boiled and afterwards steam-filtered. The filtrate is perfectly clear and transparent, but sets somewhat slowly. Slants should be kept in the oblique position for 12–18 hours.

The foregoing medium seems specially adapted for diphtheria bacilli, and it is not favourable to the growth of Streptococci.

New Medium for Growth and Differentiation of Bacillus coli communis and B. typhi abdominalis.* — Mr. A. T. MacConkey draws attention to a medium having a marked inhibitory effect on soil and water organisms, and therefore useful for the examination of water, soil, and food-stuffs. It is composed of sodium glycocholate 0·5 per cent.; pepton 1·5 per cent.; lactose 0·3–0·5 per cent.; agar 1·5 per cent.; tap water q. s. The lactose is added after filtration.

If stab-cultures be made and incubated at 42° C. for 24–48 hours, the tubes containing *B. col. com.* will be found to have become cloudy, while those inoculated with *B. typhi abd.* remain quite clear.

If glucose be used instead of lactose, both tubes become cloudy; but the cloudiness due to *B. coli* begins from below, and that from *B. typhi* from above. In plates made with the glucose medium, incubated at 42° C. for 48 hours, and then left at room temperature for 3–4 days exposed to the light, the colonies turn orange-colour.

Piorkowski's Medium for Diagnosing Typhoid Bacilli.† — Dr. G. Mayer finds that urine is effectively rendered ammoniacal by infecting it with *Proteus vulgaris.* 5 ccm. of a bouillon culture grown for 24 hours at 22° C. are added to about 2 litres of morning urine. In 15 to 20 hours the urine has acquired the correct grade of ammoniacal reaction. This procedure is extremely convenient for Piorkowski's method for detecting typhoid bacilli. The medium used is composed of alkaline urine, 3·3 per cent. gelatin, and 0·5 per cent. pepton. When cultivated on this urine-gelatin, the typhoid colonies assume characteristic shapes distinguished by root-like ramifications proceeding from a central core of variable dimensions. Forty-five different samples of bacterial growth are depicted. These are subdivided into five groups. The first example resembles a sphere with a few radiating stumpy processes, the last a piece of thistledown.

Medium for Isolating the Typhoid Bacillus from Stools.‡—Dr. L. Remy used the following medium for isolating the *Bacillus typhosus* from the stools of typhoid patients:—Distilled water 1000 grm.; asparagin 6 grm.; oxalic acid 0·5 grm.; lactic acid 0·15 grm.; citric acid 0·15 grm.; bisodic phosphate 5 grm.; magnesium sulphate 2·5 grm.; potassium sulphate 1·25 grm.; sodium chloride 2 grm. All the salts except the magnesium sulphate are pounded up in a mortar, and then placed in a

* Lancet, 1900, ii. p. 20.
† Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900) pp. 125–36 (1 illustration).
‡ Ann. Inst. Pasteur, xiv. (1900) pp. 355–70.

flask with a litre of distilled water and 30 grm. of pepton. The flask is then heated in an autoclave for 1/4 hour. The contents are then poured into another flask which contains 120–150 grm. of gelatin. After the gelatin is dissolved, some soda is added to render it slightly alkaline. It is then kept for 1/4 hour in an autoclave at 110°, after which it is acidified with a deminormal solution of H_2SO_4 in such wise that the acidity of 10 ccm. of the gelatin is neutralised by 0·2 ccm. of a deminormal solution of soda. This acidity is equivalent to 0·5 of H_2SO_4 per litre. The mixture is again heated for 8–10 minutes, filtered, and the acidity tested with phenolphthalein and deminormal soda solution. If red colour appears when 0·2 ccm. of soda solution have been added to 10 ccm. of the gelatin, the magnesium sulphate may be added in the proportion of 2·5 per litre of gelatin. The mass is then distributed into tubes (10 ccm. each) and sterilised thrice. When about to be used, 1 ccm. of a 35 per cent. solution of lactose and 0·1 ccm. of a 2·5 per cent. solution of phenol are introduced into each tube.

This medium is stated to give very certain results for isolating the typhoid bacillus from stools in the presence of *B. coli*, more especially in the earlier stages of the malady.

Neutralisation of Media.*—Dr. Eyre, after calling attention to the important influence exercised by the reaction of the medium upon the growth of an organism cultivated thereon, advocated the adoption of media (broth, gelatin, and agar) of a definite "standard" reaction for ordinary laboratory use, and pointed out that litmus, the indicator chiefly used in this country, was totally unsuited for exact work, as it was not sufficiently sensitive to weak organic acids and acid phosphates. Phenolphthalein, however, was a sensitive and reliable indicator, and gave a sharp and definite "end-point." At the meeting of the Pathological Society at Cambridge, Dr. Eyre exhibited a series of flasks of agar and gelatin, demonstrating the colour produced when the end-point or neutral point to phenolphthalein was reached, and showing the marked effect of the addition of minute quantities of decinormal solution of caustic soda to the medium after that point had been reached, an effect which proved that it was hardly possible for the most inexperienced worker to make a greater error than 5 per cent. when titrating with $\frac{N}{10}$ NaOH, and using phenolphthalein as the indicator.

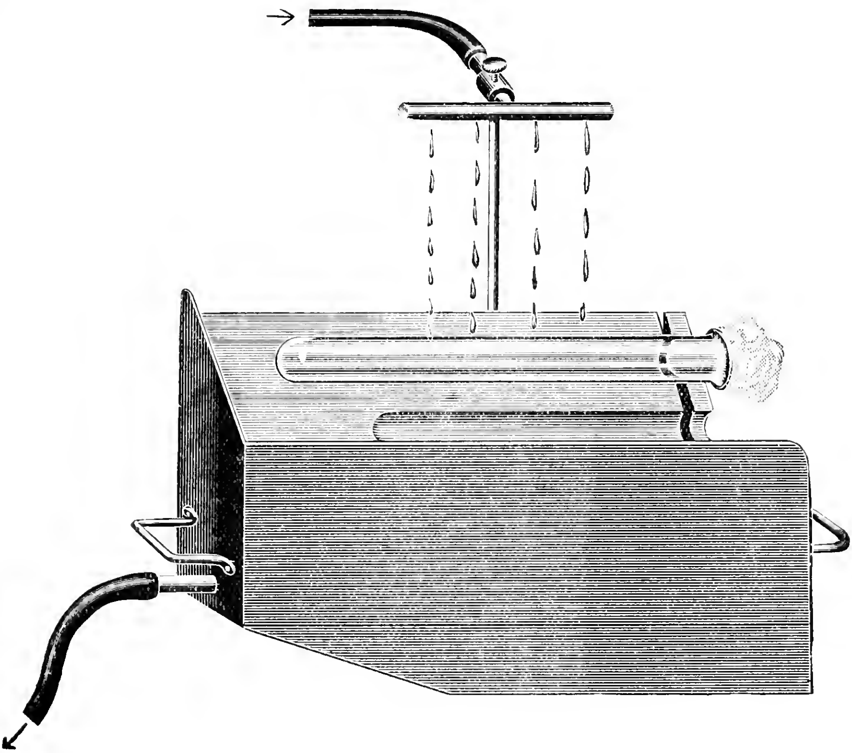
Apparatus for Making Roll-cultures.†—Dr. G. H. F. Nuttall has devised a convenient apparatus for making roll-cultures (figs. 173, 174). The principal parts are a marble block and a tin box. The upper surface of the block is polished, and has two grooves for tubes, the section of the grooves being less than a semicircle. About 1 cm. from the edge is a third groove for carrying off the water which might wet the plugs. In order to make the surface of the block perfectly smooth, a very thin layer of melted paraffin is brushed over it and rolled smooth with a hot tube. Should the layer get worn, it is easily wiped off with a cloth damped with turpentine or xylol, and a fresh film applied. The block is kept in an oblique position, and prevented from touching the sides of

* Brit. Med. Journ., 1900, ii. p. 21.

† Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 605–9 (2 figs.).

the pan by means of supports (not shown in the illustrations). The bottom of the pan is quite flat, and the front and left sides are higher than the other two. The front and back sides, which are prolonged downwards to form a support for the box, are sloped off on the left side. There are two handles and an outflow pipe near the bottom. To the

Fig. 173.



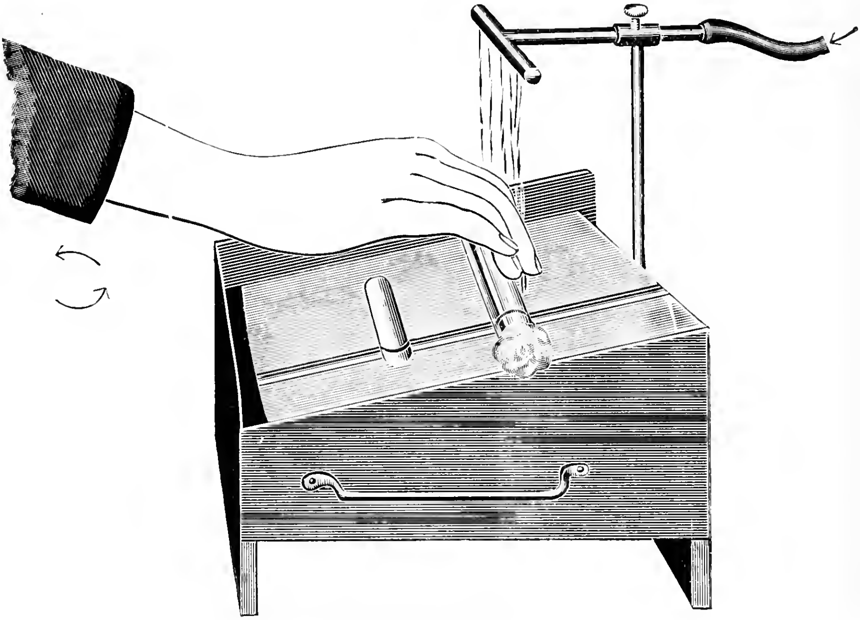
back of the pan is fixed a bar which carries a T-shaped tube, through the leg of which the water enters, passing out through holes in the arms. When the apparatus is used, it is tilted by pressing on the left handle, the tube is inserted in a groove and rolled round in the direction indicated by the arrows, and then the apparatus restored to the horizontal position.

Incubator for Student Use.*—Prof. V. A. Moore describes an incubator which he has devised for the use of a large class. It consists of a chest of drawers after the Lillie paraffin oven pattern, which are placed within the jacket of the incubator. Each drawer is of sufficient size for the working cultures of one student. The apparatus is heated by gas-

* Trans. Amer. Micr. Soc., xxi. (1900) pp. 103-6 (4 figs.).

burners placed underneath, the heat being radiated from a metal plate at the bottom and one at the top, and the metal tubes connecting them. The tubes are arranged at the sides and back, and are placed close to one another. The drawers are made of sheet zinc with a wooden front.

FIG. 174.



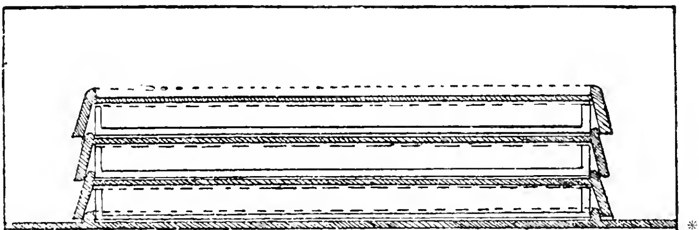
Each is 49 cm. long, 10·5 cm. wide, and 19 cm. deep. The sides and back are perforated. The drawers are provided at the top with a narrow flange which runs in a metal groove, and in which the drawers are supported. In front of each drawer are a pull and a frame for a card. The Roux bimetallic regulator is inserted at the back.

Improved Cultivation Capsules.*—Dr. R. J. Petri describes some improvements and modifications of his well-known culture dishes. The covers are now made of yellowish-brown glass in order that the growth of the colonies should not be interfered with by the harmful action of the red and violet rays. The dishes and covers, which are circular as of yore, are of two patterns. In fig. 175 the dish has upright sides; the flange of the top-piece is twice as thick as the rest of the cover, and its upper edge projects above the general level in order to prevent slipping of the dish above. In fig. 176 the side of the dish is sloped outwards, while the margin of the cover is bent to an acute angle into which the side of the dish is received. At *, figs. 175 and 176, is shown a plate made of yellowish-brown glass, having a circular rim within which the lowermost dish is inserted. This serves to make a pile of dishes quite

* Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900) pp. 79–82 (6 figs.).

steady. The colour of the cover-piece in no way interferes with observation of the growth.

Fig. 175.



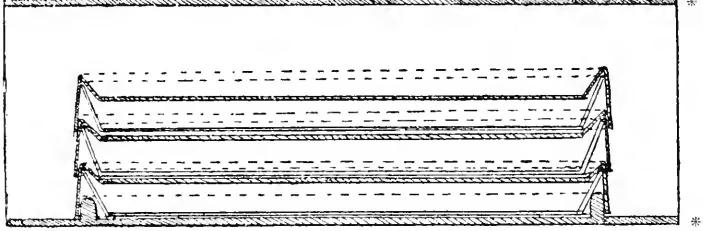


Fig. 176.

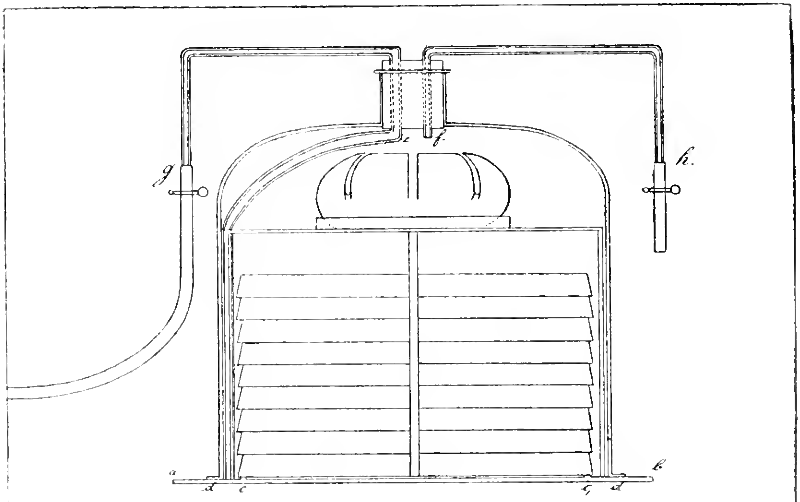
New Anaerobic Culture Apparatus.*—Dr. R. J. Petri describes a new apparatus for anaerobic cultivation in which the improved capsules are employed. As shown in the illustration (fig. 177) the pile of capsules is covered with a bell-jar through the stopper of which pass two tubes; the entrance tube *g* for the introduction of hydrogen reaches to near the bottom, while the exit tube *h* stops short at *f*. Over the pile of capsules is placed a four-footed wooden stand, and on this a circular plate which supports a basin having eight clefts in its side, so that it looks something like an artichoke. The basin contains caustic potash solution, and into the clefts are inserted strips of blotting-paper which have been saturated with pyrogallic acid and afterwards dried. The bell-jar is placed upon a glass plate, and the junction smeared with fat to make it air-tight. This plate is made of yellow glass, and has a circular elevation *c c* upon which the lowermost capsule rests. After hydrogen has been passed through for a sufficient time, the test for determining the entire expulsion of oxygen is applied. The apparatus is slightly tilted so as to wet one of the paper strips, and if it is not discoloured all the oxygen has been driven out. If, however, the colour alter (yellow to black) more hydrogen must be passed through, and then the test applied to another strip, and so on. In this apparatus the potash-pyrogallic acid is used as indicator; the oxygen is not absorbed but driven out.

Cultivating Gonococci on Simple Media.† — Dr. Thalmann has successfully cultivated *Gonococcus* on media with an acid reaction. The

* Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900) pp. 196–9 (2 figs.).
† Op. cit., xxvii. (1900) pp. 828–34.

media used were brain, meat-water agar, serum, and bouillon. The acidity was calculated by means of phenolphthalein. In the case of brain, 100 ccm. was found to have an acidity of 1·4 ccm. normal acid (= 56 mg. H_2SO_4). To meat-water agar containing 1 per cent. pepton and 0·5 per cent. NaCl was added sufficient soda solution to neutralise two-

Fig. 177.



thirds of the acid. Serum was treated with two-thirds to three-fourths of the neutralising soda solution. Bouillon gave the best results when 70 per cent. of the total acid was neutralised. The simple expedient of mixing 7 parts neutral and 3 parts acid bouillon was quite unsuccessful.

The author is of opinion that a mixture of neutral and bibasic phosphates is necessary for the growth of *Gonococcus*.

Cultivation of Dictyostelium mucoroides and other Amœbæ.*—Herr G. A. Nadson finds that it is not difficult to cultivate *Dictyostelium mucoroides* on sterilised manure, and also on gelatin mixed with manure, on malt extract, on alkaline meat-pepton, gelatin, or agar. The colonies look pure to the naked eye, but careful microscopical examination shows that this is not the case. *D. mucoroides* does not liquefy gelatin; it is strongly aerobic, prefers slightly alkaline media, but can exist on acid substrata. Fluid media are not advantageous for growth, but pure cultures were obtained in the following nutrient solution:—Aq. dest. 100 ccm., glucose 5 grm., pepton Witte 1 grm., potassium phosphate 0·1 grm., magnesium sulphate 0·1 grm., traces of calcium and iron phosphates. In most media bacteria were a constant accompaniment, and their presence was favourable to the development of the organisms. The usual companion of *D. mucoroides* is *B. fluorescens liquefaciens*,

* Scripta Botanica, 1899, fasc. xv. Petersburg. See Bot. Centralbl., lxxxii. 1900, pp. 227–8.

and between the two exists an association or symbiosis. The presence of the bacterium is favourable to the development of the amœba, as it forms ammonia and thus maintains the alkalinity of the medium. On the other hand the amœba supplies the bacterium with organic substances. Though pure cultures of *D. mucoroides* can be obtained on gelatin and agar media, yet their development is not nearly so good as when they are accompanied by their customary followers.

Perfectly pure cultures are weak, easily perish, and produce mostly dwarf forms. Pure cultures do not give at all a correct picture of the normal growth of these organisms.

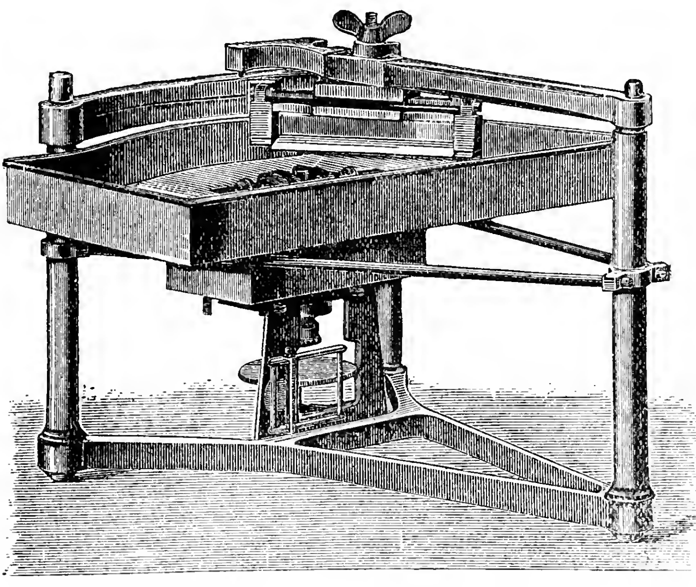
(2) Preparing Objects.

Demonstrating Bone Lacunæ.* — Dr. G. Schmore demonstrates bone lacunæ and canaliculi by means of thionin and picric acid.

The thionin solutions recommended are:—(1) a saturated solution in 50 per cent. alcohol 2 parts; water 10 parts. (2) 1 per cent. carbol water 90 parts; saturated solution of thionin in 50 per cent. alcohol 10 parts.

After staining with thionin for 5–10 minutes the sections are washed and then immersed in saturated aqueous solution of picric acid for a half to one minute. Excess of stain is removed in 70 per cent. alcohol. The sections are mounted in balsam.

Fig. 178.



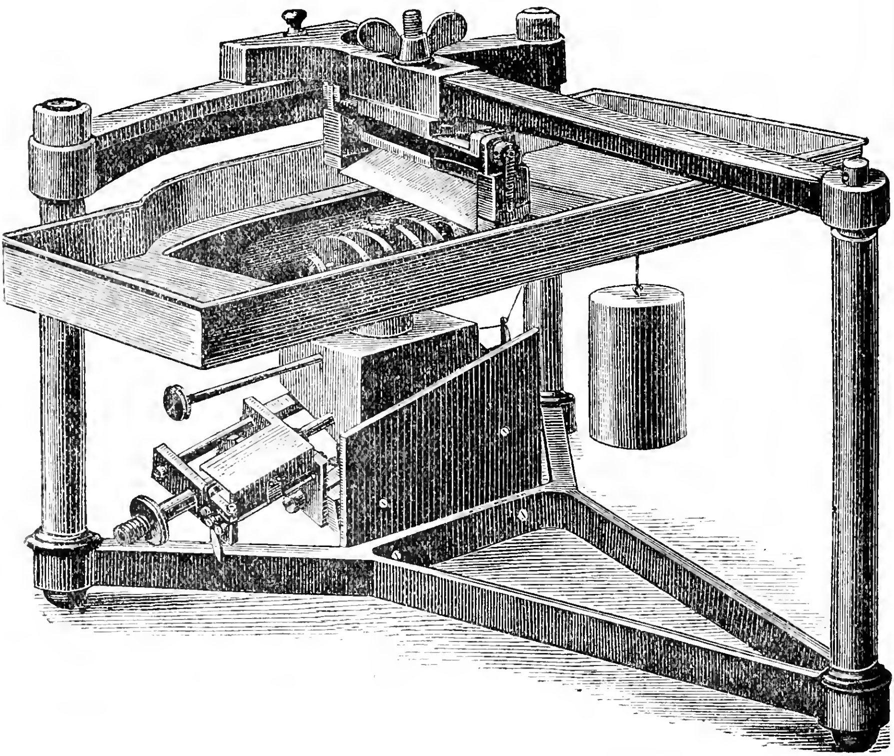
(3) Cutting, including Imbedding and Microtomes.

Microtome with Arc-movement of Knife for Section-cutting under Water, Alcohol, &c.† — Herr Paul Thate, of Berlin, describes a form

* Centralbl. f. allgem. Pathol. u. pathol. Anat., x. (1899) pp. 745–9.
† Zeit. f. angew. Mikr., June 1900, pp. 73–6 (2 figs.).

of microtome (figs. 178 and 179) brought out since 1888, and of interest as being the first to exhibit a completely circular knife-movement. The frame is a cast-iron tripod on a triangular base, the three pillars being connected with one another. One of these pillars is provided at its upper end with a socket in which a ball of corresponding shape fits, forming the extremity of a travelling arm. The two front pillars are connected at their upper ends by a strong cast-iron arc-piece, on whose upper plane face the distal broadened end of the traveller finds support and guidance. Two small round-headed steel knobs, screwed into the under side

Fig. 179.



of the broadened end of the traveller, give it a steady support and easy movement on the circular frame. Thus the traveller moves circularly round the ball-and-socket joint as its centre. The traveller is mortised about 20 cm. from the free end for the purpose of taking the knife-holder, which is adjustable at any point of the mortise, and is clamped by a butterfly nut. The knife is fastened at each end by screws to the lower faces of a pair of lateral flanges, whose heads are perforated and connected by a horizontal arm forming part of the knife-holder. An indicator at one extremity of this arm regulates the setting of the knife, which can be sloped as desired. Below the plane swept out by the knife is the clamp for holding the preparation, and around it is a kind of trough for receiving the liquid (water or alcohol) under which the cutting is to be done. A micrometer screw bearing a notched disc raises the preparation 0·005 mm. for each tooth. A balance weight over a pulley takes the pressure off the micrometer screw.

Fig. 178 shows the earlier form in which trough and preparation were both simultaneously moved; fig. 179 a later form in which the trough remained stationary and the preparation alone was raised.

(4) Staining and Injecting.

Fungus and Bacterial Pigments.*—M. L. Matruchot advocates the use of a pigment derived from Schizomycetes (*Bacillus violaceus* and *Bacterium violaceum*), which he calls *violacein*. Experiments on its reactions with the protoplasm of a fungus, *Mortierella reticulata* (see p. 614), showed that it has selective properties, staining only the granular protoplasm and leaving the hyaloplasm and the cell-membrane uncoloured. Similar properties are possessed by the green pigment of *Fusarium polymorphum*. This staining property must be distinguished from "false pigmentation" (simple coloration by a foreign chromogenous organism) (*Mucor*, the Pyrenomycete of green wood), and from "auto-pigmentation" (the coloration of an organism by the excretion of its own pigment) (*Monascus purpureus*, *Eurotiopsis Gayoni*, *E. Saussinei*, the *Peziza* of green wood, *Mollisia Jungermanniæ*, *Bacillus erythrosporus*).

Kreso-fuchsin, a new Pigment.†—D. P. Röthig reports on a new pigment, kreso-fuchsin, which appears to be a specific stain for elastic tissue. Kreso-fuchsin is an amorphous powder, easily soluble in acetic acid, sparingly soluble in alcohol, and very slightly in water. The alcoholic solution has a blue, the aqueous a red colour. The alcoholic solution stains elastic tissue dark blue, cartilage, keratin, and mucus red. The aqueous solution does not stain elastic tissue at all, but cartilage, &c. red. The formulæ given by the author are two. The first or stock solution is composed of kreso-fuchsin 0·5 grm., alcohol 75 per cent. 100 grm., hydrochloric acid 3·0 grm. The second or staining fluid consists of stock solution 40 ccm., alcohol 95 per cent. 24 ccm., picric acid 1–2 ccm., aq. dest. 32 drops.

The sections remain in the staining solution 2 hours or more; an immersion of 24 hours does no harm. They are then transferred to 95 per cent. alcohol, and afterwards to absolute alcohol in order to remove excess of pigment and to dehydrate them. After passing through xylol the sections are mounted in Canada balsam. In sections thus prepared the elastic fibres are stained deep blue. Contrast and nuclear stains may be used; for these, orange G, carmin, borax alum, and lithium carmin and hæmatoxylin are recommended.

Neutral Red as a means for Diagnosing Bacterium Coli.‡—Herr W. Scheffler finds that *B. coli commune* produces a green fluorescence

* Rev. Gén. de Bot. (Bonnier), xii. (1900) pp. 33–60.
† Arch. f. Mikr. Anat. u. Entwicklungs., lvi. (1900) pp. 354–61 (1 pl.).
‡ Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900) pp. 199–205.

when cultivated in neutral red-grape-sugar agar in from 24–48 hours. The medium is composed of 100 ccm. fluid agar, 0·3 grm. grape sugar, 1 ccm. saturated aqueous solution of neutral red.

Romanowski's Stain for Bacteria.* — Prof. Zettnow gives the following information as to his modification of Romanowski's method of staining bacteria.† 50 ccm. of 1 per cent. solution Höchst's medicinal methylen-blue are mixed with 3–4 ccm. of 5 per cent. solution of crystallised soda. The mixture is ready for use in 2–3 weeks. The eosin stain is a 1 per cent. solution Höchst's eosin B.A. When required for use, 1 ccm. of the eosin solution is added drop by drop to 2 ccm. of the blue solution, and the mixture kept well stirred the while.

Some of the mixture is poured or pipetted on to the cover-glass films and allowed to act for 5 minutes. The preparation is then washed in water and inspected in this under the Microscope, after which it is differentiated with eosin, &c. These preparations when mounted in balsam keep better than might be anticipated.

Modification of Romanowski's Stain for Bacteria.‡—Dr. Feinberg recommends the following modification of Romanowski's method for staining bacteria. The films are air-dried and fixed in absolute alcohol for ½–1 hour. They are then stained in a mixture made by heating 1·5–2 per cent. solution of methylen-blue to 70°–80° C. on several successive days, to get rid of the red pigment in the methylen-blue. To 1 ccm. of this solution 4–6 ccm. of 1 per thousand eosin solution are added. The cover-glasses are immersed in the mixed eosin-blue solution for 20 minutes, and on removal are washed with water. They are next decolorised in absolute alcohol. This takes some minutes. In successful preparations the nucleus is red and the plasma blue. The nuclear division in diphtheria bacilli is specially well seen by this method.

New Method for Staining Fibrin.§ — Prof. Kockel adopts the following procedure for staining fibrin. The sections are stuck on with albumen-glycerin, and when freed from paraffin are immersed for 5-10 minutes in 1–5 per cent. chromic acid solution. After washing they are stained for 15–20 minutes with Weigert's hæmatoxylin. They are again washed and then immersed in 1 per cent. alum solution until they become dark blue. After washing, the sections are differentiated in Weigert's ferridcyanide solution, and then washed again. Next, they are transferred to a saturated solution of alum for 15 minutes to 1 hour. After washing they are contrast-stained with carmin or safranin, and having been dehydrated are passed through clove oil or xylol and mounted in balsam. The fibrin is dark blue to bluish-black.

New Method of Staining Actinomyces.‖—Dr. A. Sata gives the following method for staining Actinomyces in sections. The pieces are fixed in formalin solution and the sections stained with a dilute hæmatoxylin solution. The sections are then immersed in alcohol for

* Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 803–5.
† See this Journal, 1899, p. 664.
‡ Deutsche Med. Wochenschr., xxvi. (1900) pp. 256–7.
§ Centralbl. f. allgem. Pathol. u. pathol. Anat., x. (1899) pp. 749–57.
‖ Op. cit., xi. (1900) pp. 101–2.

some minutes, and afterwards transferred to a saturated solution of Sudan iii. in 96 per cent. alcohol for 12–24 hours. They are then washed in alcohol and mounted in glycerin.

Staining Envelope of Ascospores.*—Mr. W. A. Riley recommends a strong aqueous solution of Bismarck-brown for staining ascospores. Fifteen minutes is sufficient, though it is impossible to overstain. The spores are then washed in water and mounted in glycerin jelly.

Rapid Conversion of Hæmatoxylin into Hæmatein in Staining Solutions.†—Dr. H. F. Harris uses mercuric oxide for rapidly converting hæmatoxylin into hæmatein. The first formula given is one which makes a solution much the same as Mayer's hæmalum:—Hæmatoxylin 1 grm., alcohol 10 ccm., alum (potash or ammonia) 20 grm., distilled water 200 ccm. The alum is dissolved in the water by the aid of heat and then the hæmatoxylin solution is added. The mixture is then brought to the boil as rapidly as possible and half a gram of mercuric oxide added. The solution, which is now dark purple, is at once cooled by plunging the vessel into a basin of cool water. It is then ready for use. Its nuclear effect is heightened by dilution.

By adding 4 per cent. glacial acetic acid to the foregoing, a solution which corresponds to Mayer's acid hæmalum, and much resembles Ehrlich's hæmatoxylin, is produced. The addition of 30 to 70 ccm. of the hæmalum solution serves to keep the stain well, and the mixture is termed glychæmalum.

A hæmacalcium solution is prepared as follows:—(A) Hæmatoxylin 0·5 grm., aluminium chloride 0·5 grm., glacial acetic acid 2·5 ccm., 70 per cent. alcohol 150 ccm. The hæmatoxylin and aluminium chloride are dissolved in the alcohol, the solution brought to the boil, and then 1 grm. of mercuric oxide is gradually added. When it becomes dark purple the solution is rapidly cooled. The acid may be added before or after boiling. (B) Calcium chloride 25 grm., acetic acid 2·5 grm., 70 per cent. alcohol 150 ccm. The calcium is dissolved in the alcohol. The two solutions may be mixed, but it is better to keep them apart till just before use. Delafield's hæmatoxylin is prepared as follows:—Dissolve hæmatoxylin 1 grm. in alcohol 6 ccm. and add saturated solution of alum 100 ccm. Boil, and add 0·5 grm. of mercuric oxide. When the liquid assumes a dark purple colour, cool rapidly. When cool add 25 ccm. both of methylic alcohol and glycerin.

For staining mucin the following solution, termed muchæmatein, is advised. Aluminium chloride 0·1 grm., hæmatoxylin 0·2 grm., 70 per cent. alcohol 100 ccm.

Dissolve the aluminium chloride and hæmatoxylin in the alcohol, boil, and add gradually 0·6 grm. mercuric oxide; when purple, cool. A drop of hydrochloric acid should be added just before or after boiling.

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

Simple Method of Fixing Blood-films.‡—Dr. A. Edington has used the vapour of formic aldehyde for fixing blood-films, with extremely good results. He uses a bell-jar, the diameter of which is

* Journ. Applied Microscopy, iii. (1900) pp. 781–2. † Tom. cit., pp. 777–80.
‡ Brit. Med. Journ., 1900, ii. p. 19.

135 mm., and the height to the lower border of the neck about 150 mm. There is an opening at the top of the bell-jar, and this is closed by an indiarubber stopper, on the bottom of which is glued an ordinary cover-glass. The cover-glasses the films on which are to be fixed are laid on a glass plate and covered by the bell-jar. The stopper is removed and a drop of formalin is placed on the attached cover-glass at its lower end, and the stopper immediately replaced. The films, which must be quite dry, are exposed to the vapour for 15 minutes or more, but not longer than 30 minutes. The films should be thin, as thick ones are liable to crack.

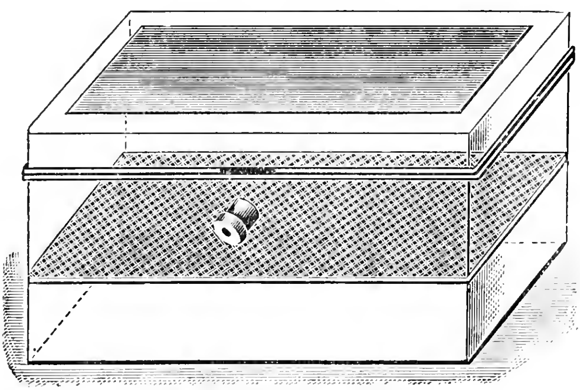
Mounting of Mosquitos.*—Dr. G. M. Giles recommends the following method for mounting mosquitos. As microscopical specimens, mosquitos should be mounted dry, and for this purpose Carpenter's foraminifera slide is best suited. This consists of a wood slip 3 in. by 1 in. by $\frac{1}{16}$ in. thick, with a hole about $\frac{3}{4}$ in. in diameter in the middle. This hole is converted into a cell by means of a cover-glass secured by gummed paper. The mosquito is spread out in the cell, which is then closed by means of another cover-slip, secured in the same way.

By this dry-mounting method the colour characters, only visible by reflected light, are preserved. When wet or balsam-mounted the specific distinctions are lost.

(6) Miscellaneous.

Apparatus for Ascertaining the Effect of Disinfectants.†—Dr. Piorkowski describes an apparatus (fig. 180) which he has found very valuable for determining the effect of disinfectants. It consists of a metal box made air-tight when closed by means of a rectangular bayonet

FIG. 180.



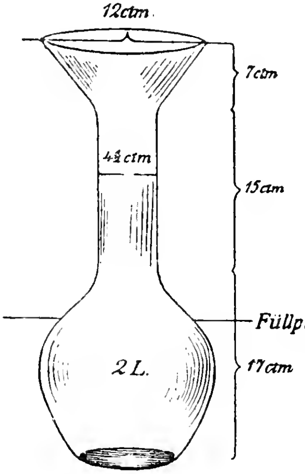
fastening. About half-way down the well is fitted a removable wire net tray. In the front (and at both ends if necessary) is a small tube which can be closed with a metal cap. Through this tube the disinfectant in the form of spray is introduced and made to play on the various objects

* Brit. Med. Journ., 1900, ii. pp. 459-60. Cf. this Journal, *ante*, p. 527.
† Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 609-10 (1 fig.).

deposited on the tray. A glass plate is inserted in the lid for inspecting the distribution of the spray.

Glass Flask for Preparing Nutrient Media.*—Dr. A. von Borosini describes a glass vessel which obviates the inconvenience of overheating nutrient gelatin. The upper part of the flask is funnel-shaped. The illustration (fig. 181) gives the measurements for a two-litre flask.

F G. 181.



Some Laboratory Apparatus.†—Professor S. H. Gage, in order to meet the requirements of a large class, has made use of flat-headed stove bolts as holders for the paraffin blocks to be sectioned by the Minot microtome (fig. 182). For small blocks the bolts answer without any modification, but for most objects a larger surface than the head of the bolt is necessary. To increase the surface an American cent, or some coin still larger, is soldered on to the head of the bolt. The convenience of having a sufficient supply of holders for a large class is obvious. The blocks can be kept ready for use in a glass phial; the fore end should be sealed with paraffin and the holder placed with the block end downwards (fig. 183).

Another apparatus described is a tray for holding ribands of sections. They are made of wood and measure 30 × 40 cm. The illustration, fig. 184, shows the face and sectional views. The bottom of the tray is covered with paper on which the ribands are deposited; this facilitates the numbering of the sections. The trays may be piled one upon another and so used as covers.

For the bichromate and sulphuric acid cleaning mixture a low iron kettle lined with heavy sheet lead is recommended, as the lead is not appreciably corroded and the kettle does not burst with the heat.

New Method for Counting Bacteria.‡ — Herr A. Klein describes a new method which is specially adapted for counting bacteria in the moist condition. A definite quantity (e.g. 0·5 ccm.) of a liquid culture, or an emulsion of a solid culture in physiological salt solution, is thoroughly mixed with an equal quantity of anilin water-gentian violet. In 2–3 minutes the bacteria are deeply stained. The mixture is again stirred so as to distribute the bacteria fairly equally throughout the fluid, and then a standard loopful removed to a clean cover-glass and carefully spread out. When dry the film is mounted in balsam. Fifty fields are then counted, and the number of bacteria in one ccm. of culture or

* Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900) p. 23 (1 fig.).
† Trans. Amer. Micr. Soc., xxi. (1900) pp. 107–9 (3 figs.).
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvii. (1900) pp. 834–5.

emulsion is calculated from the known size of the loop, the cover-glass, and the field of vision. The complete details of this method are promised later.

Fig. 182.

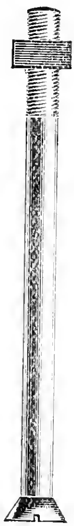


Fig. 183.

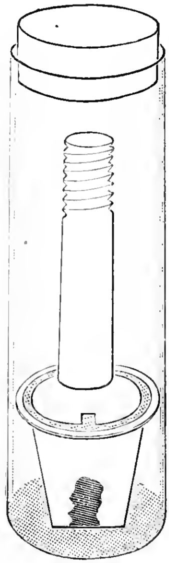
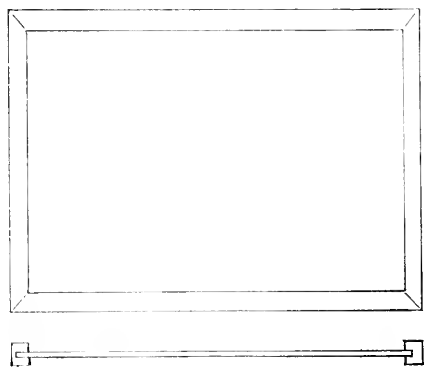


Fig. 184.



Method of Identifying Butter.* — Mr. J. A. Hummel made an examination of Brown and Taylor's official method of identifying butter. In the manufacture of renovated butter, the butter fat is melted and then rapidly cooled in a stream of cold water; this induces a semi-crystallisation of the fat which may be recognised by the Microscope. A small piece of the sample is placed on a glass slide and pressed into a thin film with a cover-glass; it is then at once examined with a polarising Microscope magnifying 120–150 diameters. A selenite plate is placed between the slide and the lower Nicol's prism. In every case normal butters gave a uniform blue-coloured field, showing the entire absence of crystals; but the renovated samples gave a blue field mottled with yellow, which varied in intensity, but was very distinct in each case.

Stine, W. M.—**The Microscopic Study of Metals.**
[An interesting introduction to the subject.]
Journ. of App. Micr., March 1900, pp. 786–91 (2 figs.).

Chamot, E. M.—**Micro-chemical Analysis.**
[A series of introductory articles.] *Journ. of App. Micr.*, Jan. et seq. 1900.

* Journ. Amer. Chem. Soc., xxii. (1900) pp. 327-9. See Journ. Chem. Soc., lxxviii. (1900) Abstr. ii. p. 582.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY

DECEMBER 1900.

SUMMARY OF CURRENT RESEARCHES

Relating to Zoology and Botany *(principally Invertebrata and Cryptogamia),* Microscopy, &c., *including Original Communications from Fellows and Others.**

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Transplantation of Ovaries.‡—Dr. A. Herlitzka experimented with forty guinea-pigs of both sexes into which the ovaries of adult females of the species were transplanted. In all cases, equally in the two sexes, the transplanted ovarian tissue degenerated; in one case a normal ovum appeared to survive. The adaptability of the tissues of the transplanted ovary is greater with the more differentiated (the connective) and less with the more "specific" (the germinal) tissue. Adaptability is in inverse ratio to "*Specificität.*" The degeneration of transplanted ovary depends mainly on the unpropitious or unsuitable "idioplasmic" influences of the new somatic environment, to which the germ-plasm is especially susceptible. Herlitzka criticises the work of Schultz § who claims to have succeeded in five cases of transplantation. If these be accepted, along with two reported by Gregorieff, and the one case noted above, there are eight cases of success as against fifty-seven of failure.

Structure of Mammalian Ovum.‖—Dr. Alexander Gurwitsch finds that the so-called yolk-nucleus of the young ovocyte in the guinea-pig is a true sphere in van Beneden's sense, that is, it consists of a mass of

* 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, Reproduction, and allied subjects.

‡ Biol. Centralbl., xx. (1900) pp. 619–24. Festschrift Luciani, Milan, 1900.

§ Centralbl. Allg. Pathol., xi., April 1900.

‖ Arch. Mikr. Anat., lvi. (1900) pp. 377–92 (1 pl.).

clearly defined protoplasm surrounding the central corpuscles. During mitosis the protoplasmic mass gives rise to at least a part or probably the whole of the achromatic figure, and from its sharp definition it merits Meves' term of "idiozom." The idiosome of the ovocyte is completely used up during the course of mitosis, but reappears again in the egg during its growth period, showing, however, then slightly different physical appearances. The exact relation between the earlier and later idiosome could not be determined, but it is probable that the latter originates directly from the former.

Oogenesis in Mammals.*—Dr. Hans von Winiwarter has made an investigation of the ovary in the rabbit and in *Homo*, which finally resolved itself into the consideration of two points: (1) the development of the ovum up to the time of the formation of the Graafian follicle; and (2) the development of the ovary itself during the same period. As to the first point, he finds that, contrary to the usual opinion that the growth-period of the egg coincides with the period of formation of the Graafian follicle, the most important nuclear changes occur before the foundations of the follicle appear. The primordial oogonia have nuclei of ordinary reticulated structure (*protobroch* nuclei). These increase by karyokinetic division, and when the divisions cease the nuclei of the resulting ovocytes undergo a complicated series of changes. The reticulum gives rise to a chromatic thread (*deutobroch* stage), which at first fills the nuclear cavity (*leptotænic* stage), and later forms a central dense mass (*synaptænic* stage). At this stage the filaments are clearly double; but as the chromatic thread spreads itself again through the nuclear space, this duality disappears, and the thread is single, thick, and moniliform (*pachytænic* stage). The duality reappears later in the *diplotænic* stage, where the thread breaks up into a number of segments, but is lost as the nucleus finally recovers the reticulated condition. In other words, in the interval which separates two reticulated stages, the nucleus exhibits a filamentous condition, the filament becomes double, then single, and finally appears double a second time. As to the meaning of the process, the author is disposed to regard it as follows. In the synaptænic stage the duality is produced not by division but by the approach of distinct filaments towards one another. The thick moniliform filaments of the pachytænic stage are produced by the union of these filaments, and the apparent duality of the diplotænic stage is produced merely by a loosening of the connection between the previously united filaments. Generally, the author is of opinion that the double appearance of the chromatin thread is an indication of the union of parts, not of the splitting of a previously uniform structure. These results are compared with those obtained by Moore and Montgomery for other animals, both as to male and female genital products. With Montgomery's results the author's show close analogy, but two striking differences are apparent. In the cases studied by Montgomery the series of changes ("early anaphase," "synapsis," "post-synapsis," "telophase," "rest-stage"), occur in nuclei which have just divided—in the author's case in resting nuclei. Secondly, the chromosomes in Montgomery's cases remain distinct throughout—in the author's case the chromatic filament is certainly single at the beginning

* Arch. Biol., xvii. (1900) pp. 33–199 (2 pls. and 2 figs.).

of the changes, transverse segmentation not appearing till later (diplotænic stage).

In regard to the organogenesis of the ovary, the author finds that the primordial germinal epithelium gives origin successively to the following structures: medullary cords, true germinal epithelium, and epithelial invaginations.

Zona pellucida and Egg.*—V. von Ebner notes that most modern anatomists believe that Flemming, Paladino, and Retzius have proved that the radial striping of the zona pellucida is due to prolongations from the follicular cells which pass into the egg, and that the egg grows while enveloped in the membrane. Nagel, on the other hand, believes that a perivitelline cleft exists between the surface of the egg and the inner surface of the zona, and that the latter does not appear till the egg has attained its full size. The author believes that Nagel's "perivitelline cleft" is an optical effect in the case of fresh eggs, though such a space may exist in degenerating eggs. Further, very careful measurements have convinced him that the egg does increase in size while it is invested by the zona. As the zona is a formation which arises between the intercellular bridges connecting egg and follicular cells, there is no difficulty in supposing that it can increase in diameter, and so allow room for the increasing egg.

Effect of Gravity on Development.†—Prof. Oskar Schultze notes that the dispute between himself and Roux on this point suffers from a want of precision in the use of terms. The problem which he has set before himself is as follows:—Is it necessary for the normal development of the frog's egg that its chief axis should be allowed to take up a definite position under the action of the force of gravity? In such a form the problem is capable of definite experimental investigation. In the first place, while within the ovary the egg does not appear to be influenced by gravity, and this peculiarity is retained until fertilisation. After fertilisation the secretion of the perivitelline fluid makes it possible for the egg to rotate in its membranes, and so to respond to the action of gravity by the adoption of one definite position. If this be rendered impossible, the egg perishes; if it be prevented for a limited period and then gravity be permitted to again exert its effect, abnormalities of varying degree are produced. Much of the paper is concerned with a detailed discussion of the methods of experiment adopted by Roux and the author respectively, and a criticism of Roux' results.

Development of Spleen.‡—Dr. W. Tonkoff has studied this subject in the case of the Amniota, and finds that the spleen originates in them from cells split off from the cœlomic epithelium. These at once lose all connection with the epithelium, and become indistinguishable from the mesenchyme. The connective-tissue basis of the pancreas and the investment of the duodenum originate in precisely similar fashion, save that in their case the cell-migration takes place even more rapidly. If, therefore, these are to be reckoned as mesenchymatous, then the spleen is mesenchymatous. Its origin should be contrasted with that of such

* Anat. Anzeig., xviii. (1900) pp. 55–62 (2 figs.).
† Arch. Mikr. Anat., lvi. (1900) pp. 309–34. Cf. this Journal, 1895, p. 292.
‡ Tom. cit., pp. 392–458 (3 pls. and 8 figs.).

structures as parts of the excretory system, the Müllerian duct, &c., which also originate from the cœlomic epithelium, but retain their epithelial character, and remain distinct from the mesenchyme.

With regard to the spleen in the Anamnia, the author is not as yet prepared to formulate conclusions, and thinks that further research is necessary. He gives a useful list of the times at which the spleen appears in the Vertebrates most commonly used for embryological work.

Mesothelial Allantoic Villi of Pig.*—Dr. C. S. Minot finds that in young embryos of the pig the allantois gives rise to processes resembling villi which grow between the organs of the abdomen, are clothed with mesothelium, and when at their maximum appear like small bladders. They reach their maximum development in embryos of 17 mm. in length, and in those of 20 mm. are already undergoing regressive metamorphosis. The author has not as yet found any reference in literature to these structures, nor has he found them as yet elsewhere, but he has not searched in any other Ungulate. In many other forms (man, cat, dog, &c.), there are slight irregularities on the surface of the mesothelium in the vicinity of the umbilicus—these may represent the point of origin of the villi of the pig.

Peculiarities of Breeding and Development in Anura.†—Lilian V. Sampson has brought together a useful account of unusual modes of breeding and development among Anura. Thus she notes *Rhacophorus schlegelii* which kneads the jelly around the eggs into a trough; *Phyllomedusa hypochondrialis* which makes a sort of leaf-nest; *Cystignathus mystaceus* which never goes to water even for spawning; the Surinam toad; the obstetric frog; and many others. The value of the paper is in bringing together the widely scattered observations on the subject.

Development of Torpedo marmorata.‡—Dr. J. Emmert has studied embryos of this species corresponding to Balfour's stages D, F, G, and H, and also embryos of *Pristiurus*. With regard to the origin of the blood-vessels—one of the points specially studied—the author finds that they originate exclusively from the mesoderm, especially the splanchnopleure. There is no indication that the endoderm takes any part in the process. The aorta appears to originate from cells which migrate from the dorsal end of the splanchnopleure, perhaps also from the primitive segments in the space beside the notochord: but this is uncertain.

Oocytes of Cat.§—Dr. Emil Holmgren has examined various kinds of cells in search of the intracellular canaliculi, which he has already demonstrated in nerve-cells. He has obtained interesting results in the case of ova in their growth period in new-born kittens. Such ova, on staining with iron-alum-hæmatoxylin and acid fuchsin-orange, show, near the excentric nucleus, a body which stains with the acid-fuchsin and is usually invested by a mass of granules which take up the orange stain. The body varies in shape, consists of rods or canaliculi, and from its staining reactions would appear to arise from prolongations of the mesenchymatous investment which surrounds the cells. These

* Anat. Anzeig., xviii. (1900) pp. 127-36 2 (figs.).
† Amer. Nat., xxxiv. (1900) pp. 687-715.
‡ Arch. Mikr. Anat., lvi. (1900) pp. 459-90 (1 pl. and 38 figs.).
§ Anat. Anzeig., xviii. (1900) pp. 63-9 (8 figs.).

prolongations—which possibly have a lumen of lymphatic origin—appear to stand in causal relation to the formation of deutoplasm, the growth of the cell, and possibly also to the increase in size of the cell-nucleus. In addition, there are fine fibrils, possibly of nervous origin, also penetrating the cytoplasm. The present notice is preliminary, and the author suggests various further lines of investigation, some of which he hopes to pursue.

b. Histology.

Functions of the Nucleus.* — M. Henri Stassano has been struck with the resemblances between the changes of the nucleus in red blood-corpuscles during the absorption of iron-salts, e.g. the saccharate, and the phases exhibited in the development of these elements. He has been led to the conclusion that the nucleus has to do with the assimilation of nutritive materials, with the elaboration of proteid substances like hæmoglobin, and with the protection of the cells against injurious substances absorbed.

Mitosis and Amitosis.†—Bernhard Solger notes that his statement that the nuclei of the myocardium in the pig probably multiply by direct division has been contested by Hoyer on account of observations made on the myocardium of the calf. Further observations in the case of the pig have convinced Solger that his surmise was correct, and that the nuclei do multiply there without any sign of a karyokinetic process. Even in the calf he has found indications of the occurrence of direct division, as well as mitotic figures. Both processes therefore occur, but the reasons for the apparently sporadic occurrence of amitotic division have yet to be determined. The author briefly discusses the other cases of amitotic division in plants and animals which have been described by different authors, especially those cases where mitotic division is replaced by the amitotic method. Though unable to explain the appearance of the latter in the nuclei of the myocardium, he notes that according to Godlewski the same thing occurs in the nuclei of striped muscles.

Structure of Medullated Nerve-fibres.‡ — G. Sala summarises the present condition of knowledge in regard to the so-called skeletal substance of the medullary sheath, which has been the object of many investigations in recent years. He has been able to demonstrate not only the spirally coiled fibrillæ shown by Golgi to exist at the ends of the medullary segments, but also a series of fine threads, often with swollen nodes, which connect the successive spirals, and seem to serve like them to support the substance of the medullary sheath.

Nerve-endings in Sclera of Eye.§—A. E. Smirnow notes that though it has been shown that the tunica albuginea of the eye has a special nerve-supply, nothing is known of nerve-endings in it. He has studied the point in various mammals by the help of Golgi's method and the methylen-blue method, and finds that, in addition to nerve-endings in the walls of the vessels, sensory endings occur between the bundles of fibres (true sensory endings), and also upon the connective-tissue corpuscles (probably trophic end-organs).

* Comptes Rendus, cxxxi. (1900) pp. 298–301. Cf. this Journal, *ante*, p. 566.
† Anat. Anzeig., xviii. (1900) pp. 115–21 (4 figs.).
‡ Tom. cit., pp. 49–55 (1 pl.).
§ Tom. cit., pp. 76–80 (3 figs.).

Nerve-endings in Heart.*—A. E. Smirnow has applied both Golgi's method and Ehrlich's method to the study of the endings of the motor nerves in the muscle-cells of the heart of Vertebrates. He has obtained specially good results in the case of the frog's heart and those of certain mammals (cat, dog, &c.). He finds that each muscle-cell has its nerve-ending, and that the nerve-endings are different from both the end-organs of striped muscles and the plexuses of unstriped muscles. Fine varicose fibrils arise from the nerve-fibres of the intra-muscular fibrillar ramifications, branch repeatedly on the surface of the muscle-cells, and finally form free telodendrites of varying form and extent in different groups of Vertebrates on the surface of the cells.

Hair-cells of the Crista and Macula Acustica.†—Prof. C. M. Fürst has studied these structures, especially in salmon embryos. Each hair-apparatus includes a hair (of connected cilia), a basal disc (apparently composed of round corpuscles), and a cone which is continued downwards into the cell. These parts correspond to the cilia, the basal corpuscles, and the conus of a ciliated cell. The hair-apparatus, probably specialised as a sensory part of the cell, has distinct structural peculiarities, but the cell as a whole belongs to the ciliated type. The hypothesis of Lenhossék and Henneguy, that the basal corpuscles are derived from the central corpuscles, remains probable.

Nerve End-organs in Muscle.‡—Dr. Chr. Sihler returns to the discussion of some difficult points in regard to this subject. First, as to the occurrence of sensory end-organs in muscles, he believes that the "muscle-spindles" represent such organs. They can be readily found in the muscles of snakes, lizards, and the frog, and are described in detail for all three. As an example the spindle of the snake may be described. It consists of three parts, the nerve, the capsule, and the muscle-fibril. The last is somewhat broader than usual at the point where the nerve enters, shows projections on its surface, and contains a number of rounded nuclei; at times the characteristic muscle-striping is absent at the point of entrance of the nerve. The capsule consists of layers of membrane, is spindle-shaped, and appears to have the same composition as Henle's sheath. The nerve enters at one end of the spindle and loses Henle's sheath as it enters, this being lost in the capsule. It retains Schwann's sheath and the medullary sheath until nearly the tip, where it rests upon the muscle. The nerve ends in a plate on the surface of the muscle-fibril. As to the function of the spindles, the author considers that they are probably sensitive to the state of contraction of the muscle.

A further point discussed by the author is the significance of the nuclei found in the motor end-organs of muscles. He finds that these nuclei, in e.g. the lizard, are of two kinds, distinguished by their shape and staining reactions. He believes that the one set belongs to the endothelial cells of Henle's sheath, which is continued to the end of the nerve-fibrils, the other set to Schwann's sheath. He is further of opinion that the end-organ lies above, and not, as has been supposed, below the sarcolemma of the muscle-fibre.

* Anat. Anzeig., xviii. (1900) pp. 105-15 (3 figs.).
† Tom. cit., pp. 190-203 (6 figs.).
‡ Arch. Mikr. Anat., lvi. (1900) pp. 334-54 (1 pl.). Cf. this Journal, 1896, p. 397.

Multiplication of Nuclei in Striped Muscle of Vertebrates. * — E. Godlewski, jun., has studied this in late embryos and recently born young of guinea-pig and mouse, and in salamander larvæ. Nuclear multiplication takes place both by direct and by indirect division. Though previous observers have never announced the presence of centrosomes in differentiated transversely striped muscle, the author found them in typical form, not only in the monaster stage, but even as early as the spirem stage.

Structure of Hair-follicles.† — Dr. Adolfo Calef finds that in the developing hairs of *Mus decumanus* var. *albina* the outer root-sheath is furnished with an epithelial appendix, which is also seen, though less markedly, in *Sus scrofa*. In the mouse the appendix becomes differentiated into two regions, an upper which forms the sebaceous gland, and a lower, separated by an incision, which lies at the side of the circular zone of proliferation, already noted by Torri in developing human hairs. Comparison with the adult mouse shows that the appendix corresponds to the rudimentary accessory hair which often lies at the side of the true hair. From a comparison with the pig and with the results of other authors as to the zone of proliferation, Calef concludes that in all mammals the outer root-sheath exhibits a more or less evident zone of proliferation which is the point from which an accessory hair may originate, or simply the rudiment of an atrophied hair; it may possibly be the point from which the first rudiment of the substitution-hair originates.

Secretion in Amphibian Oviduct.‡ — V. Ellermann notes in frog and newt the presence of granules as preliminary stages of the oviducal mucus; they occur on the threads of a plasmic network, and show differential staining, e. g. with hæmatoxylin. The mucus occurs in the cells in the form of large polyhedral bodies, and a complete series from the minutest granules to these can be traced, especially in the newt.

Intestine of Amia.§ — Mr. W. A. Hilton notes that the intestinal convolutions are very complex in form and arrangement, being made up of variously shaped folds and free projections or villi. There is a well-developed outer longitudinal muscular coat and a very thick inner muscular coat. Next the latter there is a thick connective-tissue band, which sends up projections of fibres into some folds and villi. A *muscularis mucosa* is present, a few fibres of which are prolonged into the cores of the folds and villi. The epithelium is simple, columnar, and not ciliated, except for a small area towards the caudal end of the spiral valve.

New Edition of 'The Cell in Development and Inheritance.'‖ — Prof. E. B. Wilson has enlarged his valuable text-book by over a hundred pages, and has added about fifty new figures. Some changes have been made. It is recognised that the centrosome is not always a permanent cell-organ; the alveolar theory of cytoplasmic structure is now more

* Bull. Acad. Sci. Cracovie, 1900. See Amer. Nat., xxxiv. (1900) pp. 671–3.
† Anat. Anzeig., xvii. (1900) pp. 509–17 (4 figs.).
‡ Op. cit., xviii. (1900) pp. 182–9 (6 figs.).
§ Amer. Nat., lxxxiv. (1900) pp. 717–35 (19 figs.).
‖ 'The Cell in Development and Inheritance,' by E. B. Wilson, 2nd ed., New York, 1900. xxi. and 483 pp., 194 figs.

prominent; and it is suggested that different plasmic appearances may represent different phases of function. It is enough to say that the value of the work has been enhanced.

c. General.

Fauna of Japan.* — Dr. Arnold Jacobi has a brief note upon the Vertebrates of Japan, their distribution and origin. He believes that the problem of the Japanese fauna has been needlessly complicated by the inclusion in the area of the Kurile Islands on the north, and the Lutschu and Bonin Islands on the south. When these are excluded, it is seen that Japan affords an example of a mixed region, its fauna consisting of three distinct elements, an endemic fauna due to the insular separation, and continental forms introduced at various periods from north and south respectively. Part of the peculiarities may be ascribed to the great meridional extension of the island chain, part to the variety of climatic conditions within a narrow area.

Vibrissæ on Forepaws of Mammals.† — Mr. F. E. Beddard notes that there have been incidental references to the occurrence of an innervated tuft of hairs on the wrist, as Bland Sutton noted for Lemurs. Beddard has found such vibrissæ on those Lemuroids, Carnivores, Rodents, and Marsupials that use their forepaws as climbing or grasping organs, or in both ways. They may be really detected by touch, and they are often conspicuous in colour. Thus in a pale almost albino example of the squirrel *Sciurus maximus*, the hairs were black, and in a black cat they were white.

Phylogeny of Mammalian Hairs.‡—Prof. A. Brandt discusses four hypotheses:—(*a*) that hairs are derivable from reptilian horny scales; (*b*) that hairs are comparable to epidermic proliferations which occur here and there in cold-blooded animals, e.g. to the *Perlausschlag* of Cyprinoids; (*c*) that hairs are modifications of the sensory papillæ of Amphibians; and (*d*) that hairs are in structure and development related to teeth, and derivable from placoid Selachian scales. It is the fourth hypothesis which commends itself to the author. He discusses the structural correspondence, the similarity in mode of development, and possible transitional structures such as the bristle-like outgrowths on *Selache maxima*.

Function of Thyroid. § — Herr Oswald has been led to conclude that the bearer of the specifically potent substance of the thyroid is the iodine-containing thyreoglobulin, and that the colloid of the normal gland is a mixture of this thyreoglobulin with a nucleoproteid.

Carotid Gland and Suprarenal Capsule in Mammals.‖—Dr. Swale Vincent discusses the bearing of recent work on his view that the carotid gland is the equivalent of the medulla of the suprarenal in mammals, and of the suprarenals of Elasmobranchs. He considers that Kohn's ¶ results support this view, and that the differences between his own work

* Zool. Jahrb. (Abt. Syst.), xiii. (1900) pp. 463–78 (1 map).
† Nature, lxii. (1900) p. 523. ‡ Biol. Centralbl., xx. (1900) pp. 572–92.
§ Münchener Med. Wochenschr., No. 33, 1899. See Beihefte Bot. Centralbl., ix. (1900) pp. 382–5. ‖ Anat. Anzeig, xviii. (1900) pp. 69–76.
¶ Cf. this Journal, *ante*, p. 560.

and Kohn's are apparent rather than real, and chiefly due to differences in terminology. While the medulla of the suprarenal in mammals is, as he believes, in origin derived from the sympathetic as in other Vertebrates, yet in the adult it seems to be no longer nervous but glandular, producing a characteristic internal secretion. The cortex of the suprarenal the author regards as corresponding to the interrenal of Elasmobranchs. Believing therefore that the above position is confirmed on all sides by different forms of evidence, the author is wholly unable to accept Aichel's * views that both medulla and cortex originate from the nephrostomes of the mesonephros, and that the medulla has nothing to do with the sympathetic. He points out especially that Aichel says nothing of the remarkable secretion, so characteristic of the paired suprarenals of Elasmobranchs and of the medulla of the suprarenals in Mammals, or of the comparative morphology of the suprarenal throughout the Vertebrate phylum, and believes that Aichel's results emphasise the danger of relying exclusively on embryological work in studying such a problem.

Japanese Dancing Mice.†—E. von Cyon notes that in these creatures, which move only sidewards, never forward or backward, only one of the three semicircular canals is developed. The mice can hear notes about the pitch of their own squeak. If their eyes are bandaged, equilibrating movements are disturbed. On a turntable they stop their dance-like movements and remain at rest.

Nostrils of Aquatic Snakes.‡—Dr. Ludwig Thothariner notes that among the peculiarities of those snakes which habitually live in water, the presence of *valved* nostrils is usually numbered, the inference being that the nasal openings are closed by muscular action. He finds that this is not the case in any aquatic snake, for the nostrils invariably close automatically under water, and are opened by muscular action during breathing. The closing action is effected by means of cavernous tissue, which is compressed by muscular action during breathing. In order to allow room for the closing apparatus, the outer nasal chamber (*Nasenvorhof*), which is virtually absent in other snakes, is not only present, but may (*Chersydrus* and Hydrophidæ) reach a great length. The nasal gland is generally present in aquatic snakes, but is absent in *Pelamis bicolor*, and the olfactory epithelium diminishes in superficial extent as the adaptation to the aquatic life increases. The nasal muscle is absent in Hydrophidæ and *Chersydrus*, although, except in *Pelamis*, the nasal gland is present. Jacobson's organ was found to be well developed in all the snakes studied.

Variation in Frog.§—Dr. Earnest Warren notes that three times in three years he has noticed in frogs used for class-dissection the occurrence of a vessel passing from the lung to the hepatic portal system. In the last case observed an artery and a vein ran side by side. The artery arose from the posterior mesenteric artery, and passed to the apex of the lung, while the corresponding vein bifurcated, one

* Cf. this Journal, *ante*, p. 561.

† Arch. Ges. Physiol., lxxix. (1900) pp. 211–302. See Zool. Centralbl., vii. (1900) p. 705.   ‡ Zool. Jahrb. (Abt. Syst.), xiii. (1900) pp. 415–42 (2 pls. and 4 figs.).

§ Anat. Anzeig., xviii. (1900) pp. 122–3 (1 fig.).

branch being continuous with the renal portal and the other with the rectal vein of the hepatic portal. The interest of the variation is the similarity to the conditions obtaining in a Teleostean, where the mesenteric artery sends a branch to the rete mirabile of the air-bladder, the blood returning to the portal system. The author suggests that the case is one of reversion.

A Remarkable Axolotl.* — Prof. H. L. Osborn describes an "axolotl" from a low level marsh stream in Dakota. It displays a combination of larval and adult characters in its exterior form. In size it greatly exceeds the average of *Amblystoma*, and its length, 312 mm., goes beyond the maximum reported length by 20 mm. There is a close general resemblance to *A. tigrinum*, but a decided unlikeness to the hitherto recorded *Siredon* larvæ of that species:—in total size, the shape of the gular fold, the size and shape of the gills, the number, size, and shape of the gill-filaments, the proximity of the eyes to the snout, the coloration of the body, the length of the front limbs, the outline of the post-abdomen, and the locality in which the animal was found.

Caudal Heart of the Hagfish.†—Dr. C. W. Greene describes the caudal heart in the Californian hagfish, *Polistotrema* (= *Bdellostoma*, *Homea*) *stouti*. Retzius noticed in 1890 a similar paired pulsating organ in the tail of *Myxine*. Its function is to drive the blood of the subcutaneous spaces back into the circulatory system.

Compensatory Movements of the Eyes in Fishes.‡ — E. P. Lyon finds that certain compensatory eye movements in the dogfish can be produced without the intervention of the semicircular canals. If the tail of a dogfish is turned to one side, the eye of that side is directed forwards, and that of the other side backwards. But as this occurs after the eighth nerves are cut, the reflex does not originate in the ear. As the reflex ceases, however, when the spinal cord is divided well forward in the body, the author concludes that the sensory disturbances which give rise to the reflex are located in the posterior part of the trunk. This seems inconsistent with Lee's conclusion that the normal compensatory movements of the eye are reflexes produced by a stimulation of the semicircular canals.

Races of Mackerel.§—Mr. H. C. Williamson has made a laborious investigation with a view of determining whether racial differences exist between the mackerel of the West and East coasts of Scotland. The methods employed were those used by Heincke in his study of the local forms of the herring. It need hardly be pointed out that the work is of interest in connection with the general problem of variability.

Of the numerous characters painstakingly measured there are, with three exceptions, probably none which differ in the three groups to an extent that would permit stress to be laid upon them, when the inevitable shortcomings of the dimensions in respect to accurate measurement are taken into account. In the case of the fin-rays, finlets, and vertebræ, no

* Amer. Nat., xxxiv. (1900) pp. 551–62 (4 figs.).
† Amer. Journ. Physiol., iv. (1900). See Amer. Nat., xxxiv. (1900) pp. 666–7.
‡ Tom. cit., pp. 77–82. See Amer. Nat., xxxiv. (1900) pp. 669–70.
§ Ann. Rep. Fishery Board for Scotland, xviii. (1900) pp. 294–329 (15 tables).

differences which would on Heincke's method admit of their separation into races were found. Between the mackerel caught in the Clyde, at Barra and Stornoway, and off Aberdeen, the differences in the lengths of the head, skull, and pectoral fin may with some probability be granted racial distinction. The shorter length of head and skull, in which the Clyde and Barra and Stornoway lots more closely resemble one another, separate them slightly from the Aberdeen collection, and in respect to a shorter pectoral fin the Aberdeen and Barra and Stornoway fishes are separated by a small interval from the Clyde individuals. With regard to the other characters, the author considers that the evidence does not prove them of racial distinction.

Natural History of the Plaice.* —Mr. H. M. Kyle finds that the average size at first maturity for the plaice of the southerly North Sea lies between 13 and 14 in. for the female and between 10 and 11 in. for the male. In the northerly North Sea plaice this average is for females about 15·5 in., for males about 12·5 in. The difference between the sizes of the sexes at this period may correspond to a year's growth. Following the example of Heincke, he applies the mathematical method to the problems of sex-, growth-, and race-variability. Secondary sexual differences have not been found in vertebræ, fin-rays, body-height, nor tail. The skull-dimensions, length, breadth, and depth are slightly greater in the female than in the male, and this is probably connected with the mass and position of the reproductive organs, which are larger and placed more posteriorly than in the male. In a group of individuals, similar in size and sex, there is a range of variation in number of vertebræ and fin-rays, which is probably due to surrounding physical and chemical conditions only. These structures do not vary with growth, but are fixed at the earliest stages. The body-height and length of tail do not alter relatively to the body-length during growth, but there is a relative decrease of skull-length and breadth. As to skull-depth, this dimension does not alter relatively to the skull-length. As to race variability, it is shown that the North Sea plaice are divided into at least two groups by distinct differences in structure. The northern forms have greater body-height, they are rounder more massive fish, while the southern forms are more slender but longer. The changes in the relative proportions of structures due to sex, growth, or race, probably do not disturb the "balance of organs." If this balance is constant for the species, these alterations in the relative proportions of structures indicate the various possible combinations of structures and organs which may arise from the specific variability of the organism.

Flat-Fishes.†—Mr. H. M. Kyle gives a classification of the Heterosomata. The family groups are, with slight modifications, taken from the recent work of Jordan and Evermann.‡ As important characters distinguishing the various sub-families he makes use of :—(1) the position of the nasal organ of the under or blind side relative to the anterior extremity of the dorsal fin ; (2) the form and structure of the olfactory epithelium. The geographical distribution and affinities of the various sub-families are discussed.

* Ann. Rep. Fishery Board for Scotland, xviii. (1900) pp. 189–241 (2 pls.).
† Tom. cit., pp. 335–69 (2 pls.).
‡ 'The Fishes of North and Middle America,' Washington, 1898.

Nesting Habits of Brook Lamprey.* — Messrs. R. T. Young and L. J. Cole have made interesting observations on the behaviour of the brook lamprey (*Petromyzon wilderi*) in moving stones for nest-building. The lampreys seem to have little method, they seize a stone and carry it straight ahead *from* the nest, in a few cases observed *into* the nest. Two lampreys may move a stone conjointly. In a postscript, Prof. Gage recalls his observation that this lamprey keeps to the brooks, attains its full size in the larval state, is never parasitic, remains in the sand during the transformation-period (September to April), emerges in April to May, builds a nest, spawns, and disappears.

Zoological Yearbook.† — We have received the Naples *Jahresbericht* for 1899. It preserves the character it has had of recent years, continuing to exclude systematic papers. It is once more ahead of the *Zoological Record* in its date of publication.

Tunicata.

Branchial Sac in Ciona intestinalis. ‡ — D. Damas has made a detailed study of this structure in adult and larva, and has obtained results in essence similar to those of Marc de Sélys Longchamps § for *Ascidiella*. In the adult the branchial sac shows six areas defined by five sinuses which differ from the other sinuses. Development shows that these areas correspond to the protostigmata, the sinuses to the primitive sinuses which ran between the protostigmata. Their persistence is to be explained as due to the simple primitive character of *Ciona*. Of the intervening sinuses in the adult, it is found that each order contains twice as many sinuses as the order below, thus there are six sinuses of the second order, twelve of the third, and so on. Again, the area between any two sinuses of one order is exactly halved by a sinus of the next order, that is, a sinus of order three lies midway between two sinuses of order two, and so on. These rules are true not only of the transverse sinuses, but also of dorsal languets and branchial muscles, and are a necessary consequence of the method of development. But although the development follows uniform rules, it is not necessarily synchronous in the six primitive areas; for sinuses, languets, and muscles begin to appear in the first of these before the fifth and sixth are completely formed, and this difference persists in the adult. The consequence is that, although the six areas in the adult have their sinuses, &c., arranged on the same plan in all cases, the number of sinuses is not the same in each case. There appears to be no (known) limit to the complexity which may be attained by the surface of the branchial sac.

INVERTEBRATA.

Plankton of the Elbe.‖ — Herr B. Schorler finds the potamoplankton of the Elbe at Dresden to be distinguished by the scarcity of animal as compared to vegetable life; the latter is characterised by the great abundance of diatoms, especially in the spring and autumn. Among

* Amer. Nat., xxxiv. (1900) pp. 617–20. † Berlin, 1900, not continuously paged.
‡ Arch. Biol., xvii. (1900) pp. 1–32 (2 pls.). § Cf. this Journal, *ante*, p. 36.
‖ Gravelius' Zeitschr. f. Gewässerkunde. ii. (1900) 27 pp. See Bot. Centralbl., lxxxiii. (1900) p. 146.

the animal plankton there is an especial rarity of Crustacea, Radiolaria being relatively much more abundant. The vegetable plankton has a double effect in the purification of the water. It consumes substances which would otherwise corrupt the water, and it gives out the oxygen which is required by the animal life.

Plankton of Mammoth Cave.*—Mr. C. A. Kofoid has studied tow-net collections made in the Echo River in the Mammoth Cave, but finds that the organisms of the collections are chiefly surface forms swept in by means of swallow-holes. Copepods are numerous, but there is no evidence that any of them are true cave-forms; such cave-forms are indeed remarkable by their absence.

Mollusca.

α. Cephalopoda.

Development of Placenticeras.†—Prof. J. P. Smith has studied the development and phylogeny of this type, and his results, he says, illustrate the possibility of deciphering racial history in individual ontogeny. The stages wholly lost out of the ontogeny lie between the nautilian protoconch and the glyphioceran larval stage, perhaps corresponding to the period before hatching. All later stages are recorded in the ontogeny with a fair degree of distinctness. The protoconch cannot be correlated with any nautiloid, but the later stages can be compared with ammonoid genera, the exactness of the correlation becoming less as the stage advances, on account of unequal acceleration of development of ancestral characters, but on the other hand easier, on account of the greater number of characters one has to deal with. The earliest larval stage is nautiloid in septa, but ammonoid in its calcareous protoconch. The middle larval stage is comparable to the Palæozoic *Glyphioceras*, the last larval stage to the Mesozoic *Mannites*. In the adolescent period *Placenticeras* goes through a *Cymbites*-like stage, an ægoceran stage, a perisphinctoid stage, is then like *Cosmoceras* of the Jurassic, and finally resembles *Hoplites* of the Cretaceous. It is thus shown by ontogenetic study that *Placenticeras* developed out of *Hoplites*, and comes near the Stephanoceratidæ. The development gives an unusually fine illustration of the law of acceleration or tachygenesis, with its two corollaries, unequal acceleration and retardation.

γ. Gastropoda.

Minute Structure of Snail's Stomach.‡—Rina Monti describes the lining epithelium which consists of (*a*) caliciform cells full of mucus, and (*b*) cylindrical cells with cilia. The tissue which supports the epithelium includes large connective-cells (Leydig's), fibrillar connective-tissue, pigment-cells, smooth muscle-fibres, and vessels lined with endothelium. Outside this there are longitudinal and then circular muscles; and this muscular sheath is enveloped in a connective-tissue rich in large cells analogous to those of the sub-mucosa.

* Trans. Amer. Micr. Soc., xxi. (1899) pp. 113-26.

† Contributions to Biol. from the Hopkins Seaside Lab., xxii. Reprint from Proc. California Acad. Sci., i. (1900) pp. 181-240 (5 pls.).

‡ Rend. Ist. Lombardo, xxxii. (1899) pp. 1086-97.

Salivary Glands of Pulmonata.*—Rina Monti describes the structure of the salivary glands of terrestrial Gastropods, distinguishing the stroma of fibrillar connective-tissue and the parenchyma of mucous, transparent, and granular cells. He contrasts the resting with the active phases, and notes the absence of any hints of mitosis.

Albumen-gland of Snail.†—Dr. G. Paravicini finds that this gland exhibits profound changes both in form and structure in the course of its development. It is at first unciniform and secondarily linguiform. It arises from the same embryonic stratum as the prostate gland. The occasional appearance of supernumerary lobes in the adult is to be interpreted as the persistence of a transitory embryonic state.

Development of Aplysia.‡—P. M. Georgevitch has studied the earlier stages in the development of *Aplysia depilans*, with special reference to the origin of the mesoderm. As in many molluscs, a vitelline membrane is absent. If at the four-cell stage the two cells of the animal pole be called A, B, and those at the vegetative pole C, D, and the nomenclature be preserved throughout the divisions, then the primitive mesoblasts are 2 *d* and 2 *c*, and appear at the 12-cell stage. In their origin these cells are closely similar to the mesoblasts of Polyclades, and by their division they give rise to the mesoblastic bands. The author compares in detail his figures and results with those of other previous observers, and in his summing-up maintains that it is now proved that the mesoblast arises in *Aplysia* after precisely the same fashion as in other molluscs. At the same time the author's work on *Aplysia* accentuates the resemblance between Mollusca and Polyclades in regard to the origin of the mesoblast.

δ. Lamellibranchiata.

Pelecypoda of the Chicago Area.§—Mr. F. C. Baker has prepared the first part of the Chicago Natural History Survey, which deals with the Pelecypoda. After a general introduction discussing molluscs in general, methods of collecting and preserving, the features of the area, and so on, the author proceeds to a systematic survey of the species.

Sexual Dimorphism in Lamellibranchs.‖—A. Ostrooumoff notes that it is commonly stated that in *Unio* alone among Bivalves is there any trace of secondary sexual characters. He has, however, found that in *Astarte sulcata* Phil. the females have the edges of the valves toothed, while in the males they are smooth.

Arthropoda.

α. Insecta.

Middle Ocellus of Insects.¶—Chujiro Kochi points out that if the middle ocellus in the adult insect, which Leydig and Brandt long since showed to be double, is formed from the fusion of two ocelli once separate, one might expect to find traces of two pairs of ocelli in

* Rend. Ist. Lombardo, xxxii. (1899) pp. 534–5. † Tom. cit., pp. 918–23.
‡ Anat. Anzeig., xviii. (1900) pp. 145–74 (30 figs.).
§ Bull. Chicago Acad. Sci., No. iii. (1898, received 1900), 130 pp. and 27 pls.
‖ Zool. Anzeig., xxiii. (1900) pp. 499–500.
¶ Amer. Nat., xxxiv. (1900) pp. 641–3 (1 fig.).

generalised insects. The fenestra of some male cockroaches (*Corydia* and *Heterogamia*) is replaced by an ocellus, and a little below the fenestra there is on each side a peculiar spot which may be another rudimentary ocellus. Some histological evidence of this is promised.

Ecdysis in Aspidiotus perniciosus.*—Dr. L. Reh finds that in this insect there are three different dorsal shields, the first or white larval shield, the second or black larval shield, and the final shield. The first and second consist only of wax threads, without relation to the larval skin, which participates only in the formation of the third shield. The first is always thrown off, the second usually, neither forms any part of the third. The first moult occurs at the beginning of the formation of the third shield, and the last coat is utilised in its formation.

Balloon-like Metatarsi.†—Mr. Brues finds that the enormously swollen metatarsus of *Bittacomorpha clavipes* Fabr., a near relative of the crane-flies, is almost entirely occupied by an enlarged tracheal tube. The insect flies poorly, and the author suggests that the balloon-like metatarsi enable it to be wafted easily by currents of air. When suspended in the air the insects are like thistle-down.

Female Eciton.‡—Prof. W. M. Wheeler has succeeded in finding the female of the driver ant, *Eciton sumichrasti* Norton. He gives some account of the habits of the species, noting, for instance, that it possesses in a very marked degree the power of swarming so characteristic of certain tropical Ecitons. Two other species, *E. omnivorum* Ol. (= *cæcum* Latr.) and *E. californicum* Mayr., were seen in the vicinity of Austin, but the diversity of the males (formerly described as species of *Labidus*) taken about the electric lights shows that there must be other species in the district. Prof. Wheeler has also some notes on the myrmecophiles found in the Eciton-nests, e.g. a small Staphylinid beetle which has a very striking resemblance to a worker Eciton. Since the Ecitons are blind, the colour of the Ecitophiles cannot matter *to them*, but the form and surface sculpture of the guest-insect are of great importance, and the author follows Wasmann in hinting that we have here a new and elsewhere unknown form of mimicry—a deception of the sense of touch which must be extraordinarily keen in these blind ants.

Mating in Moths.§—Mr. A. G. Mayer took 449 cocoons of *Callosamia promethea* from Cambridge, Mass., to Loggerhead Key, off the Florida coast, many hundred miles south of the southernmost range of this species. In this locality, where intrusions were eliminated, the observer found that the sexes pay no attention to the appearance or coloration of their partners.

β. Myriopoda.

Swarming of Diplopoda.‖—Prof. Karl W. Verhoeff notes that in 1879 J. Paszlavsky described *Brachyiulus unilineatus* C. Koch as occurring in such dense masses on the railway line in Hungary as to seriously

* Zool. Anzeig., xxiii. (1900) pp. 502–4.
† Biol. Bull., i. (1900) pp. 155–60. See Amer. Nat., xxxiv. (1900) p. 677.
‡ Amer. Nat., xxxiv. (1900) pp. 563–74 (4 figs.).
§ Psyche, ix. (1900) pp. 15–20. See Amer. Nat., xxxiv. (1900) pp. 674–5. Cf. this Journal, *ante*, p. 197.
‖ Zool. Anzeig., xxiii. (1900) pp. 463–73.

impede traffic. In June of this year he read of a similar occurrence at Sennheim near Mülhausen, the animals being described in the newspapers as "*Julus terrestris.*" Prof. Verhoeff obtained numerous specimens from the Sennheim station-master, and learnt also that the delay to the traffic resulted, not, as currently reported, from the volume of the animals, but from the fact that when crushed they rendered the rails so slippery that the wheels would not grip. Verhoeff found that the animals were in reality *Schizophyllum sabulosum*, and were all sexually mature. He believes that the swarming is due to over-population of a special area. In consequence the females are unable to find suitable spots in which to lay their eggs, and the migratory instinct, natural to the ripe condition, is greatly intensified, the movement of the unfertilised females leading to an equivalent movement among the males. All the specimens studied were found to belong to the form *typica*.

Genera Schendyla and Pectinunguis.* — Prof. Karl W. Verhoeff considers that these two genera should be united, as transitional stages exist between the two conditions on which the generic distinction is based (arrangement of the ventral pores). He thinks *Pectinunguis* must lapse, and divides *Schendyla* into two sub-genera, *Schendyla* s. str. and *Haploschendyla*, according to the shape of the ventral plate and the presence or absence of glands.

Diplopoda of Switzerland.† — Dr. H. Rothenbühler publishes a second paper on this subject. The present paper gives first records for Switzerland of various known forms, and describes several new species, one of which falls into a new genus. The last-named, described as *Trimerophoron grypischium* g. et sp. n., is based on a single male from the Engadine, and belongs to the Chordeumidæ. The genus is defined chiefly by the characters of the gonopods.

γ. Protracheata.

New Genus of Onychophora.‡—Dr. Arthur Dendy proposes a new genus, *Ooperipatus*, for the reception of three species described by him, *O. oviparus*, *O. insignis*, *O. viridimaculatus*, in all of which the genital aperture of the female is placed at the end of a prominent ovipositor which lies between the legs of the last pair. The legs have three spinous pads. The above constitutes the generic definition; in addition all are probably oviparous, but this is uncertain in the case of *O. insignis*.

Species of Peripatus.§—Prof. E. L. Bouvier has received from the British Museum a further series of specimens of *Peripatus*, including among others the collection of Jamaican forms. His observations lead him to the conclusion that two species have been described under the single name *P. jamaicensis*. Of these one should retain this name; this form occurs in two varieties, known respectively as mut. *swainsonæ* and mut. *gossei*. The other species, which has been confused with the first-named mutation, is a variety of *P. juliformis* (var. *gossei*).

* Zool. Anzeig., xxiii. (1900) pp. 483-6.
† Rev. Suisse Zool., viii. (1900) pp. 167-92 (1 pl.).
‡ Zool. Anzeig., xxiii. (1900) pp. 509-11.
§ Quart. Journ. Micr. Sci., xliii. (1900) pp. 749-57.

δ. Arachnida.

Are Solpugids Poisonous?*—E. Lönnberg has made careful observations on *Galeodes araneoides* in the neighbourhood of Baku, on the Caspian. The animal did not poison the insects and other animals on which it preyed. "In attacking a small scorpion, it crushed one of the slender joints of the abdomen and then the segment containing the poison-sac. It next attacked the larger abdominal segments, working its jaws into the interior and devouring the flesh. During this whole time the scorpion struggled and fought, moving freely and showing no sign of being poisoned. It could not penetrate the skin of a frog, although it attempted to bite it several times." It could not penetrate the human finger-tips. Flies which were bitten, but had not the nervous system injured, were able to crawl about for a long time. These facts, along with the absence of openings in the chelæ, through which poison could escape, led Lönnberg to the conclusion that *Galeodes* at least is not poisonous, in spite of its reputation.

ε. Crustacea.

Fresh-water Entomostraca from Celebes.†—Dr. Theodor Stingelin has studied a collection made in a pond near Macassar, and finds that it contains the following forms:—three species of Copepods represented only by a few adults but by many larvæ; three species of Cladocera present in small numbers; two species of Ostracoda abundantly represented both as larvæ and adults. In addition, the material contained two unrecognisable insect larvæ, a Hydrachnid larva, and fragments of a Rotifer. The Entomostraca include such widely distributed forms as *Moina paradoxa* and *Cyclops leuckarti*, as well as peculiar forms such as the Further Indian *Diaphanosoma sarsi* and its varieties. It is to be noted that when European and tropical fresh-water forms are identical, the latter are not larger or more luxuriant, but actually smaller than the northern forms.

Heliotropism of Cypridopsis.‡—Elizabeth W. Towle shows that in the case of this Crustacean and of *Daphnia* the direction of movement in response to light does not result from the effort on the part of the animal to reach a certain optimum intensity. It is determined (1) by the direction of the impinging rays, and (2) by their relative intensities. The animal (*Cypridopsis vidua*) may be at one time "positive," at another time "negative" in regard to light, and one cause of this variation is contact. Contact with the sides of the trough or pipette or with obstructions therein causes a change from negative to positive, whereas the reverse change takes place independently of external conditions.

Plates and Scales of Cirripedes.§—A. Gruvel notes that the question of the relation of the scales of the peduncle to the capitular plates in *Scalpellum* or *Pollicipes* has never been adequately discussed. The evidence, palæontological, embryological, and morphological, seems to him to lead to the following conclusions:—The ancestral Cirripede was

* Öfversigt K. Akad. Stockholm, lvi. (1900) p. 977. See Amer. Nat., xxxiv. (1900) p. 673.
† Rev. Suisse Zool., viii. (1900) pp. 193–207 (1 pl.).
‡ Amer. Journ. Physiol., iii. (1900). See Amer. Nat., xxxiv. (1900) pp. 603–4.
§ Proc.-Verb. Soc. Sci. Bordeaux, 1899, pp. 118–24.

covered by a series of cuticular formations showing no distinction into plates and scales; the capitular plates have arisen by a specialisation of these primitive scales, and are therefore equivalent to modified and elaborated peduncular scales; on the other hand, in those Cirripedes which have soft peduncles, the primitive scales have in that region undergone gradual degeneration, and may be represented only by little specks of lime.

In a later communication* the author discusses the relation of the pedunculated and sessile Cirripedes, as indicated by the hard parts. He believes that the relation is best indicated in the following scheme:—

```
                                          &c.
                                           |
                                         Lepas
                                           |
                                   Pollicipes
                                      |
                           Scalpellum
                              |
          Plumulites.   Loricula
                              |
                           Tubicinella ?
                                 |
                              Chthamalus
                                   |
                                 Balanus
                                      |
                                     &c.
```

The genera *Plumulites* and *Loricula* represent the point of origin of both sessile and pedunculated forms, the base of the Balanidæ, which was at first membranous and then calcareous, being formed by an increase in size of the zone of fixation in the Lepadidæ. The "rampart" of the Balanidæ has arisen from a fusion of peduncular scales; the operculum is equivalent to the terga and scuta of the Lepadidæ. The genus *Tubicinella*, save for its enlarged base, may represent the first stage in the development of the Balanid type, the successive stages showing increasing proliferation and coalescence of the peduncular scales, while the opercular valves remain unaltered or even atrophy. In the Lepadid type, on the other hand, the peduncular scales have gradually diminished and the capitular plates have attained a higher degree of development.

A further paper † suggests a modified classification of the Thoracica, the salient features of which may be indicated as follows:—

Sub-order Lepadidæ (Pedunculated Cirripedes).
Family (1) Polyaspidæ (scales on peduncle).
„ (2) Pentaspidæ (no scales on peduncle).
„ (3) Tetraspidæ „ „
„ (4) Anaspidæ „ „

* Tom. cit., pp. 140–7.

† Tom. cit., pp. 152–7.

As indicated in the names of the families, this classification depends on the number of capitular plates.

Sub-order Balanidæ (Sessile Cirripedes).
I. Unsymmetrical forms.
Family (1) Verrucidæ.
II. Symmetrical forms.
Family (1) Octomeridæ.
„ (2) Hexameridæ.
„ (3) Tetrameridæ.

These families are founded on the number of pieces in the test. The paper includes a synoptical list of genera.

New Chondracanthid.*—MM. C. Vaney and A. Conte have found in the gill-chamber of *Clinus argentatus* Riss., a parasitic Copepod belonging to the genus *Diocus* Kröyer. Kröyer's genus was established for *D. gobinus* Fabr., a parasite of the fresh-water fish *Cottus gobio*, and the author's form differs from the type species in the absence of all segmentation in the male, whereas in *D. gobinus* the abdomen in the male has six segments. Nevertheless, the new form is placed in the genus *Diocus* as *D. clini*. In *Clinus argentatus* one specimen of the parasite only was found in the gill-chamber, but both sides of the body are usually affected. The pigmy male is usually free in the bottom of the gill-chamber. Parasitised fish have rudimentary genital organs, and were found only in the Rade du Lazaret in the roadstead of Toulon. As *Clinus argentatus* has been studied at various points on the shores of the Mediterranean, there seems no reason to doubt that this is another case of that localisation of parasites to which attention has already been drawn.

Studies on Argulidæ.†—Herr L. von Nettovich describes *Argulus viridis* sp. n., a fresh-water form new to Europe, takes a survey of the other species, and gives an account of the structure of the shell-gland and integumentary glands. The shell-gland opens at the base of the second maxillipedes; it consists of terminal saccule, urinary canaliculi, and ureter (the last arising from an inturning of the skin). Shell-gland and antennary gland are homodynamous. There are both unicellular and compound integumentary glands, and two types of each.

Development of Nebalia geoffroyi.‡—Prof. Peter Butschinsky has continued his observations on this subject, and in a preliminary note gives a list of his chief results, the more important of which are as follows. The eggs are of the meroblastic type and contain a large amount of yolk, the segmentation is centrolecithal, and the yolk remains unsegmented. All the segmentation nuclei pass to the surface of the egg and take part in the formation of the blastoderm. Three pairs of Nauplius appendages appear at an early stage in the space between a posterior and two anterior thickenings on the ventral surface. The cells of the posterior thickening give rise to a mass of meso-endoderm cells, from which endoderm and mesoderm originate. The former spreads over the whole yolk and forms the large mesenteron, while the

* Rev. Suisse Zool., viii. (1900) pp. 97–105 (1 pl.).
† Arbeit. Zool. Inst. Univ. Wien, xiii. (1900) pp. 1–32 (1 pl.).
‡ Zool. Anzeig., xxiii. (1900) pp. 493–5.

mesoderm, which never forms true mesodermal somites, arises from the remainder of the meso-endodermal mass after the separation of the endoderm.

North American Grapsoids.*—Mary J. Rathbun gives a synopsis of the North American Catometopous or Grapsoid crabs, which include the common ocypode of the New England shores, the fiddlers with their remarkable development of one claw in the male, the land crab *Cardisoma guanhumi*, the *Pinnotheres ostreum* of oysters, and the anomalous Palicidæ, inhabitants chiefly of warm waters or of considerable depths.

Variation of the Rostrum in Palæmonetes vulgaris.†—Dr. Georg Duncker has investigated the number of rostral spines in 1050 shrimps, and his facts lead him to the conclusion that the indices of variability alone, not the coefficients of variation, are morphologically significant, and the former are similar in homologous characters, but independent of their mean values.

Colour Change in Crustacea.‡—Messrs. F. W. Gamble and F. W. Keeble's important researches on the colour physiology of *Hippolyte varians* were reported here somewhat fully on the appearance of their paper in abstract; in the complete memoir which is now available the following points merit further notice:—First, the series of water-colour drawings which illustrate the paper, and show admirably the skill which the prawns—especially the females—display in *selecting* weeds of tints which harmonise with their own, when freedom of choice is allowed. Second, a detailed account is given of a relatively simple apparatus in which the prawns may be readily kept alive for purposes of experiment. The complete paper further contains full details of the experiments upon which the conclusions stated in the abstract were based, with tables of the observations. The most important point in an impressive paper is perhaps the occurrence of a periodic cycle of colour change—a point dealt with in the previous abstract, but the paper raises many important questions in reference to the colour physiology of Crustacea, some of which the authors hope to pursue further.

Annulata.

An Atlantic "Palolo."§—Mr. A. G. Mayer under this title describes *Staurocephalus gregaricus* sp. n., a Nereid whose swarming habits he has studied at Loggerhead Key, Tortugas Islands, Florida. It would appear that the swarming occurs on the day preceding the day of the last quarter of the June-July moon (two observations). Swarming begins before sunrise, and the discharge of the genital products occurs about sunrise. There is no external difference between the anterior barren segments and the posterior fertile ones, but the discharge of the products is so violent as usually to tear and injure the fertile segments. The entire worm appears at the surface, and, shortly after the discharge of the products, sinks again to the bottom, but whether the injured segments are sloughed off or not was not ascertained. The eggs con-

* Amer. Nat., xxxiv. (1900) pp. 583–92 (15 figs.).
† Tom. cit., pp. 621–33 (3 pls.).
‡ Quart. Journ. Micr. Sci., xliii. (1900) pp. 589–698 (5 pls.). Cf. this Journal, *ante*, p. 202.
§ Bull. Mus. Comp. Zool., xxxvi. (1900) pp. 1–14 (3 pls.).

tain much yolk, segmentation is total and unequal, and the gastrula is epibolic. Till the fifteenth day the larvæ show strong positive phototaxis, at the end of the fifteenth day they lose their cilia and sink to the bottom. The larva is telotrochal and possesses large ectodermal cephalic glands.

Nephridia of Polychæta.*—Mr. E. S. Goodrich, in Part III. of his memoir on this subject, discusses the anatomy of the nephridia in the Phyllodocidæ, the Syllidæ, and the Amphinomidæ, together with some other forms, summarises the anatomical results contained in Parts I., II., and III., and upon the basis of this work, draws the following conclusions in regard to the homology of the Polychæte nephridium, and its relation to the genital funnel. In the first place he opposes the view that the genital funnel is merely a specialised portion of the nephridium, and contends that its development shows it to be the homologue of the genital ducts of other Annelida. His results show that in the Phyllodocidæ the nephridia have no internal openings, but in most segments a genital funnel fuses with the nephridium at maturity, the compound organ forming the genital duct. In some other families (Nereidæ, Nephthyidæ, &c.) various conditions of the genital funnel occur, showing more or less intimate relation between nephridium and genital funnel. This culminates in the Hesionid *Irma*, where the fusion is so complete that the two organs can only be histologically distinguished. In the remaining large families (Eunicidæ, Amphinomidæ, &c.) the condition occurs which has been always regarded as the typical one for Polychætes—that is, there is a "nephridium" with a large trumpet-shaped internal opening, which also functions as a genital duct. The author believes, however, that this "nephridium" is in reality produced by the complete fusion of true nephridium and genital funnel. In consequence, he believes that three main types of nephridia occur in Polychæta :—(1) those found for example in *Alciope*, which are blind internally and are furnished with solenocytes ; these are probably primitive and homologous with the protonephridia and flame-cells (= solenocytes) of Nemertines; (2) the Nereid type, where there is a true nephrostome, may be supposed to have arisen from the above by the development of the internal opening; (3) the most specialised type, exemplified in *Polymnia*, is the *nephromixium*, produced by the union of true nephridium and genital funnel. This is the type most commonly found in Polychæta. The author believes that the variations in the nephridia in Polychætes might be readily utilised as a basis for a revised classification, and that the adoption of the above conclusions brings the group, in regard to the excretory organs, more into line with the Oligochætes and Hirudinea, and diminishes the difficulties in deriving these from the excretory system of Nemertines and Platyhelminths, in which the excretory ducts are distinct from the genital.

Heart-body of Oligochætes.†—Dr. M. de Bock finds that this body exists in *Lumbriculus*, *Rhynchelmis*, *Tubifex*, and *Nais*, as well as in the Enchytræidæ, and that it is made up of metamorphosed amœbocytes

* Quart. Journ. Micr. Sci., xliii. (1900) pp. 699–748 (6 pls.). Cf. this Journal, 1897, p. 384; 1899, p. 36.

† Rev. Suisse Zool., viii. (1900) pp. 107–66 (2 pls.).

from the blood. These amœbocytes have pronounced phagocytic properties. At times they increase in size, their substance becomes more liquid, and they surround themselves with a membrane; they may also take up coloured granules. Such modified cells place themselves on the ventral surface of the dorsal vessel and constitute the heart-body; in structure they closely resemble the chloragogenous cells. They may quit the dorsal vessel and pass into the body-cavity. Without being able to clearly define the relation between phagocytosis, the metamorphosis of the amœbocytes, and their passage into the body-cavity, the author is yet of opinion that the entire process is excretory in nature. The amœbocytes of the blood multiply by amitotic division, and also originate from a collection of cells along the ventral line of the intestinal sinus. The cœlomic lymphocytes multiply also by direct division, and probably arise from cellular masses on the dissepiments of the Lumbriculidæ. They take part in excretion by taking up the chloragogen, and also substances excreted by the intestinal epithelium. The chloragogen arises probably both from the protoplasm of the chloragogenous cells, and from the cells of the intestinal epithelium, and is an excretory product.

Variation in Earthworm.* — Mr. Raymond Pearl describes a remarkable variation of the genital organs in *Lumbricus agricola* Hoffm. In addition to the two pairs of testes normal for the species, there is a supernumerary pair in somite 12, the lateral seminal vesicles are shifted backwards at the left side, and at that side there is a supernumerary seminal receptacle and a large unpaired supernumerary seminal funnel. There is a supernumerary pair of ovaries, and the left oviduct is displaced so as to lie below the supernumerary ovary of that side. It would appear that this displacement is associated with the existence of the extra seminal funnel at that side. The chief interest of the variation the author regards as the evidence it affords of correlation in development of the different parts of the reproductive system.

North American Species of Glossiphonia. † — Mr. W. E. Castle describes six species of these Rhynchobdellids, often known by the name Clepsine. There are two distinct groups, the first including *G. stagnalis*, *G. elongata* sp. n., *G. fusca* sp. n.; the second including *G. parasitica* and *G. elegans*, with the closely related European species *G. complanata* and *G. concolor*. *G. heteroclita* occupies a somewhat isolated position intermediate between the two groups.

Nematohelminthes.

Life-cycle of Filaria bancrofti.‡—Dr. T. L. Bancroft has studied the metamorphosis of the young form of *Filaria bancrofti* Cobb (= *F. sanguinis hominis* Lewis, *F. nocturna* Manson) in the body of *Culex ciliaris* L., the introduced "house mosquito" of Australia. By feeding the mosquitos on banana he kept infected forms alive for weeks, indeed for a couple of months. Thus mosquitos do not seem to be seriously injured by the filariæ. When the young filariæ are artificially liberated from the thorax of the mosquito into water, they die in three or four

* Anat. Anzeig., xviii. (1900) pp. 123–7 (1 fig.).
† Bull. Mus. Harvard, xxxvi. (1900) pp. 17–64 (8 pls.).
‡ Journ. and Proc. Roy. Soc. N.S. Wales, xxxiii. (1900) pp. 48–62 (8 figs.).

hours; water therefore cannot be the medium, as was generally supposed, by which they reach man. It is suggested that the mosquito must be swallowed if the young filariæ are to infect man; but in a postscript Dr. Bancroft notes that they may perhaps gain entrance to the human host while the mosquitos bearing them are in the act of biting. A useful description of the method of keeping mosquitos for studying is given.

The following is a short account of the life-cycle of *F. bancrofti*:—The mature parasites in the lymphatic vessels of man are three or four inches in length by 1/90 in. in breadth; they produce the embryo filariæ, 1/90 in. × 1/3500 in., which live in the blood-vessels, swimming about when the host is sleeping and resting when he is awake. Mosquitos, biting a filariated subject during the night, withdraw with the blood some embryo filariæ. Soon after they reach the mosquito's stomach they pierce the wall and find their way to the muscles, particularly the thoracic muscles, where they imbed themselves. Nourished by the mosquito's plasma they grow with great rapidity, and by the seventeenth day they have attained their maximum development as far as life in the mosquito is concerned. The filaria now awaits the chance of gaining entrance to the human host, there, presumably, to begin another period of development which leads to the sexually mature form of three or four inches. It remains to be proved that this will happen. Besides proving that *Culex ciliaris* L. is an efficient host, Bancroft has shown that *C. notoscriptus* Skuse and *C. annulirostris* are not.

"Gapes" in Birds.*—Herr Klee gives a concise account of *Syngamus trachealis*, which is often a cause of considerable loss in domesticated birds. He gives lists of birds known to have been infected, describes the symptoms of attack, gives the life-history of the parasite, and discusses means of preventing the spread of the disease and curative measures. An intratracheal injection of a 5 p.c. watery solution of sodium salicylate (Moquet's method) gives the best results.

Strongylus capillaris in the Goat.†—Herr Schlegel finds that this Nematode is the cause of epidemic broncho-pneumonia among goats. The young are taken in with the food, are returned to the mouth during rumination, and thence find their way to lungs and bronchi. Here they become mature and pair. The embryos reach the mouth, pass through the alimentary canal, and reach the exterior with the fæces. They appear to have a brief free life in damp earth, and then, being taken up with food, begin the cycle anew. Direct infection of one animal by another appears to be impossible. The characters of the parasite, symptoms produced, and means of distinction from other species of *Strongylus* are described in detail. An interesting point is that the different species are distinguished by the colour-differences in the worm nodules; thus *S. capillaris* forms intensely yellow nodules, *S. commutatus* dark brown or red-brown.

New Nematodes.‡—Dr. v. Linstow describes several new or little known Nematodes, and seizes the opportunity to protest against the division of large genera into innumerable new genera. In helminthology this is especially inconvenient; for in e.g. the genus *Tænia* the character

* Deutsch. Tierärtz. Wochenschr., vii. (1899). See Centralbl. Bakt. u. Par., xxvii. (1900) pp. 466–7.

† Arch. wiss. prakt. Thierheilkunde, xxv. See Centralbl. Bakt. u. Par., xxvii. (1900) pp. 468–71. ‡ Arch. Mikr. Anat., lvi. (1900) pp. 362–76 (1 pl.).

now taken as generic—the number of rostellar hooks—varies in closely allied species. Inconvenient as these genera are, however, their adoption becomes almost a necessity from the fact that the specific names are often reduplicated in the new genera. For instance, *Urogonimus insignis* and *Distomum insigne*, *Prymnoprion anceps* and *Distomum anceps*, &c., though all distinct, yet all strictly belong to the genus *Distomum*. The author inclines to the device of subgenera as a way out of the difficulty. He further protests against the practice of reviving old names, never adequately defined, in place of well-defined names in common use.

Nematodes of Coffee-plant.* — Herr A. Zimmermann described in 1898 the disease in the Java coffee-plants induced by *Tylenchus coffeæ*. He now discusses *T. acutocaudatus*, which does similar damage. It seems that neither *Heterodera radicicola* nor *Aphelenchus coffeæ* Zn. is injurious to Java coffee-plants. An important fact is that *Coffea liberica* is relatively resistant to the two species of *Tylenchus* which attack the Java plant.

Platyhelminthes.

Heteromorphosis of Planarians.†—Rina Monti has an interesting note on the occurrence of Planarians, especially *Planaria alpina*, with two heads or two tails in natural conditions. His object is to show that the heteromorphosis which can be induced experimentally may also be induced mechanically in the streams which the planarians frequent.

North American Heterocotylea.‡ — H. S. Pratt gives a very useful synopsis of the North American monogenetic Trematodes, or Heterocotylea on Monticelli's system. A diagnostic key to the families, subfamilies, genera, and species is given.

A Distomum with a Genital Papilla. § — Herr L. A. Jägerskiöld describes *Levinsenia* (*Distomum*) *pygmæa* Levinsen from the herring gull and the eider duck. It has an enlarged partly muscular genital sinus, which seems to lack the radial musculature distinguishing the true genital papilla seen in species of *Cœnogonimus* and *Tocotrema*. The author shows how *L. pygmæa* differs from *L. brachysoma*; in fact it may be necessary to place them in separate genera.

New Trematodes.‖—Dr. J. Stafford describes a considerable number of new Canadian flukes, and also gives details as to host, anatomy, &c. of some previously described forms. Of the new species the most interesting is *Distomum pelagicum* sp. n., which was found in tow-net material from Passamaquoddy Bay, New Brunswick. It is remarkable in having the posterior end of the body invaginated to form a large cavity which opens to the exterior by a narrow opening, and receives (probably) the openings of the excretory canals. The author believes that this cavity is to be regarded as equivalent to a greatly enlarged expulsion canal, and that its function is probably to enable the fluke to swim by the forcible expulsion of water from its interior. Positive evidence of this is however lacking.

* Mededeelingen uit s'Lands Plantentuin, xxxvii. (1900). See Bot. Centralbl., lxxxiii. (1900) pp. 87–8. † Rend. Ist. Lombardo, xxxii. (1899) pp. 1314–21.
‡ Amer. Nat., xxxiv. (1900) pp. 645–62 (50 figs.).
§ Centralbl. Bakt. u. Par., xxvii. (1900) pp. 732–40 (3 figs.).
‖ Zool. Jahrb. (Abt. Syst.), xiii. (1900) pp. 399–414.

Flukes from Gall-bladder of Fishes.*—Dr. M. Lühe has re-found *Distomum capitellatum* Rud. in *Uranoscopus scaber*, and finds that it differs so strikingly from other species of *Distomum* that it is necessary to place it in a different genus. He erects the new genus *Anisocœlium* for its reception, and believes that it is most nearly related to the species of the genus *Gymnophallus*. Another remarkable form from the gall-bladder of *Trigla lineata* is described as *Derogenes ruber* g. et sp. n. Its affinities are somewhat doubtful, but from the topography of the genital organs it should probably be placed near the genus *Hemiurus*.

Singapore Nemertea.†—Mr. R. C. Punnett reports briefly on a collection of ten species, of which nine have not hitherto been described.

In *Eupolia melanogramma*, the excretory system possesses, besides the usual external ducts, communications with the alimentary canal close behind the mouth. In *E. pholidota*, the excretory ducts reach back into the intestinal region, thus co-existing in the same region as the gonidial ducts, which seems to show that the two sets are not serially homologous. In *Eupolia*, the lateral nerve-stems may form a commissure above the anus, or below, or may not form one at all, which suggests doubt as to the primitive character of this commissure. No hint of incipient metamerism was seen in the ducts of the excretory system in Lineidæ. The vascular system of Lineidæ shows little variation in the different species. The frontal organ characteristic of most Lineidæ is not always present. The structure of the skin is highly characteristic for each species.

Incertæ Sedis.

Development of Phoronis sabatieri.‡—Louis Roule gives a general account of his observations. The segmentation of the ovum is total and very nearly equal; a morula stage is succeeded by a blastula; a process of incurving results in a gastrula; the blastula flattens and is bent upon itself; the blastocœl remains between the protectoderm and the protendoderm; mesenchyme cells arise separately from the protendoderm. The gastrula, attached to the tentacles of its parent, becomes oval, the enteropore persists as the mouth, a large pre-oral lobe surmounted by a cephalic plate developes, the ventral surface shows a longitudinal groove, the ectoderm forms an anus and rectum and lines a short œsophagus; in short, a modified trochophore—the Actinotrocha—arises. The young Actinotrocha developes tentacles, enlarges its pre-oral lobe, forms a metasomic pouch, gains a posterior wreath of cilia, the blastocœl becomes the cœlom, the enteron forms anteriorly and inferiorly a large ventral diverticulum. The fully formed larva is then described. A period of free-swimming is followed by the extraordinarily rapid metamorphosis; in 10–30 minutes histolysis and histogenesis lead to complete re-organisation, the metasomic pouch is evaginated and forms the wall of the body of the young *Phoronis*. An immediately operative factor is the pressure of the cœlomic fluid on the metasomic pouch and on the enteron. This cause of the metamorphosis is briefly discussed, and then

* Zool. Anzeig., xxiii. (1900) pp. 504–9.
† Proc. R. Soc. Edinb., xxiii. (1900) pp. 91–2.
‡ Bull. Acad. Sci. Toulouse, ii. (1899) pp. 159–76.

the author emphasises the thoroughly pelagic adaptation of the larva, the sedentary habit of the adult, and the fact that the metamorphosis, which puts a stop to the vital functions, must be brief. The affinities with Pterobranch Bryozoa and with Chordata (not including Enteropneusta) are finally hinted at. We have previously noted some of Roule's work, the paper now summarised may be useful as a terse and vivid general account of a very interesting life-history.

Rotatoria.

Notogonia ehrenbergii.*—Mr. J. C. Smith, in a short note, gives a figure of this rare rotifer, and states that he has found it in abundance in an old well near New Orleans. It may be noted that this species has been re-named *Metopidia notogonia* by Dr. Ternetz, and to this genus it undoubtedly belongs.

Echinoderma.

Treatise on Echinoderms.†—We welcome this first published part of *A Treatise on Zoology*, edited by Prof. E. Ray Lankester, which deals with Echinoderma. The bulk of it is by Mr. F. A. Bather, who has been assisted by Prof. J. W. Gregory and Mr. E. S. Goodrich. That it will be a valuable book for "the serious student of zoology," for whom, as the preface states, it is intended, is certain; and we cannot but regret that the Eleutherozoa have not been allowed a more proportionate place. Mr. Bather's careful discussion of the Pelmatozoa occupies pages 38–216, and the Eleutherozoa occupy pages 217–332.

Movements of Antedon rosacea.‡—Herr H. Bosshard has made a careful study of the connections of the skeletal parts in the arms and cirri of this Crinoid. The ventral arm-muscles are so different histologically from the dorsal fibres and those of the cirri, that the latter cannot be called muscular. Oral curvature is the result of muscular contraction, the bending towards the apex of the calyx seems referable to the elasticity of the non-contractile fibres. This—the older—view is supported by physiological experiments.

Cœlentera.

Gigantic Hydroid.§—M. Miyafima speaks of the commotion caused at the Marine Biological Station at Misaki, when, on January 1, 1899, there was brought in a gigantic Cœlenterate, 700 mm. in height, of a prevailing transparent scarlet colour (a magnificent natural size figure is given), which turned out to be nearly allied to *Branchiocerianthus urceolus* Mark, and apparently the same as Allman's *Monocaulus imperator*. The author started with the idea that he was dealing with an Actinian, but he soon swung round to Allman's *Monacaulus*. There is strongly expressed bilateral symmetry; the hydranth cavity is divided into two parts, of which the upper is in its outer part again divided into many radial canals visible even on the surface of the disc; the filiform tentacles are in two sets,—distal and marginal; a dendritic appendage

* Trans. Amer. Micr. Soc., May 1900, pp. 95–6 (1 fig.).

† 'A Treatise on Zoology,' edited by E. Ray Lankester. Part II. The Echinoderma. London, 1900, 344 pp., many figures (numbered separately for the different sections).

‡ Jenaische Zeitschr. Naturwiss., xxxiv. (1900) pp. 65–112 (6 pls.).

§ Journ. Coll. Sci. Tokyo, xiii. (1900) pp. 235–62 (2 pls.).

—a gonosome—bears the sexual elements in its summit; the hydrocaulus is marked with many wavy bands visible from the surface, and possesses a thin sheath with filamentous appendages at its lowest end.

Medusæ from the Tortugas.*—Mr. A. G. Mayer finds that there is at the Tortugas, Florida, a tropical Medusan fauna, only three species of which are established upon the southern coast of New England; and not one species of which is found upon the New England coast north of Cape Cod. The Hydromedusæ of the Tortugas are more closely related to those of the Fiji Islands, South Pacific, than they are to those of the Canary Islands, off the Atlantic Coast of Africa. The Leptoline forms of the Tortugas are almost wholly distinct from those of the Canary Islands, but a number of Trachyline forms (which range widely in the open ocean) are common to the two groups of islands. As to the Siphonophoræ, they are very closely related to those of the Canary Islands, and also display a relationship to those of the Fiji Islands. The Scyphomedusæ are, for the most part, distinctly West Indian types, and are not closely related to forms known from the African coast.

The report includes 33 Hydromedusæ, 3 Siphonophoræ, 1 Hydroid, and 2 Scyphomedusæ, new to science, while 44 forms are new to American waters. The following are especially noteworthy:—*Pseudoclytia pentata*, a hydromedusa normally pentamerous, "the survival of a discontinuous meristic variation"; *Multioralis ovalis*, a new Hydromedusan with four separate manubria on a single straight chymiferous canal which traverses the long diameter of the bell; *Eucheilota paradoxa*, the only known Leptomedusa which gives rise to the young medusæ by a direct process of budding; *Niobia dendrotentacula*, a Hydromedusan whose tentacles develope into medusæ and are set free, after which the adult reproduces sexually; *Bougainvillia niobe*, in which the medusa buds on the proboscis are entirely ectodermic; *Oceania McCradyi* Brooks, with hydroid-blastostyles on its gonads; and *Dysmorphosa dubia*, a Tubularian medusa, which seems to be unique in having four rudimentary gonads (?) on the four radial canals.

Atlantic Medusæ.†—Mr. A. G. Mayer describes a number of new species of Hydromedusæ, a new Ctenophore of the genus *Mnemiopsis*, and a new Scyphomedusan which forms the type of a new genus. The last named, described as *Bathyluca solaris* g. et sp. n., is believed to be a deep sea form, but is known only from an injured specimen found at the surface. The generic diagnosis is as follows:—"Discomedusæ with a simple cruciform central mouth-opening, without mouth-arms or palps. There are sixteen wide radial gastro-vascular pouches (eight ocular and eight tentacular). There is no ring canal. There are eight marginal sense-organs and sixteen marginal tentacles. There are four gonads in the oral floor of the disc, and there are four sub-genital pits." The paper is fully illustrated.

Structure of Lucernaridæ.‡—Herr J. Gross discusses the differences between Eleutherocarpidæ and Cleistocarpidæ into which James Clark divided the Lucernaridæ. In the former there are four radial pouches separated by septa; in Cleistocarpidæ there are eight, four outer and

* Bull. Mus. Zool. Harvard, xxxvii. (1900) pp. 13–82 (44 pls.).

† Tom. cit., pp. 1–9 (6 pls.). ‡ Jena. Zeitschr. Naturwiss, xxxiii. (1900) pp. 611–23.

four inner pouches. An anatomical comparison leads the author to conclude that the difference is readily explained on the assumption that the inner perradial pouches of the Cleistocarpidæ arise by the formation of transverse partitions which divide the radial pouches of the Eleutherocarpidæ into two. This is in accordance with James Clark's views.

Palythoa and Epizoanthus.*—M. Louis Roule was led, by his discovery of *Palythoa paguricola* on small hermit-crabs, to investigate the generic differences between *Palythoa* and *Epizoanthus*, and his conclusion is that not only *Epizoanthus*, but *Gemmaria*, *Corticifera*, and *Parazoanthus* should be re-embraced in the genus *Palythoa*, the fact being that modifications due to habitat—on convex shell, or on sponge-spicules, or on rough rock—have been misinterpreted as specific or generic differences. The numerous forms of *Palythoa arenacea* show this clearly.

North American Actiniaria.†—Prof. G. H. Parker furnishes a synopsis and diagnostic key to the tribes, genera, and species of the North American members of the sub-order Actiniaria.

Chinese Alcyonacea.‡—August Pütter describes certain new Alcyonacea from the collection in the Breslau Museum. The most interesting form is *Eleutherobia japonica* g. et sp. n., which is remarkable in that the colony is not attached, but free like a *Pennatula*. The generic diagnosis is as follows:—Free living Alcyonacea with sterile stem and cylindrical unbranched polypary.

Porifera.

Monograph on French Sponges.§—E. Topsent continues his monograph on French sponges, and in this (the third) part he begins his description of the sub-order Hadromerina of the Monaxonida, which he divides into two sections: (A) the Clavulida, including Clionidæ, Spirastrellidæ, Polymastidæ, Suberitidæ, and Mesapidæ; and (B) the Aciculida, including Coppatiidæ, Streptasteridæ, Tethyidæ, and Stylocordylidæ.

Protozoa.

Protozoa of the Rice-fields.‖—Rina Monti gives a list of these, which includes forms common in running water, e.g. *Monas ovata*, others frequent in vegetable infusions, e.g. *Chilomonas paramæcium*, others abundant in stagnant water, e.g. *Paramæcium aurelia*, others characteristic of marshes, e.g. *Pelomyxa palustris*, others found in damp earth, e.g. some forms of *Amœba*, and others which occur in drinking water, e.g. *Actinophrys sol*.

Notes on Pelomyxa.¶—Prof. H. V. Wilson describes *P. carolinensis* sp. n. obtained in quantity from a "culture"—a good handful of *Nitella*, two or three opened mussels, and a crayfish, in a wooden tub with 4 in. of sand. A gentle stream of water was turned on for a short time every few days as decomposition went on. The structure and habits are

* Comptes Rendus, cxxxi. (1900) pp. 279–81.
† Amer. Nat., xxxiv. (1900) pp. 747–58 (22 figs.).
‡ Zool. Jahrb. (Abt. Syst.), xiii. (1900) pp. 442–62 (2 pls.).
§ Arch. Zool. Expér., viii. (1900) pp. 1–331 (8 pls.).
‖ Rend. Ist. Lombardo, xxxii. (1899) pp. 159–64.
¶ Amer. Nat., xxxiv. (1900) pp. 535–50 (11 figs.).

described. In the assumption of complexly branched shapes, *P. carolinensis* differs from *P. palustris* Greef and *P. villosa* Leidy; the posterior "villi" of the latter are absent from *P. carolinensis*, nor is there gorging with mud or occurrence of *Stäbchen* (symbiotic bacteria?). Minute crystals, however, were abundant. But the author attaches no importance to the cytoplasmic inclusions, which seem to be inconstant, and doubts whether there is, after all, more than one species.

Monograph on Acinetaria.*—René Sand divides the "Tentaculifera" into six groups:—(1) Dendrocometinæ, (2) Dendrosominæ, and Ophryodendrinæ, (3) Hypocominæ and Urnulinæ, (4) Podophryinæ, (5) Metacinetinæ, (6) Acinetæ and Ephelotinæ. He sketches a possible phylogeny, starting from a Heliozoon like *Acanthocystis*. After some notes on movements, variations, distribution, the author goes on to mention the Infusorians on which the Acinetaria prey, and the enemies (amphipods, a hypotrichous ciliate, fungi, &c.) which prey upon them.

Sand has studied 44 species, of which 16 are new. Among his conclusions we may note:—that the animals are enveloped in a delicate chitinoid pellicle, which also forms the stalk and the test; that the gelatinous content of the stalk is disposed in filaments; that the division shows karyokinesis and the presence of centrosomes; that the conjugation is a plastogamy; and that the class is allied to that of the Heliozoa by forms like *Acanthocystis pectinata*, *Heliocometes conspicuus*, and *H. digitatus*. The monograph includes useful diagnostic tables, and also lists of the animals on which the Tentaculifera occur.

Adaptation of Infusorians to Concentrated Solutions.†—Prof. A. Yasuda has experimented with *Euglena viridis*, *Chilomonas paramæcium*, *Mallomonas plosslii*, *Colpidium colpoda*, and *Paramæcium caudatum*, in relation to concentrated solutions of sugars and salts. Isotonic solutions have approximately similar effects; the Infusorians withstand less alteration of concentration than the lower Algæ and Fungi do; a sudden transference to solutions of greater concentration induces longitudinal cuticular folds which are gradually smoothed out; the rate of multiplication is lessened; the movements are retarded. In strong sugar solutions the size is increased; vacuoles, chromatophores, and starch-grains increase in size; the shape becomes rounder. Near the maximum of endurable concentration the cytoplasmic enclosures tend to fuse.

Coccidia and their Rôle.‡—Prof. R. Blanchard discusses (*a*) the dimorphism, (*b*) the life-history, and (*c*) the classification of Coccidia. Before the discovery of the dimorphism of Coccidia, the schizogonic or eimerian phase was regarded as generically or specifically distinct from the rest of the life-cycle. An entire revision has been necessary, and the author recognises three families based on the number of sporocysts contained in the oocyst.

1. Disporocystidæ:—*Cyclospora*, *Isospora*.
2. Tetrasporocystidæ:—*Coccidium*, *Crystallospora*.
3. Polysporocystidæ:—*Gymnospora*, *Barrouxia*, *Adelea*, *Legeria*, *Klossia*, and *Hyaloklossia*.

* Ann. Soc. Belge Micr., xxv. (1899) pp. 1–205 (8 pls.).
† Journ. Coll. Sci. Tokyo, xiii. (1900) pp. 101–40 (3 pls.).
‡ Causeries Scient. Soc. Zool. France, No. 5, 1900, pp. 133–72 (12 figs.).

Cœlomic Coccidian in an Insect.*—Louis Léger notes that the occurrence of cœlomic coccidia in insects is comparatively rare, indeed it has only been recorded twice previously. In the Tenebrionid beetle *Olocrates abbreviatus* Ol., Léger has found, however, a cœlomic coccidian, almost if not quite identical with *Adelea akidium.*

New Parasite of Brook Trout.†—Mr. G. N. Calkins describes, under the title *Lymphosporidium truttæ* g. et sp. n., a sporozoon parasite which caused an absolutely fatal epidemic among brook trout (*Salvelinus fontinalis*) in a hatchery on Long Island. The organism probably enters the digestive tract in the spore stage; sporozoites penetrate the epithelial lining of the gut and get into the lymph; there they grow into amœboid forms which penetrate the muscle bundles; thence when mature they withdraw, and form spores, possibly after conjugation; the spores are liberated into the body-cavity or into the lymph and are carried to all parts of the body; in the muscles of the body-wall they accumulate and block the lymph passages; the tissues, unable to get sufficient food, die and fall out, leaving characteristic sores and ulcers. The parasite is placed provisionally beside Pfeiffer's *Serumsporidium* from fresh-water Entomostraca.

Life-history of Malarial Parasites.‡—Dr. M. Lühe gives a comprehensive historical account of the present state of knowledge on this subject, and of the steps by which it has been attained. The paper has a very full bibliography, and treats the subject from the scientific point of view as opposed to the practical one, being especially concerned with the relation of the life-cycle in malarial parasites to that of Coccidia. The following table shows clearly the relation of the two phases of the life-history:—

Schizogony (often repeated in warm-blooded animals):
- Sporozoite = Schizont
  - Merozoite = Schizont
    - Merozoite:
      - Schizont (schizogony of brief duration).
      - Microgametocyte
        - Macrogamete. Microgamete (Sexual individuals, by means of which the mosquitos are infected);

Sporogony (in the mosquito):
- Copula = "Ookinet" = Oocyst (Sporont)
  - Sporoblast
    - Sporozoite (Means of infection of warm-blooded animals)

* Arch. Zool. Expér., viii. (1900), Notes et Revue, pp. i.–iii.
† Zool. Anzeig., xxiii. (1900) pp. 513–20 (6 figs.).
‡ Centralbl. Bakt. u. Par., xxvii. (1900) pp. 436–60 (9 figs.).

In regard to the vexed question of terminology, the author believes that there are three clearly defined malarial parasites which occur in man,—*Plasmodium malariæ* (Laveran), the parasite of Quartana; *P. vivax* (Grassi et Feletti), the parasite of Tertiana; *P. præcox* (Grassi et Feletti), the parasite of Perniciosa; and that the generic name *Plasmodium* must stand. The *Proteosoma* of birds appears to be identical with *Plasmodium præcox*, but the position of *Halteridium* remains uncertain.

BOTANY.

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

a. Anatomy.

(1) Cell-Structure and Protoplasm.

Cytological Investigations.* — Herr B. Němec finds that in the periblem of the root-tips of *Allium Cepa*, before the appearance of the hyaline periblast, the threads of the polar radiation are differentiated in a collection of dense protoplasm at the two poles of the nucleus. The threads radiate towards the equator of the cell.

From a great number of observations the author derives the conclusion that the form and the polar disposition of the chromatin loops in the spirem are dependent on the arrangement of the nuclear network.

In the nuclear division in the root-tip of the alder, the nucleole diminishes in size during the prophase, then places itself in the equatorial plane, and becomes constricted into two halves, each of which moves towards one of the poles, and there vanishes. The two daughter-nucleoles have a perfectly free motion, and are not in contact with any achromatic threads.

In the nuclear division in the root-tips of *Equisetum arvense* no hyaline periblast exists up to the time of the dissolution of the nuclear wall.

The author does not believe in the existence of centrosomes or similar structures in the vegetative cells of vascular plants. The part played by the centrosome where it does exist is in them played by the entire nucleus.

Amitotic Division of the Nucleus.† — Herr A. Nathansohn has followed out the observations of Gerasimoff on the influence of cold on the division of the nucleus, by experiments on the action of ether (a 1 p.c. aqueous solution); the objects being *Spirogyra*, *Closterium*, the root-cells of flowering plants, &c. Similar results were obtained. The constriction of the nucleus is preceded by that of the nucleole where there is only one; if there are two nucleoles, the nucleus is first constricted, then the nucleoles in the two daughter-nuclei. No perfect transition between mitotic and amitotic division was observed. Amitotic division of the nucleus can therefore be produced artificially, and may proceed as far as the production of perfect daughter-cells.

Karyokinesis in the Pollen-mother-cells of Liliaceæ.‡—The results of observations on this subject made by M. V. Grégoire in the case of *Lilium speciosum*, *L. candidum*, *L. croceum*, and *Fritillaria imperialis*, lead him to different conclusions from those of Weismann. He states that the ball divides at first longitudinally into two halves interlacing with one another, and subsequently transversely into twelve distinct

* Fünfstück's Beiträge, iv. p. 37. See Bot. Ztg., lviii. (1900) 2te Abt., p. 206.
† Pringsheim's Jahrb. f. wiss. Bot., xxxv. (1900) pp. 48–79 (2 pls.).
‡ La Cellule, xvi. (1899) pp. 233–98 (2 pls.).

chromosomes, each of which is composed of two longitudinal halves. The chromosomes take up their definite form, not in consequence of a folding on themselves, but as the result of becoming shorter and thicker. They do not curve when they approach the spindle, but become attached at a point most often near one of their ends. They insert themselves into the spindle in such a way that the daughter-chromosomes are placed upon one another in the axial plane. Before the separation of the equatorial plate the daughter-chromosomes undergo a fresh longitudinal division, in consequence of which they assume the V-form in which they retreat towards the poles. This second longitudinal division is often completed during the return to the poles. The daughter-chromosomes of the first karyokinesis preserve their individuality in the reconstituted nucleus. They reappear with their characteristic V-form at the beginning of the second karyokinesis. These V-formed bodies, without undergoing any further longitudinal division, furnish, by separation at their angles, the daughter-chromosomes of the second karyokinesis.

Development of the Karyokinetic Spindle in the Pollen-mother-cells of Cobæa scandens.*—Mr. Anstruther A. Lawson gives the following summary of observations made by him on this process. In the cytoplasm, which assumes a distinctly reticulate structure, two constituents may be distinguished—a filamentous part which forms the framework of the reticulation, and a granular portion which collects round the nucleus as a complete zone, and to which the author gives the name *Perikaryoplasm*. When the nuclear membrane bursts, the lining of the nucleus and the perikaryoplasm form a network which occupies the central portion of the cell. This network increases, extending in several directions so as to form the cones of the multipolar figures. The fibres of the spindle are formed by the lengthening of the meshes of the network in the direction of the extensions. The cones lengthen and become sharply pointed; they separate into two groups, and form the bipolar spindle. The mature spindle is characterised by its great length and by the intercrossing of the fibres of its mantle. The spindle of the second division is formed in precisely the same way as that of the first division. No structures which could be identified with centrosomes were detected in any stage of the karyokinetic process.

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

Proteids of Plants.†—Researches made by T. B. Osborne and G. F. Campbell show that the leguminous plants examined—pea, bean, lentil, vetch—all contain legumin, legumelin, and proteose, and the first three also vicilin. Globulin is the most frequent proteinaceous constituent of the seeds. Vicilin is most abundant in the lentil, least so in the bean. It is apparently not a product of legumin, since the seeds of vetches do not contain any. Legumelin is probably an albumin. It was found in all leguminous seeds examined except *Phaseolus vulgaris* and the blue and yellow lupins. The most abundant proteid in the bean is glycinin, a globulin closely resembling legumin in its properties, but containing twice as much sulphur.

* Proc. California Acad. Sci., i. See Bull. Soc. Bot. Ital., 1900, p. 177.

† Journ. Amer. Chem. Soc., xx. pp. 393 and 419. See Bot. Centralbl., lxxxiii. (1900) p. 324.

Arginin.*—This proteid, to which the formula $C_6H_{14}N_4O_2$ is given is found by M. U. Suzuki to be a constant ingredient of the seeds of Coniferæ (*Pinus Thunbergii*, *Cryptomeria japonica*, *Gingko biloba*), and to be peculiar to that family. It occurs also in the etiolated seedlings. It appears to be formed both by the decomposition of albumen and also synthetically out of ammonium salts. In other families of plants it is replaced by asparagin. It appears to be used by the plant directly in the regeneration of proteinaceous substances.

Albumen-Crystalloids in Lathræa.†—Herr E. Heinricher finds the proteid-crystals of *Lathræa*—chiefly *L. squamaria*—not only in the nuclei, but also in the cytoplasm and the leucoplasts. Those which occur in the nucleus are found in all the vegetative organs of the plant, but are wanting in the primitive meristem of the growing point. They are to be found in seedlings six weeks old. The crystals which are distributed through the cytoplasm are exceedingly minute, and occur also in all the vegetative organs; both kinds reaching a large size in the haustoria. The author claims to have definitely demonstrated that these crystals are not artefacts, but are constituents of the living cell.

(3) Structure of Tissues.

Central Cylinder of Angiosperms.‡—According to Dr. E. C. Jeffrey, Van Tieghem's three types of vascular cylinder in the stem of Angiosperms, polystelic, astelic, and medullated monostelic, are but modifications of a single type, the siphonostelic, characteristic of Angiosperms, Gymnosperms, and Filicales, as contrasted with Lycopodiales and Equisetales. In this type the central cylinder is primitively a fibro-vascular tube with foliar lacunæ opposite the points of exit of the leaf-traces. In the so-called polystelic modification, the central cylinder has internal as well as external phloem, and may be described as "amphiphloic." In the so-called astelic type of axis, the internal phloem is wanting, and the central cylinder may be termed "ecto-phloic." The medullated monostelic type of Van Tieghem is derived from the last-named by the suppression of the endoderm.

Sieve-Tissue.§—M. E. Perrot publishes a treatise on this subject, including the elements which accompany the sieve-tubes in the phloem of vascular plants. The wall of the meristematic cell which is destined to become differentiated into a sieve-cell is at first uniformly thin and composed of pectose-cellulose; it early undergoes a notable thickening, due entirely to the increase of the cellulose; this thickening coinciding with the perforation of the transverse walls previously thickened in a reticulate manner. These peculiarities of structure characterise sieve-tubes in their state of greatest activity. In the leaf-veins the vessels are accompanied by sieve-tubes right up to their extremities.

In the sieve-tubes and the adjoining cells, sometimes also in the laticifers, is a principle endowed, like diastase, with the power of de-

* Bull. Coll. Agric. Tokyo, iv. (1900) pp. 1–23, 25–67 (6 pls.). See Bot. Centralbl., lxxxiii. (1900) pp. 354, 356.

† Pringsheim's Jahrb. f. wiss. Bot., xxxv. (1900) pp. 28–47.

‡ Trans. Canadian Inst., vi. (1899) pp. 599–634 (5 pls.).

§ Le tissu criblé, Paris, 1899 (122 figs.). See Bull. Soc. Bot. France. xlvi. (1900) p. 439.

composing the oxygenated water, and thus indirectly producing oxidation. This substance, which the author calls *leptomin*, can be isolated in the form of a white amorphous powder.

The function of sieve-tubes as conductors of food-material is discussed at length, and special attention is paid to the medullary and intraxylary sieve-bundles.

Contrary to the statement of some observers, the author never finds the phloem-bundles entirely wanting in aquatic Phanerogams, though they are greatly simplified in structure, and may often be reduced to a single sieve-tube.

Pericycle.*—An account by Herr H. Fischer of the structure of the pericycle in the free axial organs closes with the following general remarks. In about 32 p. c. of the Dicotyledons examined, an endoderm was more or less distinctly detected, indicating the distinction between the cortex and the central cylinder. The so-called pericycle, by its position between the limit of the cortex and the ring of vascular bundles, is allied with the pericambium of the root. Considered histologically, genetically, and as a formative region, there are no common characteristics of pericycle and pericambium. In Monocotyledons, Conifers, and about 68 per cent. of the Dicotyledons examined, there is no characteristic limit to the cortex. The mechanical ring of Monocotyledons is from no point of view allied to the pericambium.

Increase of Tissues outside the Cambium-layer.† — According to M. H. Devaux, the increase in diameter of the tissues situated outside the cambium-layer [in a Dicotyledonous stem] is not effected mainly by any rupture of the tissues, nor by the formation of lacunæ, though these are not infrequent, but by a tangential growth, accompanied by the more or less frequent production of radial septa. This increase takes place in general only in the outermost layers in contact with the periderm (bark, pericycle, or liber). In the more interior parts it is always localised, chiefly between the pericyclic or liber-bundles; these regions of increase, prolongations of the medullary rays, being often readily visible. When sclerotised sheaths occur in the pericycle or liber, these are burst through by the tangential growth.

Crystal-cells of the Pontederiaceæ.‡—Herr W. Rothert has investigated these structures, chiefly in the case of *Eichhornia speciosa*. They are peculiar to the order, but do not occur in all the genera. They are found chiefly in the lamellar parenchyme of the petiole and lamina of the leaf, and in the transverse septa and lateral walls of the air-chambers; their axis being usually at right angles to the wall. Each crystal is enveloped in a closely fitting homogeneous envelope, formed out of the protoplasmic layer nearest to the crystal after its formation. The crystals consist of calcium oxalate, but are quite distinct from raphids; they are very much larger and are usually solitary in each cell, very rarely more than two.

Injuries produced by Heterodera radicicola.§—M. M. Molliard calls attention to the pathological structures induced by the attacks of

* Pringsheim's Jahrb. f. wiss. Bot., xxxv. (1900) pp. 1–17 (1 pl.).
† Mém. Sci. Phys. et Nat. Bordeaux, v. (1899) pp. 47–58.
‡ Bot. Ztg., lviii. (1900) 1te Abt., pp. 75–106 (1 pl. and 2 figs.).
§ Rev. Gén. de Bot. (Bonnier), xii. (1900) pp. 157–65 (1 pl.).

this nematode on *Cucurbita*, *Coleus*, and *Begonia*. It appears to be independent of external circumstances, and of the specific nature of the host, and to consist in the production of large vesicular multi-nucleated cells for the special nutrition of the parasite.

(4) Structure of Organs.

Flower and Fruit of the Paper-Mulberry.*—Prof. M. Möbius has undertaken a detailed investigation of the flower and fruit of *Broussonetia papyrifera*. Among the more interesting points are the following. *Broussonetia* differs from *Morus* in the absence of rudiments of stamens from the female flowers, while the male flowers possess the rudiment of an ovary. The drupe is the result of an energetic growth of mesocarp-cells of peculiar structure which the author terms the "rod-layer," accompanied by splitting of the pericarp. As in *Artocarpus*, the axis of the inflorescence contains medullary vascular bundles which are wanting in the vegetative shoots.

Sepaline and Capsular Hydathodes.†—M. K. Shibata adds four to the 15 (all tropical) examples known of "water-calices," viz. *Tecoma grandiflora* and *Catalpa kæmpferi* (Bignoniaceæ), and *Clerodendron trichotomum* and *C. squamatum* (Verbenaceæ). The inside of the calyx is furnished with capitate hairs which excrete water. In *Sterculia platanifolia* the follicle is, up to the time of bursting, filled with a coffee-brown watery fluid, of an alkaline reaction, owing to the presence of carbonates, which is also secreted from trichomes which clothe the inner surface of the follicle.

Protuberances on the Branches of Æschynomene indica.‡—Sig. A. Terracciano has investigated these structures, and finds them to be special organs for enabling the branches to float when covered with water, and to absorb the moisture of the air when exposed. The rootlets on the submerged parts of the plant are true floating organs. The leaves are provided with hydathodes which regulate the absorption and excretion of water.

Roots of Palmæ and Pandanaceæ.§—Herr G. Gillain describes the specialities of the anatomy of the root in six families of palms, viz. the Phœnicieæ, Sabaleæ, Borasseæ, Lepidocaryeæ, Ceroxyleæ (including Areceæ and Caryoteæ), and Cocoineæ, which together with the Phytelephanteæ, make up the order Palmæ. To this is appended an account of the same organs in the Pandanaceæ derived from the genera *Pandanus* and *Freycinetia*.

Mangrove-Vegetation.‖—In a series of papers on the flora of the Danish West Indies, F. Boergesen and O. Paulsen give an interesting account of the trees which constitute the swamp-flora, belonging to the orders Rhizophoraceæ and Verbenaceæ, especially *Rhizophora Mangle*, *Avicennia nitida*, and *Laguncularia racemosa*. The aerial roots of

* Pringsheim's Jahrb. f. wiss. Bot., xxxiv. (1900) pp. 425–56 (7 figs.).

† Arb. bot. Inst. k. Univ. Tokio. See Bot. Centralbl., lxxxiii. (1900) p. 350.

‡ Contrib. Biol. Veget., ii. (1899) pp. 195–206, Palermo. See Bot. Centralbl., lxxxiii. (1900) p. 115.

§ Bot. Centralbl., lxxxiii. (1900) pp. 337–45, 369–80, 401–12 (1 pl.).

‖ Rev. Gén. de Bot. (Bonnier), xii. (1900) pp. 225–45 (45 figs.).

Avicennia are especially remarkable; they spring from the horizontal suckers, and rise erect into the air to the height of half a metre, with a diameter of 0·5–1 cm.; they often branch, and bear a large number of pneumathodes or lenticels.

β. Physiology.

(1) Reproduction and Embryology.

Relationship between Parasitism and Sexual Reproduction.—Prof. M. Moebius* calls attention to the fact that in both cryptogams and phanerogams the parasitic or saprophytic habit is very commonly associated with a limitation of the functions or even with a complete suppression of the organs of sexual reproduction. This is the case throughout the whole class of Fungi, and with many of the parasitic flowering plants, such as the Balanophoraceæ, Santalaceæ, and Rafflesiaceæ. He suggests an antagonism between the two physiological processes or conditions.

Commenting on this suggestion, Prof. K. Gœbel † points out that *Balanophora* is at present the only known instance of a complete loss of sexual reproduction in flowering plants. Examples of apogamic embryo-formation are not uncommon; but these are by no means confined to parasites and saprophytes (e.g. *Allium*, *Cœlebogyne*, *Funkia*).

Double Impregnation in Angiosperms.‡—A further series of observations leads M. L. Guignard to the conclusion that the process described by him as double impregnation is a usual phenomenon in Angiosperms. He has observed it in members of the orders Ranunculaceæ, Resedaceæ, Malvaceæ, and Compositæ. In all the examples the secondary nucleus of the embryo-sac is formed, by complete fusion of the polar nuclei, a considerable time before impregnation. The fusion of the antherozoids with this nucleus and with that of the oosphere takes place with great rapidity.

In *Caltha* and *Ranunculus* one of the male nuclei applies itself, in the form of a crescent swollen in the centre, to the nucleus of the oosphere, from which it is easily distinguished by the greater capacity for staining of its chromatic granulations. In *Anemone nemorosa* the very large secondary nucleus is usually found towards the base, and near the well-developed antipodals. The antherozoids are small elongated slightly curved bodies. In all the Ranunculaceæ examined, a large number of endosperm nuclei are formed before the first septation of the embryo. In *Reseda lutea* the nucleus of the oosphere, comparatively poor in chromatin, is smaller than those of the synergids; its single nucleole is also smaller. In *Rudbeckia* the antherozoids are not elongated and curved, as they are in *Helianthus*.

Embryo-sac of Monocotyledons.§—Karl M. Wiegand makes the following obervations on the development of the embryo-sac in certain monocotyledonous plants.

Convallaria majalis. The stages of the growth and development of the archesporial nucleus are identical with those of the nuclei of the

* Biol. Centralbl., xx. (1900) pp. 560–71 (5 figs.). † Tom. cit., pp. 571–2.
‡ Comptes Rendus, cxxxi. (1900) pp. 153–60. Cf. this Journal, *ante*, p. 481.
§ Bot. Gazette, xxx. (1900) pp. 25–47 (2 pls.).

microsporangial archespore. Its first division is heterotypic, and corresponds to the first pollen-mother-cell division in every respect. The number of chromosomes in the vegetation nucleus is about 36; during the heterotypic and "reducing" divisions, 18 may be counted. The apparent reduction takes place, therefore, prior to the first division of the archespore.

Potamogeton foliosus. The mature embryo-sac contains two small synergids and a large egg-nucleus near the micropyle enclosed by a wall, a very thin parietal layer of protoplasm, and four antipodal cells cut off by a transverse wall at the lower end of the embryo-sac, of which three are very small and one is very large. The nuclei are peculiar in having most of the chromatin aggregated in a ball at the centre of the cavity. At the time of fertilisation the two sperm-nuclei lie together near the egg-nucleus, but only one is really in contact with it.

Canna indica. The nuclei of *Canna* resemble those of *Caltha* more nearly than those of *Potamogeton.* They have a true nucleole but no central chromatin mass. The number of chromosomes in the vegetative divisions is six; when passing to the poles at the heterotypic division there are still six; but in the second division there are only three. This number is one of the smallest yet found in vegetable tissue.

In all three species examined the hypodermal cell at the apex of the nucellus divides into an upper and a lower cell, of which the inner cell becomes the archespore, and the upper one forms part of the wall of the embryo-sac.

Endosperm and Embryo of Peperomia.* — Mr. D. S. Johnson does not agree in all respects with the observations of Prof. Campbell on the structure of the embryo-sac of *Peperomia pellucida.* But both this species and others of the same genus do present peculiarities not hitherto observed in other families of plants. In the formation of the endosperm, the embryo-sac first of all divides into two by a cell-wall stretching from the oospore to the base of the sac. Two endosperm cells are thus formed, which subsequently divide into a large number, each with a large nucleus and several nucleoles. There is no group of basal nuclei corresponding to the antipodals, and only a single synergid, which is long persistent. Finally the endosperm nucleus is formed by the fusion of a large number of small nuclei.

Embryology of Avena fatua.†—Mr. W. A. Cannon has studied the development of the flower and of the embryo in this grass. The generative nucleus divides within the pollen-grain, and the male cells are elongated spindle-shaped; the archesporial cell of the ovule cuts off no tapete; the four potential megaspores are formed in various ways. The antipodals multiply before the impregnation of the ovum-cell, becoming 36 or more in number, and begin to disorganise with the beginning of the development of the endosperm. The suspensor consists of only a single cell. The cotyledon and the stem-apex are developed from the distal segment of the embryo; the root, the root-cap, and the periblem initials of the root from the middle segment; and the coleorhiza from

* Bot. Gazette, xxx. (1900) pp. 1–11 (1 pl.). Cf. this Journal, *ante*, p. 217.
† Proc. California Acad. Sci., iii. (1900) pp. 329–64 (5 pls.). See Bot. Gazette, xxix. (1900) p. 445. Journ. Applied Micr., iii. (1900) pp. 718–9.

the basal segment. The organs of the embryo originate in the distichous manner characteristic of the vegetative leaves of grasses.

Embryology of Quercus.* — Mr. Abram H. Conrad gives a few details of the development of the embryo in *Quercus* (*velutina* and *coccinea tinctoria*). During the first year the carpels fuse so as to form three nearly distinct loculi; but it is not till the following spring that the first indication of an ovule is manifest. The mature embryo-sac contains the usual two groups of four nuclei each. There occurs an early fusion of the polar nuclei, followed by a copious development of endosperm. The first division of the ovum-cell is transverse, and the suspensor undergoes but one subsequent division, which is vertical.

Fertilisation of Cynomorium.† — Sig. R. Pirotta and Dr. B. Longo state that, in *Cynomorium coccineum* the ovule is destitute of a micropyle, the pollen-tube finding its way to the embryo-sac through a vacuolated and amyligerous cone of tissue in the micropylar region of the ovule. The embryo-sac is very small as compared to the very large nucellus. The cells [? nuclei] of the sexual triad resemble one another in all respects; the three antipodal nuclei increase greatly in number by karyokinetic division during the cell-formation in the endosperm. The pollen-tubes traverse the single thick integument, and find their way between the cells of the cone already described to the embryo-sac, probably through the chemotactic action of the contents of the cells of the cone. Immediately after impregnation the cell-walls of this cone bacome suberised, thus effectually preventing the access of any other pollen-tubes.

The ovary of *Cynomorium coccineum* contains two fertile ovules, not one, as usually stated. The authors regard the appendages to the stamens as constituting a true stylodium. They consider that the genus should be removed from the Balanophoraceæ, and placed in an order by itself.

Hybrid Fecundation (Xenia) in Maize.—By the term *xenia* Focke designated the influence exercised by the pollen on the hereditary characters of the fruit and the seed outside the embryo. M. H. de Vries ‡ has demonstrated the occurrence of this phenomenon in the hybridisation of the endcsperm of the maize. In hybrid races of Indian corn he shows that every grain in which the endosperm displays the characters of the male parent has a hybrid embryo, and that every grain in which the endosperm shows the characters of the female parent has an embryo of a pure race, and is then self-fertilised. Hybridisation of the embryo is always accompanied by hybridisation of the endosperm.

Mr. H. J. Webber § has carried out a long series of experiments on this subject on cultivated varieties of Indian corn. His general conclusion is that xenia in maize is in all cases caused by the fecundation of the embryo-sac-nucleus by one of the male nuclei, resulting in the

* Bot. Gazette, xxix. (1900) pp. 408-18 (2 pls.).
† Atti r. Accad. Lincei, ix. (1900) pp. 150-3.
‡ Rev. Gén. de Bot. (Bonnier), xii. (1900) pp. 129-37 (1 pl.). Cf. this Journal, *ante*, p. 217.
§ U.S. Deptmt. Agric. (Div. Veg. Phys. & Path.), Bull. No. 22, 44 pp. and 4 pls.

production of the endosperm. All the kernels grown by the writer in which xenia was shown by changes in colour, were proved to be true hybrids. It is not improbable that in some cases the second pollen-nucleus enters the embryo-sac, but fails to unite with the two polar nuclei. In such cases it may be able to form a spindle and to divide separately, the unfecundated embryo-sac-nucleus formed by the union of the two polar nuclei also dividing separately. If this occurs, there would then be formed, in the protoplasm of the embryo-sac, nuclei of two distinct characters, one group from the division of the embryo-sac-nucleus, the other group from the division of the pollen-tube nucleus.

Hybridisation.*—Mr. W. M. Webb gives an interesting summary of the more important results obtained in the papers read at the Conference on Hybridisation and Cross-breeding held by the Royal Horticultural Society. The following may be especially mentioned.

In the genus *Anthurium* M. de la Devansaye says that the pollen, to be of value, must come from plants springing from a different batch of seeds from that giving rise to the ovule-bearing individuals; that pollen from allied genera has a beneficial effect; and that variations which are not seen in the first or second generation may appear in the third or fourth.

An intermediate condition of external structure was brought out by Dr. Wilson in hybrids of *Passiflora*, *Albuca*, *Ribes*, and *Begonia*.

From experiments with cereals and Bromeliaceæ, Dr. Wittmack concludes that the mother has more influence upon the habit, the father more influence on the inflorescence, at least upon its colour.

According to Herr Max Leichtlin, the female parent gives to the offspring the form and shape of the flowers, also certain qualities; the male parent gives more or less of the colouring of the flowers, and if it be richer and blooms more freely than the female, this property is transmitted to the offspring; artificially produced offspring give larger flowers than either of their parents; the more distant the habitats of the species intended to hybridise, the more difficult it is for them to be fertilised with each other's pollen; the offspring becomes infertile and delicate if the form of the flowers of their parents is widely different in shape and outline.

Artificial Crossing of Pisum sativum.†—Herr E. Tschermak has experimented on the artificial crossing of the garden pea, which is entirely self-pollinated within the closed corolla, and is very rarely visited by insects. His conclusions confirm those of Darwin, that the number and weight of the seeds of this species are to no extent dependent on self-pollination, or pollination between different flowers of the same plant, between different individuals of the same variety, or between different varieties. Double pollination of a pure variety by its own pollen or by that of the same variety and by pollen of another variety, or by pollen of two different varieties, is efficacious with regard to both pollens; the one kind of pollen does not in any way interfere with the potency of the other kind.

* Journ. R. Hort. Soc., xxiv. (1900) pp. 1–348 (123 figs.). See Nature, lxii. (1900) p. 174.

† Ber. Deutsch. Bot. Ges., xviii. (1900) pp. 231–9.

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

Chlorophyll Assimilation.*— Sig. G. Pollacci has confirmed, by a fresh series of observations, his previous statement that green leaves still in connection with the plant exhibit Schiff's aldehyd reaction; while this is not the case with leaves which have been darkened for some days, nor with plants grown in an atmosphere devoid of CO_2, nor with fungi. A great variety of reactions agree with the determination of this aldehyd as exclusively formic. He promises further experiments for the purpose of isolating the aldehyd.

Effect of increased Pressure on Chlorophyll Assimilation.† — Experiments made on several different plants have led M. J. Friedel to the conclusion that a lowering of the pressure even as low as to one-fourth of the normal does not alter the nature of the chlorophyll assimilation, the value of the proportion $\frac{CO_2}{O}$ remaining nearly at unity; while the intensity of the assimilation diminishes with the decrease of the pressure, following a nearly regular law.

Influence of Dry and Moist Air on Plants.‡ — As the result of a series of experiments on a considerable number of plants belonging to many natural orders, M. Eberhardt lays down the general law that moist air promotes the development of both stem and leaves, but reduces the diameter of the stem; has a tendency to increase the surface of the leaves; diminishes the quantity of chlorophyll contained in them; and greatly reduces the production of rootlets. Dry air, on the other hand, has an unfavourable effect on the growth of the stem; has a tendency to diminish the surface of the leaves; and increases the number of rootlets. As regards the tissues:—dry air increases the thickness of the cuticle and the number of stomates; promotes the formation of bark; favours the production of woody tissue and the differentiation of the sclerenchymatous tissues, both in the pith and in the cortex; and increases the development of the palisade-tissue in the leaf. In moist air, on the contrary, the differentiation is less than under normal conditions, especially in relation to the supporting tissue.

Limits of Grafting.§—M. L. Daniel finds the grafting by approach of two species to be possible within much wider limits than has hitherto been supposed. He has succeeded in inducing union in the case of young seedlings, between members of the following widely separated genera:— *Phaseolus* and *Xanthium*, *Phaseolus* and *Ricinus*, *Helianthus* and *Cucurbita*, *Brassica* and *Lycopersicon*, *Chrysanthemum* and *Lycopersicon*, *Helianthus* and *Solanum*, *Coleus* and *Achyranthes*, *Cineraria* and *Lycopersicon*, *Aster* and *Phlox*, *Coleus* and *Lycopersicon*, *Acer* and *Syringa*, *Zinnia* and *Lycopersicon*. In all these cases there was a complete and permanent union; those grafts were always the most perfect in which there was the greatest resemblance between the two species in size, vigour, and mode of growth.

* Atti R. Ist. Bot. Univ. Pavia, vii. (1899) 21 pp. See Bot. Ztg., lviii. (1900) 2te Abt., p. 154.

† Comptes Rendus, cxxxi. (1900) pp. 477–9.

‡ Tom. cit., pp. 193–6, 513–5. § Tom. cit., pp. 192–3.

Vegetative Propagation of Erythronium.*—Mr. F. H. Blodgett has studied the development of *Erythronium americanum* from the seed. The cotyledon is at first a store-house of food-material; but, after this is exhausted, it forces its way above the soil and functions as a leaf. A flowering bulb cannot be produced from seed in less than four or five years. The seeds germinate the second year and produce "plumule-bulbs." From each of these a single leaf appears in the third year, and the first runners are produced, bearing "runner-bulbs" at their distal ends; and a further period of two years at least elapses before these blossom.

Influence of Oxygen on Germination.†—From a series of experiments on the seeds of the pea, lupin, *Arachis*, and maize, M. P. Mazé concludes that the non-germination of submerged seeds is due to insufficient aeration. Seeds when placed under water, while preserving the condition of latent life, are the seat of numerous diastatic transformations. The hydrolysing diastases, in particular, and zymase, maintain comparative activity; while the oxidising diastases are unable to perform their function, and to supply the embryo with food-material. Minute seeds, like those of crucifers, may develope slowly under water; starchy seeds soon lose their germinating power under this condition; oily seeds retain it longer. The development of the plant, at the expense of the reserve-materials of the seed, is the resultant of a number of diastatic processes, whose equilibrium cannot be disturbed without causing, in a short time, the death of the individual.

Influence of Salts of the Fatty Acids on Germination and Growth.‡—Herr O. Lövinson gives the result of a series of observations on the germination and growth of *Pisum sativum*, in solutions containing formic, acetic, and propionic acids, but no mineral acid. Three nutrient solutions were employed, which he calls normal formic, normal acetic, and normal propionic solutions, the composition of which is given in detail. Among the general conclusions arrived at are the following:—These normal solutions penetrate in a short time into the interior of the seeds without killing the cells, but they check germination; this inhibition being due exclusively to the salts of the fatty acids, not to the phosphorus or to the sulphur carbide; the latter even facilitating germination. The solutions have also an unfavourable influence on growth, due again entirely to the salts of the fatty acids. The injurious effect consists chiefly in a disorganisation of the root-cells. A copious bibliography is appended.

Poisonous Effects of Salts of the Alkalies and Alkaline Earths on the higher Plants.§—M. H. Coupin gives a series of tables illustrating the degrees to which salts of the alkalies and alkaline earths exercise a poisonous effect on the growth of flowering plants. The salts of sodium are, as a rule, less poisonous than those of potassium. Salts of the

* Bull. Torrey Bot. Club, xxvii. (1900) pp. 305–15 (3 pls.).
† Ann. Inst. Pasteur, iv. (1900) pp. 350–68.
‡ Bot. Centralbl., lxxxiii. (1900) pp. 1–12, 33–43, 65–75, 97–106, 129–38, 185–95, 209–24 (4 figs.).
§ Comptes Rendus, cxxx. (1900) pp. 791–3. Rev. Gén. de Bot. (Bonnier), xii. (1900) pp. 177–93.

alkaline earths exercise a poisonous effect on plants in proportion to the atomic weight of the metal,—calcium, strontium, barium. Most of the salts of barium and strontium are poisonous; barium chlorate especially so; as also are the chlorates of potassium and sodium.

Action of Carbon dioxide on the Movements of Water in Plants.* —From a series of experiments made on *Phaseolus vulgaris*, Dr. P. Kosaroff concludes that carbon dioxide exercises a strongly depressive effect on the movements of water in plants. Under the influence of an excess of CO_2, the amount of water absorbed is decreased, whether the plants be uninjured or the leaves be removed. The injurious action of carbon dioxide is especially marked where it comes into contact with living elements. This action is due both to direct injury and to the loss of oxygen. The withering of plants on long exposure to carbon dioxide is due to the reduction of transpiration.

Transpiration in the Tropics and in Central Europe. † — Herr E. Giltay gives details of further experiments to elucidate the questions arising out of this subject, and replies to the criticisms of Haberlandt on his previous publications.

Bleeding of Cornus macrophylla.‡—Among Japanese trees this is one in which the phenomenon of bleeding is most strongly displayed. M. M. Miyoshi found the greatest pressure represented by a column of mercury 109 cm. high. The bleeding displays a daily periodicity, the maximum pressure occurring about 6 A.M. in the summer, or between that and noon in the winter, the minimum between 4 and 8 P.M.

(3) Irritability.

Geotropism.—Herr F. Noll § criticises Czapek's explanation of geotropic curvatures, controverting some of his conclusions. He thinks that Czapek places too much reliance on klinostat experiments, since the klinostat does not prevent all geotropic irritation. He further states that the reactions of the cell-contents described by Czapek in geotropically irritated apices of roots are not closely connected with the reception of the irritation.

Mr. E. B. Copeland ‖ confirms Czapek's statement that the growing hypocotyl of *Cucurbita* displays no polarity; similar results were obtained also in the case of other seedlings, and with roots. If a stem is split into two longitudinal halves, and laid horizontally, the lower half, which has the split surface upwards, will increase in length more rapidly than the upper half; while with split roots the reverse is the case.

Rheotropism of Roots.—Herr A. Berg ¶ has adopted three different modes for determining the rheotropism of growing roots:—Dipping the roots in running water; causing the roots to move in still water by the

* Bot. Centralbl., lxxxiii. (1900) pp. 138–44.
† Pringsheim's Jahrb. f. wiss. Bot., xxxiv. (1900) pp. 405–24. Cf. this Journal, 1899, p. 179.
‡ Arb. Bot. Inst. k. Univ. Tokio. See Bot. Centralbl., lxxxiii. (1900) p. 347.
§ Pringsheim's Jahrb. f. wiss. Bot., xxxiv. (1900) pp. 457–506. Cf. this Journal, 1899, p. 180.
‖ Bot. Gazette, xxix. (1900) pp. 185–96.
¶ Lund's Univ. Arsskr., xxxv. (1899) 35 pp. and 1 pl. See Bot. Ztg., lviii. (1900) 2te Abt., p. 169.

klinostat; and causing the water to rotate by the introduction of a current while the object remains still. Of these methods he prefers the third. With one exception (*Soya hispida*), Berg finds rheotropism to be always exhibited by the roots of seedlings; normally the rheotropism is positive; but it readily passes into negative rheotropism at a low temperature.

Herr H. O. Juel * has adopted a process resembling Berg's second method. From experiments on decapitated roots he has determined that the zone of growth is sensitive to rheotropism. He regards the phenomenon as having nothing in common with hydrotropism. The upper and lower limits of the rapidity of current which can give rise to rheotropic curvatures vary greatly in different plants. The highest and the lowest of all are given respectively as 20–30 cm. and 0·3 mm. per second.

Influence of the Curvature of the Root on the Production and Arrangement of the Lateral Roots.†—Herr F. Noll maintains that the unilateral arrangement of the rootlets on the convex side of curved roots cannot be ascribed altogether to external forces, since the curvature takes place whether the irritation be geotropic, heliotropic, or hydrotropic; its explanation must be sought at least partially in internal causes. Increase in thickness is not, under these conditions, the result of an extra supply of nutriment; the latter is rather the result of the former, which is the product of specific irritation.

Nutation of the Sunflower.‡ — Observations made by Prof. J. H. Schaffner on *Helianthus annuus*, both wild and cultivated, confirm the popular idea of a gradual change in position of the flower-head according to the time of day. The growing plants nutate from 60° to 90° W. in the evening, and from 50° to 70° or more E. in the morning. At night the leaves droop and the tips point downward. Similar results, though less pronounced, were obtained with *H. petiolaris*.

Peculiar Case of Contact-Irritability.§—F. Grace Smith describes a phenomenon connected with the growth of a number of "bush-beans" from seed in the dark. When the seedlings, perfectly etiolated, were about 20 in. high, and had developed their first leaves, the petioles had all arranged themselves in parallel planes; while no such adjustment was displayed on seedlings grown in the light. Experiments were made which seemed to determine that the phenomenon was not due to thermotropism or hydrotropism; it appeared to be entirely due to the near contact of the petioles with one another.

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

Nitrogen-Assimilation of Green Plants.||—Herr L. Jost reviews the various theories which have been brought forward on this subject, and sums up in favour of Schulze's, which he summarises as follows:—The

* Pringsheim's Jahrb. f. wiss. Bot., xxxiv. (1900) pp. 507–38 (7 figs.).

† Landwirth. Jahrb., xxix. (1900) pp. 361–426 (3 pls. and 14 figs.). See Bot. Ztg., lviii. (1900) 2te Abt., p. 284.

‡ Bot. Gazette, xxix. (1900) pp. 197–200 (10 figs.).

§ Bull. Torrey Bot. Club, xxvii. (1900) pp. 190–4 (17 figs.).

|| Biol. Centralbl., xx. (1900) pp. 625–37. Cf. this Journal, *ante*, p. 608.

albumen in the seed is decomposed by hydrolysis; the first substances formed are albumoses and peptons; these are, however, not stored up, but break up into amido-acids and hexon-bases, in addition possibly to asparagin and glutamin. The substances thus formed are again decomposed, with formation of ammonia, and from this are produced asparagin and glutamin in the presence of glucose. These amides are, therefore, at least for the most part, not products of decomposition, but rather the first products of synthesis.

Indigo Fermentation.* — According to M. W. Beijerinck, the substance from which indigo is formed is not identical in all indigo-plants. In the "indican-plants" (*Indigofera*, *Polygonum tinctorium*, *Phajus grandiflorus*), this substance is indican, the glucoside of indoxyl; while in the "indoxyl-plants" (*Isatis tinctoria*) it is indoxyl itself. In all cases the indigo-pigment is formed, directly or indirectly, by the oxidation of indoxyl. In the indican-plants the indican is found in the colourless protoplasm, while the indican-enzyme is located in the chloroplasts. The organisms which decompose the indican effect this in two different ways. In the smaller number it is broken up by an enzyme; in others it is split up directly without the intervention of an enzyme, through the activity of the protoplasm.

Fermentation of Saccharides.†—According to Fischer each saccharide should have its special ferment, and this view is supported by certain yeasts which hydrolyse maltose and not saccharose or trehalose. M. E. Dubourg, however, finds that all yeasts secrete all the diastases of all the saccharides. To show this, the ferments are cultivated in nutritive media rich in nitrogenous matter with a mixture of glucose and of the saccharide. Under these conditions there is fermentation, not only of the glucose but also of the second sugar. The author has worked with numerous species of yeasts, more or less active, and has always obtained alcohol with maltose, saccharose, raffinose, and trehalose, but not with lactose. *Mucor alternans* ferments only maltose and trehalose. The phenomenon of hydrolysis appears to be general among yeasts, but it is not so with the Mucorineæ.

γ. General.

Dust from Drift-Ice.‡—Herr P. T. Cleve has made a microscopical examination of four samples of dust from drift-ice north of Jan Mayen, brought by the E. Greenland current. Some of them were very rich in siliceous organisms, belonging almost without exception to diatoms, including a large number of species, both fresh-water and brackish or marine, the latter both litoral and plankton. The only other organisms recorded are a few spores of Flagellata, and a fragment of a doubtful Tertiary fossil.

B. CRYPTOGAMIA.

Cytology of Non-nucleated Organisms.§—Dr. A. B. Macallum gives the following as the summary of his observations, made chiefly on *Saccharomyces*, *Beggiatoa*, and the Cyanophyceæ.

* S.B. k. Akad. Wetensch. Amsterdam, Sept. 30th, 1899, and March 31st, 1900. See Bot. Ztg., lviii. (1900) 2te Abt., p. 188.

† Procès-verbaux des séances Soc. des Sci. Phys. et Nat. de Bordeaux, Année 1898–9, pp. 28–9.

‡ Öfv. k. Vetensk.-Akad. Förhandl. Stockholm, lvii. (1900) pp. 393–7 (English).

§ Trans. Canadian Inst., vi. (1899) pp. 439–503.

In the Cyanophyceæ there is no nucleus, nor any structure which resembles a nucleus. Two zones can be made out in the living cell, one central, uncoloured, the other peripheral, holding the pigment. There is no evidence of the presence of a special chromatophore, the pigment being dissolved in a fluid. There are two types of granule, chiefly found respectively in the central body and in the peripheral layer. The heterocyst is a degenerated cell, in which distinction between the central and peripheral parts is lost. Division of the cell is direct.

In no form of *Beggiatoa* is there any specialised chromatin-holding structure in the shape of a nuclus of any kind. There is no differentiation of the cytoplasm into a central body and a peripheral layer. The droplets of sulphur are contained in the central portion.

In *Saccharomyces* the cytoplasm is usually finely reticulated, and contains one or more vacuoles. In addition to the chromatin-like substance diffused throughout the protoplasm, there is usually a more or less homogeneous spherical body in the cell, the "corpuscle," "nucleus," "nucleole," and "nuclein body" of various observers, which stains specially with hæmatoxylin, but is not either a nucleus or a nucleole. There may be several in a cell or they may be entirely wanting. The corpuscle divides when budding begins; but the division is purely mechanical, and is not essential to the formation of the bud. In cells of *S. Ludwigii* there are occasionally structures closely resembling a nuclear organ; they are composed of vacuolised chromatin.

Reserve Carbohydrates of Thallophytes.*—In the Myxomycetes, according to M. G. Clautrian, the most abundant carbohydrate is glycogen, which usually occurs in the plasmodes in a half-dissolved condition, less often as amorphous granules; the spores contain only oily substances. The Euflagellata, whether green or colourless, contain paramylon in the cytoplasm, not in the chromatophores. The Peridinieæ contain drops of oil and true starch; their membrane gives the reactions of cellulose. The Cyanophyceæ often give with iodine a reaction resembling that of glycogen. The presence of glycogen in the bacteria has been rendered probable by Errera; their membrane gives in many cases amyloid reactions. In the green algæ starch plays the most important part. The composition of the brown algæ has been but little investigated. In many red algæ there is a carbohydrate closely allied to starch. Fungi contain abundance of glycogen and oily substances, besides various forms of sugar, glucose, levulose, trehalose, and mannite.

Influence of Chemical Agents on the Growth of Algæ and Fungi.†—N. Ono publishes the results of a large number of experiments on the effect on Algæ and Fungi of a number of different chemical salts, accompanied by a series of tables. Extremely dilute solutions of some poisonous salts promote the growth of the lower Algæ; among these are zinc sulphate, ferric sulphate, cupric sulphate, and iron arsenite. It is the power of multiplication, not the size of the individual, that is favourably affected. A smaller quantity of the mineral salt is more injurious

* Misc. biol. déd. au Prof. A. Giard, p. 114, Paris, 1899. See Bot. Centralbl., lxxxiii. (1900) p. 159.

† Journ. Coll. Sci. Imp. Univ. Tokyo, xiii. (1900) pp. 141–86 (1 pl.) (German).

to Fungi than to Algæ. The formation of spores is especially checked by these substances. Of mercuric chloride the optimum concentration for Fungi is about 0·0013 p. c.; of cupric sulphate about 0·012 p. c.

Cryptogamia Vascularia.

Megaspores of Isoetes and Selaginella.*—Herr H. Fitting describes in great detail the structure and development of the megaspores and megasporanges in these genera, especially in relation to the mode of growth of the cell-wall. The following are the more important results of the investigation. The differentiation of the megaspore mother-cells takes place, in *Isoetes*, at a much later period in the development of the sporanges than has hitherto been supposed. The tapete-cells never become absorbed; in both genera they persist until the spores are nearly fully ripe. In the spore mother-cells the first changes in the protoplasm, which precede division, take place while the nucleus is still completely at rest. The formation of the walls of the special mother-cells takes place chiefly without assistance from the combining-filaments between each pair of daughter-nuclei. The spore-wall consists, in both genera, of several differentiated layers, which the author distinguishes as perispore, exospore, mesospore, and endospore. The strongly silicified perispore is formed later than the exospore, apparently at the expense of the walls of the special mother-cells. As growth proceeds large spaces are formed between the exospore and the mesospore on the one hand and between the mesospore and protoplasm on the other hand; these are filled by a fluid which furnishes the material for the growth of the membranes, which takes place by intussusception in both the outer and the inner layers. The plasmolytic condition of the cell forbids the idea of the protoplasm taking any direct part in this growth. The small amount of protoplasm in the spores immediately before they are ripe renders it scarcely possible that the nutrient fluid of the membranes can be derived from it; it is much more probable that it is the tapete-cells which perform this function, since they behave like active gland-cells.

Sporophyll and Sporange of Isoetes.†—Mr. R. Wilson Smith publishes the results of a detailed series of observations on the structure and development of the sporophylls and sporanges of *Isoetes echinospora* and *Engelmanni*, of which the following are among the more important.

The apex of the stem lies at the bottom of a funnel-shaped depression, round the sides of which the leaves are arranged spirally. This depression is produced by the expansion of the cortical cells of the stem in all directions. The air-cavities are formed out of four longitudinal bands of cells. The ligule originates in a single vesicular cell. The mature ligule can be distinguished into four regions: the sheath, the glossopode, a region of living cells, and a region of disintegrating cells. The rudiment of the sporange is a transverse row of superficial cells below the ligule; there is no definite hypodermal archespore.

* Bot. Ztg., lviii. (1900) 1te Abt., pp. 107–62 (2 pls.).
† Bot. Gazette, xxix. (1900) pp. 225–58, 323–46 (8 pls.).

The differentiation in the development of the megasporanges and microsporanges is described in detail. They are indistinguishable until they have attained a size of 15,000 to 25,000 cells. The number of microspores in a microsporange is 150,000 to 300,000; of megaspores in a megasporange 150 to 300. In both kinds of sporange the tapete is organised out of the layers of sterile cells adjacent to the mother-cells of the spores. The first leaves of a season are megasporophylls, and these are succeeded by microsporophylls; occasionally a sporange contains both kinds of spore.

Algæ.

Assimilation, Transformation of Starch, and Respiration in the Florideæ.*—According to Herr R. Kolkwitz, the starch of the Florideæ does not differ essentially from that of the higher plants. It is used up in the same way after being stored up. Whether there are also reserves of albuminoids is doubtful. There are but few Florideæ which contain no starch. The red pigment appears to influence the accumulation of starch, assimilation, growth, and respiration. Respiration is but very feeble in the Florideæ; hence the absence of intercellular spaces.

Movements in Bornetia secundiflora.†—Continuing his observations on this singular phenomenon, Sig. A. Preda states that it commences in the cylindrical cells of the thallus, the apical portion of which swells up enormously under the influence of fresh or distilled water, while the basal portion retains nearly its normal diameter, thus giving a somewhat pear-shaped form to the cell. When the cell finally bursts, the cytoplasm contracts, detaches itself from the longitudinal walls, and forms an axile band still attached to the two septa, or to the basal septum if the cell be a terminal one. The chromatophores gradually lose their red pigment, which diffuses itself through the water. The thallus of *Bornetia* appears to possess the power of gradually adapting itself to a less saline or less aerated medium than that which it normally inhabits.

Structure and Reproduction of Compsopogon.‡—Mr. R. Thaxter has examined a species of this rare and peculiar tropical alga from Florida, distinguished by its bluish or violet-green colour, and by the filaments being composed of an axial row of very large cells surrounded by one or more layers of corticating cells—the sole representative of the family Compsopogonaceæ. The cells of the filaments show an active circulation of the protoplasm. Multiplication takes place by aplanospores, which vary greatly in size, and may possibly be of two kinds, mega- and micro-aplanospores; the former are produced singly in the sporange; both kinds are globular, and destitute of cilia. No sexual organs were discovered; but it is possible the micro-aplanospores may be antherozoids. In accordance with our present state of knowledge, the author thinks the safest place for *Compsopogon* is near the Bangiaceæ.

* Wissensch. Meeresunters. herausgegeben in Kiel, iv., Heft 1, pp. 31–62. See Hedwigia, xxxix. (1900) Beibl., p. 88.

† Nuov. Giorn. Bot. Ital., vii. (1900) pp. 209–14 (1 pl.). Cf. this Journal, *ante*, p. 359.

‡ Bot. Gazette, xxix. (1900) pp. 259–66 (1 pl.).

Classification of Diatoms.*—Prof. C. E. Bessey proposes a scheme of classification of the Diatomaceæ founded on that of Schütt, but differing from it in some minor points. He reckons up 72 genera, arranged in 15 tribes.

Chlamydomonas and its Effect on Water Supplies.†—Mr. G. C. Whipple records an instance, in Massachusetts, in which large quantities of *Chlamydomonas pulvisculus*, occurring on the surface of a pond, imparted to the water a distinct unpleasant and oily taste and odour.

Fungi.

Propagation of Fungi.‡—Herr G. Klebs closes his account of the various modes of propagation in certain fungi by an elaborate review of the physiology of the different processes, from which the following may be extracted as among the more important conclusions.

He adopts Sachs' view that one of the main factors is the action of various substances of the nature of ferments. The action of external irritants is classified under three heads, viz.:—(1) Those conditions which, under all circumstances, are essential for the inception of the process of propagation; to these factors he applies Herbst's term "morphogenous irritants." In *Saprolegnia* a deficient supply of nutriment is a morphogenous irritant for the formation of zoospores. (2) Those conditions which, by themselves, cannot induce the formative process, but are the necessary accompaniments of other vital processes; these he terms special conditions. (3) Those conditions which are conducive to propagation as to other vital processes, but which can always be altered, within wide limits, without disadvantage. The most efficient morphogenous irritants are changes in the nutrient material.

Klebs classifies the spores of Fungi, Myxomycetes, and Bacteria under three heads, viz.:—(1) *Kinospores*, those which are the result of a comparatively simple process of division (motile zoospores, conids, pycnidospores); (2) *Paulospores*, those thick-walled resting cells which are formed by a simple process of transformation of cells or nucleated parts of cells, and serve for perpetuation in unfavourable vital conditions (resting-cells of the Mucorineæ, Saprolegnieæ, cysts of the Myxomycetes); (3) *Carpospores*. These, which are the product of a more complicated formative process, often formed in special receptacles (zygotes of the Mucorineæ, spores of the receptacles of the Ustilagineæ and Basidiomycetes, ascospores, &c.).

The relations between growth and propagation are treated under four heads, viz.:—(1) Growth and propagation are vital processes which, in all organisms, depend on different conditions; in the lower organisms it is especially external conditions that determine whether growth or propagation shall take place. (2) So long as the conditions favourable for the growth of the lower organisms are present, propagation does not take place. Conditions favourable for this process are always more or less unfavourable for growth. (3) Growth and propagation are also distinguished by the fact that the limits of the general

* Trans. Amer. Micr. Soc., xxi. (1900) pp. 61–85 (1 pl.).
† Tom. cit., pp. 97–102 (1 pl.).
‡ Pringsheim's Jahrb. f. wiss. Bot., xxxv. (1900) pp. 80–103.

vital conditions—temperature, oxygen, &c.—are narrower for propagation than for growth. Growth may therefore continue when propagation is checked by the too strong or too weak action of one of the conditions. (4) Growth appears to be a preliminary stage for the inception of propagation.

Propagation, therefore, whether sexual or non-sexual, exhibits a physiological opposition to growth. It is a reaction of the organism against conditions of the environment which are unfavourable to growth. The products of sexual reproduction are better adapted for a long period of rest and for the production of a vigorous offspring than those which result from non-sexual propagation.

A very copious bibliography is appended.

Capacity of Fungi to absorb Humin-substances.* — Limiting the term humus to those substances which are compounds of humin, Herr F. Reinitzer confirms in the main Hoppe-Seyler's statement as to their extreme power of withstanding decomposition under ordinary conditions. This however applies only to the power of living organisms to extract carbon from humus. If another source of carbon, e.g. sugar, is present, *Penicillium* has then the power of obtaining its nitrogenous constituents from humus, which must therefore be regarded as a source of nitrogen for soil-organisms; whether also for mycorhiza remains to be determined.

Monoblepharideæ.†—Prof. G. v. Lagerheim publishes a monograph of this small family of fungi, consisting of the two genera *Monoblepharis* and *Diblepharis* g. n., made up of the two species *D. insignis* and *fasciculata*, with the following diagnosis:—Thallus simplex v. ramosus, protoplasmate favoso; zoosporangia zoosporis compluribus, biciliatis, post evacuationem globulum olei continentes; antheridia spermatozoidiis uniciliatis compluribus; oosphæræ singulæ, ex parte contentus oogonii ortæ, periplasmate nullo; oosporæ in oogonio inclusæ maturescentes. Of *Monoblepharis* three new species are described, *M. brachyandra*, *regignens*, and *ovigera*.

The cell-membrane appears to consist of a pectinaceous substance and chitin, with but little cellulose. The cells are multinucleate. The formation of zoospores takes place without any previous division of the nucleus. As soon as the antherids are formed they contain as many nuclei as there are subsequently antherozoids. The oogone contains only a single nucleus. After impregnation the nuclei do not coalesce immediately, but remain for a time lying side by side; complete coalescence takes place only after the warts make their appearance on the wall of the oospore. Gemmæ were observed on *M. brachyandra*.

The Monoblepharideæ are probably most nearly related to the Saprolegniaceæ; they also display resemblances to the Œdogoniaceæ and Coleochætaceæ among Algæ.

Fertilisation of Albugo candida.‡—The following results have been obtained by Prof. B. M. Davis.

Communication between the oogone and the antherid is established

* Bot. Ztg., lviii. (1900) 1te Abt., pp. 59–73.
† Bih. k. Svensk. Vetensk.-Akad. Handl., xxv. (1899) 42 pp., 2 pls., and 2 figs.
‡ Bot. Gazette xxix. (1900) pp. 297–311 (1 pl.). Cf. this Journal, *ante*, p. 92.

by a papilla from the former, which works its way through the cellulose walls to the antherid. The differentiation of the protoplasm is associated with the appearance of an organised spherical protoplasmic body in the centre of the oogone, the "cœnocentrum." A conspicuous stage in oogenesis is that called "zonation," when the nuclei, usually in mitosis, lie at or near the inner boundary of the periplasm, and the cœnocentrum is very prominent in the centre of the ooplasm. The oosphere is organised after the stage of zonation, when one of the nuclei from near the periphery returns to the interior of the protoplasm, and takes a position close to the cœnocentrum.

The oosphere of *Albugo candida* is usually (perhaps always) uninucleate. At the time of zonation the tip of the antheridial tube is very near, if not directly applied, to the ooplasm. As it penetrates the oosphere a nucleus slips down into the swollen end whose surrounding wall is later dissolved, and the sperm-nucleus is then introduced into the ooplasm surrounded by a quantity of dense cytoplasm. The sperm-nucleus approaches the female nucleus, and slowly fuses with it in close proximity to the cœnocentrum. The cœnocentrum is not a permanent structure in the protoplasm, but becomes gradually disorganised.

Nuclear Phenomena in the Ustilagineæ.*—Prof. R. A. Harper has carefully investigated the cell-fusions which occur in *Ustilago antherarum*, *Scabiosæ*, *Maydis*, and *carbo*, and has come to the conclusion that they are not of a sexual nature. In cultures 2 or 3 days old, when the supply of nutriment is deficient, two conids lying side by side put out protuberances which fuse at the apex, the protoplasm of the two cells coalescing. This is not followed by any fusion of the nuclei or nuclear substance. It is always accompanied by an increase in volume of the cells and of the amount of protoplasm contained in them. A similar fusion may also take place between the two basal cells of a 3-celled promycele. The apical cell then, as a rule, degenerates, or fuses with an adjacent single sporid. The multiplication of fused sporids is effected by direct budding, or by a 2–3-celled germ-tube. The author compares this process with similar ones in other Fungi and in Algæ, where there is a distinct non-sexual fusion of the protoplasm of different cells. Its purposes appear to be an increase of the vegetative substance, a more equable distribution of nutrient materials, and a greater power of resistance to unfavourable vital conditions.

Haustoria of the Erysipheæ.†—Mr. Grant Smith has followed out the development of the haustoria in several species of Erysipheæ, especially in *Erysiphe communis*, parasitic on *Geranium maculatum*. The absorbing organ consists of a slender proximal portion, the neck, penetrating the epidermal wall of the cell, within which it enlarges into a vesicular distal portion with a thin wall. The vesicle is filled with a delicate spongy protoplasm. The mature haustorium always contains one nucleus. It is almost always surrounded by a thick sheath-like layer, which does not belong to the protoplasm of the host-cell, as de Bary supposed, but consists of disintegrated cellulose from the cellulose ingrowth through which the haustorium has made its way. Slight

* Trans. Wisconsin Acad. Sci., xii. pp. 475–98. See Bot. Centralbl., lxxxiii. 1900) p. 112.
† Bot. Gazette, xxix. (1900) pp. 153–84 (2 pls.).

differences are found in the structure of the haustorium in *Erysiphe graminis*, parasitic on *Poa pratensis*, in which it is much branched; in *Uncinula Salicis* on *Salix discolor*; and in species of *Phyllactinia*, parasitic on *Xanthoxylon*.

Proteolysis in Aspergillus niger.*—Dr. G. Malfitano has continued his researches on the diastase produced by this fungus, which he now calls a protease. He calls attention to the remarkable resemblance between its properties and those of papayin and of the proteolytic enzyme of malt. It acts on gelatin, on the nucleo-albumins, on globulins, and on albuminates; but has no action on albumin itself; the white of egg is never digested by it. This property distinguishes the protease of *Aspergillus* from pepsin; from papayin it differs only in a greater sensitiveness to the injurious action of the alkaline phosphates. It is very distinct from pancreatin, which acts in the presence of alkaline phosphates, and which does not attack coagulated albumin.

Hydrolysation of Raffinose by Penicillium glaucum.†—As the result of a long series of experiments, H. Gillot states that, in a mineral acid solution, *Penicillium glaucum* secretes a zymase capable of inverting raffinose. This is shown by an increase in the acidity of the culture-medium due to the production of oxalic and succinic acids. In a pure 2 per cent. solution of raffinose the *Penicillium* also induces inversion. When the fungus has reached a certain degree of development, the alkalinisation of the medium does not prevent the secretion of the inverting zymase; it becomes gradually less alkaline, and finally acid, from the production of the acids named. Of the alkalies employed—soda, potassa, and ammonia—soda is the least injurious to the fungus.

New Parasite of Amœbæ.‡—In addition to *Nucleophaga*, M. P. A. Dangeard finds, on a species of *Amœba*, a different parasite, an aquatic filamentous fungus, the systematic position of which it is at present difficult to determine. He calls it provisionally *Rhizoblepharis Amœbæ* sp. n.

Parasitic Fungi.—Mr. J. C. Arthur § identifies the following æcidial and teleutospore forms of Uredineæ:—*Puccinia Convolvuli* and *Æcidium Calystegiæ*; *P. Phragmitis* and *Æ. rubellum*; *P. americana* and *Æ. Pentstemonis*; *P. Windsoriæ* and *Æ. Pteleæ*; *P. Vilfæ* and *Æ. verbenicola*; *P. peridermiospora* and *Æ. Fraxini*; *P. Caricis* and *Æ. Urticæ*; *P. angustata* and *Æ. Lycopi*; *Uromyces Euphorbiæ* and *Æ. Euphorbiæ*; *Phragmidium speciosum* and *Cæoma miniata*; *Triphragmium Ulmariæ* and *C. Ulmariæ*.

Under the name *Cordyceps Dovei* sp. n., Mr. L. Rodway || describes a new species of this genus, parasitic on a Coleopterous larva in Tasmania.

A new parasitic fungus, *Cylindrosporium Komarowi*, belonging to the Melanconieæ, has been found by Herr A. v. Jaczewski,¶ on *Polygonatum humile*, in Manchuria.

* Ann. Inst. Pasteur, xiv. (1900) pp. 420–48. Cf. this Journal, *ante*, p. 494.
† Bull. Acad. r. Belgique (Cl. d. Sciences), 1900, pp. 99–127.
‡ Le Botaniste (Dangeard) vii. (1900) pp. 85–7. Cf. this Journal, 1896, p. 446.
§ Bot. Gazette, xxix. (1900) pp. 268–76.
|| Proc. R. Soc. Tasmania, 1898–99 (1900) pp. 100–2 (1 pl.).
¶ Hedwigia, xxxix. (1900) Beibl., p. 81 (1 fig.).

Herr P. Dietel * has found the teleutospore form of *Uredo Polypodii* on *Cystopteris fragilis*, and regards both this species and *U. Aspidiotus* as belonging to *Pucciniastrum* rather than to *Melampsorella*.

Herr R. Stäger † enumerates the species of grass which can be infected by the following kinds of ergot,—*Claviceps purpurea* the ergot of rye, *C. microcephala* the ergot of *Phragmites communis*, and *C. Wilsoni* the ergot of *Glyceria fluitans*.

Mr. F. H. Blodgett ‡ records the occurrence of *Darluca filum*, parasitic upon *Uromyces caryophyllinus*, the rust of carnations.

Dr. C. Massalongo § describes a new disease of *Aucuba japonica*, caused by the attacks on the leaves of a hitherto undescribed parasitic fungus, *Ramularia Aucubæ* sp. n.

Two destructive diseases of the red cedar (*Juniperus virginiana*) are described by Mr. H. von Schrenk,‖ one caused by *Polyporus carneus*, the other by a hitherto undescribed parasitic fungus, *Polyporus juniperinus* sp. n.

Trichurus spiralis and Stysanus stemonites.¶—Mr. H. Hasselbring has established the close affinity between these two forms of Hyphomycetous fungi. In both the spores germinate in a peculiar manner by means of a stout primary germ-tube or proembryo. The mycele forms a small compact colony, from which there arises a conidial fructification very different from the normal fructification, which consists of a bundle of hyphæ bearing basids and chains of conids at its summit. An amended diagnosis is given of the genus *Trichurus*, which includes also *T. cylindricus*.

Botrytis and Sclerotinia.**—From a careful examination, in natural conditions and under culture, of *Botrytis cinerea* and *Sclerotinia Libertiana*, Mr. Ralph E. Smith comes to the conclusion that, though nearly allied, these two species are not genetically connected with one another. The latter species may grow either as a parasite or as a saprophyte, and has no conidial stage of the botrytis type; sclerotes are produced abundantly, and the peziza form is easily obtained. *Botrytis cinerea* is much less often parasitic; and it is only in this mode of life that it exhibits any close resemblance to *Sclerotinia Libertiana*. Its sclerotes are highly characteristic, but no peziza form has at present been produced from them. A detailed account is given of the diseases caused by or attributed to the two fungi.

Anthracnose of the Apple.††—Mr. A. B. Cordley has investigated the cause of this disease of apple-trees, commonly known as "canker," which is very destructive to the apple-trees in the western states of America, and finds it to be quite distinct from *Sphæropsis malorum*, which produces black-rot. The producing fungus, which is parasitic on the

* Op. cit., xxxviii. (1899) Beibl., p. 259.
† S.B. Bot. Inst. Bern. See Bot. Centralbl., lxxxiiii. (1900) p. 145.
‡ Bull. Torrey Bot. Club, xxvii. (1900) pp. 289–90 (1 fig.).
§ Bull. Soc. Bot. Ital., 1900, pp. 166–7.
‖ Bull. No. 21 U.S. Dptmt. Agric. (Div. Veg. Phys. and Path.) 1900, 22 pp., 7 pls. and 3 figs.
¶ Bot. Gazette, xxix. (1900) pp. 312–22 (2 pls.).
** Tom. cit., pp. 369–407 (2 pls. and 3 figs.).
†† Op. cit., xxx. (1900) pp. 48–58 (12 figs.).

cortex of branches, is described as a new species, under the name *Glœosporium malicorticis.*

Canker of the Coffee.*—Herr A. Zimmermann attributes the disease of the coffee-tree known in Java as canker, to the attacks of a hitherto undescribed fungus, *Rostrella Coffeæ* g. et sp. n. No diagnosis of the genus is given, but it belongs to the Ascomycetes. *R. Coffeæ* is a very characteristic wound-parasite [? saprophyte].

Bactridium flavum.†—M. P. A. Dangeard describes the structure and the protoplasmic connections in this rare fungus, found on rotten wood, belonging to a genus of Hyphomycetes distinguished by its pluriseptate conids. In the mycele each of the very elongated cells contains a number (about 10, or even as many as 20) of nuclei; adjoining filaments frequently anastomose with one another; the cytoplasm exhibits a remarkable granular structure. The cells of the thallus communicate with one another by a perforation which occupies the centre of each transverse septum; but this connection is probably only transitory. The conids are the swollen extremities of mycelial filaments, and are 150–190 μ long by 30–35 μ broad; each consists of from 4 to 6 cells, which communicate with one another by protoplasmic threads like those of the thallus. In some of the conids the author finds special spherical bodies resembling those already known in the basids of the Polyporeæ, the asci of the Pezizeæ, and the oospheres of the Peronosporeæ and Saprolegniaceæ. They do not appear to have the functions of centrospheres, and the author proposes for them the term *cœnospheres.* M. Dangeard regards *Bactridium flavum* as being probably the non-sexual state of an ascomycetous fungus. It is very subject to deformation from the attacks of a parasitic fungus, *Oidium Bactridii* sp. n.

Mycophthorous Fungus.‡—According to Herr W. Ruhland, *Hypocrea fungicola* is a true mycophthorous fungus in which the habit has become hereditary. It vegetates freely on *Polyporus betulinus*, consuming first its protoplasm and then its cell-membrane, without any direct union of the hyphæ of the two fungi. The author further states that there are 16, not 8, ascospores formed in the asci by free-cell-formation.

Origin of the Basidiomycetes.§—Starting from the discovery that *Stilbum vulgare*, hitherto regarded as a typical Hyphomycete, is a true Protobasidiomycete, Mr. G. Massee has examined other species of *Stilbum*, some of which are known to be the conidial phases of species of *Sphærostilbe*, while others are not known to be connected genetically with any higher form. He finds that the conidial conditions of *Sphærostilbe microspora* and *gracilipes* are identical in structure with *Stilbum vulgare*, in other words are true Protobasidiomycetes. Hence the conidial condition of an ascigerous fungus may be a true Protobasidiomycete. There is no evidence that the Autobasidiomycetes are descended from the Protobasidiomycetes. The former have probably been derived by gradual modification of the spore-bearing organs or basids of conidial forms of certain ascigerous fungi.

* Med. uit s'Lands Plant., xxxvii. (1900) (Batavia). See Bot. Centralbl., lxxxiii. (1900) p. 88.
† Le Botaniste (Dangeard) vii. (1900) pp. 33–46 (1 pl.).
‡ Abhandl. Bot. Ver. Brandenburg, xlii. (1900) pp. 53–64 (1 pl.). See Hedwigia, xxxix. (1900) Beibl., p. 93.
§ Journ. Linn. Soc., xxxiv. (1900) pp. 438–48 (2 pls.).

Meaning of Mycorhiza.* — Herr E. Stahl discusses, with great wealth of detail, the vital phenomena which accompany respectively the presence and the absence of ectotrophic or endotrophic mycorhiza, enumerating all the classes of plants in which it is known to exist. While there are some natural families in which the presence of mycorhiza is at present entirely unknown—Cruciferæ, Cyperaceæ, Polypodiaceæ—the author considers it probable that the greater number of the higher plants are capable, at least under certain circumstances, of entering into this symbiosis with fungi.

The explanation given by the author of the occurrence in the same forest, of plants which do, and plants which do not obtain their nourishment in this way, is that the difference is accompanied by a difference in their facility for absorbing saline food-material. Plants with a powerful transpiration current can dispense with the formation of mycorhiza; while those in which the transpiration is only feeble can obtain a sufficient supply only with the assistance of the symbiotic fungus. Indications of strong transpiration are afforded by the excretion of drops of water, rapid withering when cut, and the abundant formation of starch in leaves exposed to the light; feeble transpiration, on the other hand, by the absence of exuded water and the abundant formation of sugar. Autotrophic plants furnish, as a rule, a larger proportion of ash than mycotrophic.

A very interesting comparison is drawn between mycotrophic, parasitic, and carnivorous plants; all these phenomena being devices for attaining the same end.

Protophyta.

α. Schizophyceæ.

Glœocapsa alpina.†—Herr F. Brand gives a detailed account of the structure and life-history of this rare Alpine alga. The following are given as new results. The cell has only a very thin membrane, not usually discernible, and not separable from the cell-contents. The gelatinous envelope which surrounds the cell is covered by a cuticle. The size of the cell varies much more than has hitherto been supposed. The cell-contents appear to be sometimes homogeneous, sometimes granular; the colour is bluish-green varying greatly in its tint. The gelatinous envelope with its cuticle corresponds to the sheath of the filamentous Cyanophyceæ; it is not formed by swelling of the cell-membrane, but is excreted from the cell. Under certain conditions it becomes stiff and thin. In the vegetative condition the colony has only a single general cuticle, which never encloses more than two complete generations of daughter-colonies. The external appearance of the organism varies so greatly in many respects that all the blue-violet species hitherto described, and some also of the colourless species, must be regarded as forms of *G. alpina*.

Besides the coloured and the colourless states hitherto known, *Glœocapsa alpina* occurs also in three others:—(1) the dry state, an imperfect resting condition, with very thin dry envelope, and usually smaller cells and colonies; (2) the persistent state, with dark red or brown-violet

* Pringsheim's Jahrb. f. wiss. Bot., xxxiv. (1900) pp. 539–668 (2 figs.).

† Bot. Centralbl., lxxxiii. (1900) pp. 224–36, 280–6, 309–13 (9 figs.).

gelatinous envelope, and thick clear cuticle, during which a remarkable multiplication of cells takes place, comparable to the formation of auxospores in diatoms; (3) the disintegrated condition (*status solutus*), an *Aphanocapsa*-like condition, into which all the other states may pass. The remarkable roughness, or formation of warts and spines on the periphery of the cells, is no typical structure, but occurs only in certain individuals.

β. Schizomycetes.

Structure and Development of Bacteria.* — Prof. F. Vejdovský found in a species of *Gammarus* large numbers of a bacterium which from its size formed a suitable object for examining the structure and development of these minute organisms. The parasite existed in large numbers in the lymph, and also occurred in the fat cells, and sometimes in leucocytes. The single adult rodlet attains a length of 9–10 μ, is 2–2·5 μ broad, and its ends are more or less rounded. Many of the rodlets are somewhat narrower about the centre than at the ends, which therefore have a slightly bulbous appearance. A well defined sheath or investing membrane contains a protoplasmic juice and a centrally located nucleus. In the adult forms vacuoles, usually one at each end of the rodlet, are visible, but in the younger forms or germs these are wanting. The young microbe or germ is spheroidal and nucleated, and exists in the nephridial fat cells as well as in the lymph. The cytoplasm of the fat cells is dilated into cysts distended with young microbes. The smallest germ observed measured 4 μ in diameter. As they grow they lose their spheroidal shape, become elongated and cylindrical, and possessed of vacuoles. The observations were made from films stained with hæmatoxylin. and also with magnesia-picrocarmine and contrast-stained with bleu de Lyon. The objects depicted in the fat cells and leucocyte have little resemblance to an ordinary bacterium. Pure cultures and infection experiments are not alluded to.

Influence of Sunlight on Bacteria.† — Herr L. Kedzior records experiments as to the effect of sunlight on bacteria such as *B. pyocyaneus*, *B. diphtheriæ*, *B. anthracis*, *B. typhosus*, *Vibrio metchnikovi*, and *V. choleræ*. Sunlight exerts a bactericidal action, not only in the presence of oxygen, but also, though to a less extent, in that of hydrogen. The latter is also less marked if the bacteria be suspended in some fluid. After four hours' exposure to sunlight the cholera vibrio became quite harmless, though after two hours it remained sufficiently virulent, when injected intraperitoneally, to kill animals. On garden earth and on drain and sewage water the action of sunlight is but feeble. The colour of the soil exerts inhibitory influences of variable intensity, for while the chemical rays take 15 minutes to penetrate a layer of garden mould 2 mm. thick, they pass through a layer of sand of equal thickness in 5 minutes. After their transit, their bactericidal action is lost.

Flocculation of Bacteria.‡ — Mr. R. Greig Smith records some interesting observations and experiments on the effect of certain salts on bacterial suspensions. From his experiments he infers that bacteria

* Centralbl. Bakt. u. Par., 2[te] Abt., vi. (1900) pp. 577–89 (1 pl.).
† Arch. f. Hygiene, xxvi. (1899) p. 323. See Bot. Centralbl., lxxxiii. (1900) p. 240.
‡ Proc. Linn. Soc. N. S. Wales, xxv. (1900) pp. 65–7.

are not flocculated by salts of potassium, sodium, or ammonium, like particles of suspended inorganic matter, and consequently a pure flocculation or coagulation cannot be employed as a means of separating bacteria from cultures or of causing ultra-microscopical bacteria to cohere into visible aggregates. Salts of lime form a precipitate of calcium phosphate with the phosphoric acid of the medium. Since all ordinary media contain phosphates, and the organisms grown therein always retain traces of phosphoric acid, any substance capable of forming an insoluble phosphate will, when added to bacterial suspensions, cause a precipitate to form, and this by entrapping the bacteria will produce an apparent flocculation of the organisms. Bacteria when grown in ordinary media exhibit different powers of precipitation with calcium salts, *Bac. typhosus* requiring only one-fifth the amount required by *B. coli commune.* Calcium chloride can be employed as a means of distinguishing between these two organisms. The method consists in pipetting 2 ccm. of a two or three days' bouillon culture into a narrow test-tube, and adding 1 ccm. of calcium chloride solution containing 1 grm. crystallised calcium chloride per 100 ccm. The mixture is shaken, and allowed to stand for an hour. At the end of this time *B. typhosus* shows a well defined precipitate, and in an almost clear supernatant fluid several large floccules adhering to the walls of the tube. On the other hand, *B. coli* has an ill defined precipitate and a very turbid supernatant fluid.

Influence of Bacteria on the Decomposition of Bone.* — Prof. J. Stoklasa records experiments on the influence of bacteria on bone decomposition. The species used were *B. megaterium, B. fluorescens liquefaciens, B. proteus vulgaris, B. butyricus, B. mycoides, B. mesentericus vulgatus.* These were cultivated in a medium containing bone-dust, potassium sulphate, magnesium chloride, and iron sulphate, and after an incubation of 20 days the amount of nitrogen and phosphoric acid was determined as amid, diamin, and monamin nitrogen. The results showed that bacteria, especially *B. megaterium, B. mycoides,* and *B. mesentericus vulgaris,* are very effective agents in removing phosphoric acid and nitrogen from bone. The laboratory experiments were confirmed by cultivating oats in a hot-house with different composts and with different bacteria. The composts used were superphosphate, Chili saltpetre, bone meal, bone meal with glucose, and with xylose. The same three bacteria again stood at the head of the list.

Presence of the Members of the Diphtheria Group of Bacilli other than the Klebs-Loeffler Bacillus in Milk.†—Dr. J. W. H. Eyre, who has examined large numbers of samples of milk, states that several groups of bacilli exhibiting segmentation, metachromatism, and clubbed involution forms, are occasionally present in retail milk. The bacilli of these groups agree in resembling *Bacillus diphtheriæ* to some extent, but are capable of being differentiated from it and also from each other. They arrange themselves according to their colour-production into three well-defined groups which are characterised by the coloration of the colonies themselves in groups. In group 1 the colony is yellow, and in

* Centralbl. Bakt. u. Par., 2te Abt., vi. (1900) pp. 526–35, 554–60 (9 pls.).
† Brit. Med. Journ., 1900, ii. pp. 426–7.

group 3 white, without the nutrient medium being affected; while in group 2 the medium assumes a pinkish hue, though the colonies are but slightly chromogenic. None of these groups are pathogenic. From the foregoing the author concludes that it is practically impossible to diagnose the presence of the true *B. diphtheriæ* in a milk sample by microscopical tests alone, and that the identity of the Klebs-Loeffler bacillus can only be established by careful consideration of its biological and pathogenic characters.

Relations of Symptomatic Anthrax and the Septic Vibrio. *—MM. E. Leclainche and H. Vallée, after alluding to the close biological relations of the bacterium of symptomatic anthrax and the septic vibrio, state that it is possible to distinguish the two microbes; for while the septic vibrio produces in the serum of the specific œdema and in the peritoneal sac of guinea-pigs long forms, these are constantly absent in the case of symptomatic anthrax. The same methods for immunising against anthrax are applicable to the vibrio, and the immunising serums are in both cases rigorously specific. The same holds good for agglutination by these serums. Animals vaccinated against anthrax are not immunised against the vibrio; and reciprocally vaccination against the septicæmia does not protect against anthrax.

Filament Formation by Plague Bacilli.†—Dr. T. Skschivan calls attention to the formation of filaments by plague bacteria when cultivated on agar. The tendency to form filaments in some samples, especially when cultivated on suitable media, is so great as to deserve the term bacterial mycele. In some filaments lateral branchings were noticed, and this tendency was not confined to the longer forms, but was also manifested in the shorter ones, which then might assume a distinct Y-shape. The filaments were produced most copiously on glycerin-agar. Cultures on NaCl agar containing fish-muscle were remarkable for involution forms or heteromorphism.

New Pathogenic Streptococcus.‡—Dr. E. Libman isolated from the stools of a case of enteritis a streptococcus which produced a surface growth on glucose-agar and lactose-agar, the medium becoming milky-white. The whiteness appeared to be due to the formation of acid by which the albumen of the medium was precipitated. Saccharose-agar did not become white. The streptococcus was pathogenic to mice, and caused acute inflammation of the intestinal canal.

Other pathogenic organisms were found to be able to precipitate the albumen from human blood-serum in the presence of grape-sugar. The growth of most species is much stronger on glucose agar to which a small quantity of serum is added than on the ordinary serum-agar.

Diplococcus of Rheumatic Fever.§—Dr. F. J. Poynton and Dr. A. Paine isolated from cases of rheumatic fever a diplococcus which was cultivated in bouillon and milk, acidified with lactic acid, and then transferred to blood-agar. Pure cultures injected into rabbits produced endocarditis, pericarditis, polyarthritis, and chorea. From the lesions in the animals the diplococcus was regained. The coccus was stained with carbol-thionin.

* Ann. Inst. Pasteur, xiv. (1900) pp. 390–6.
† Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900) pp. 289–92 (4 figs.).
‡ Tom. cit., pp. 293–4. § Brit. Med. Journ., 1900, ii. pp. 1188–9.

Morphology of Bacillus Mallei.* — Prof. B. Galli-Valerio, from a further series of observations on the morphological appearances found in cultures of *Bacillus Mallei*, concludes that the filamentous and club-shaped forms are not involution forms produced in old cultures, for he has observed them both in very young cultures and in hanging drops. Indeed they may be quite rare in old cultures. On boiled young carrot they are especially frequent. The author confirms Shattock's statement that white mice are not refractory to *B. Mallei*, and has been able to recover from the lesions the short, the filamentous, and the club-shaped forms.

Bacteriolysis of Anthrax.† — M. G. Malfitano remarks that living protoplasm is able to elaborate diastases which are capable of destroying the cell which has given rise to them. The degeneration and dissolution of anthrax as observed in old cultures and unsuitable media are due to the action of diastases. This spontaneous bacteriolysis or autobacteriolysis is in constant relation to the presence of proteolytic diastase in the cell, and there is a close relation between the quantity of protease produced by the bacteria and the autobacteriolysis undergone by the cells. Protease, like other bacterial diastases, has its optimum reaction near the neutral point. What the internal mechanism is which brings this destructive agency into action is as yet unknown, though certain facts bearing on the question are mentioned. These are the condition of the medium and the sudden arrest of protoplasmic life by certain antiseptics, always provided that these agencies do not annul the action of the diastase. The author concludes by referring to similar results obtained by Emmerich and Löw and by Gameleia, and points out that his views are much more simple and probable.

Ætiology of Pulpitis.‡—Dr. O. Sieberth contests the statement of Arkövy § that *Bacillus gangrenæ pulpæ* is the cause of dental gangrene. From an examination of 134 cases he is inclined to assign the cause to streptococci which were constantly present, and not to *B. gangrenæ pulpæ* which was conspicuous by its absence.

Bacillus Pathogenic to Fish.‖ — Mr. R. Greig Smith describes a new bacillus which he designates *Bacillus piscicidus bipolaris*, to indicate its pathogenicity and the bipolar germination of the spores. The bacillus was isolated from fish which came from Lake Illawarra. Its pathogenic action was tested on fish and guinea-pigs. The latter were unaffected, but the fish died. The tissues and organs of the inoculated animals contained large numbers of the bacilli. The bacillus is a rodlet with rounded ends, measuring 0·8 by 2 to 3·6 μ. It grows singly in pairs in short chains and long filaments. It is easily stained. It forms a central spore. It is motile, with usually one polar flagellum.

The organism grows quickly in the usual media at 20° as well as at 37°. In the absence of air the growth is scanty. On gelatin, which is liquefied, the growth is white, the characters of the first two crops differing somewhat from the third and later ones. On agar the colonies

* Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900) pp. 353–9 (26 figs.).
† Comptes Rendus, cxxxi. (1900) pp. 295–8.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900) pp. 302-3.
§ Cf. this Journal, 1898, p. 579.
‖ Proc. Linn. Soc. N. S. Wales, xxv. (1900) pp. 122–30 (2 pls.).

are white and of various shapes. In bouillon a dense white deposit is thrown down. It grows well also on potato or blood-serum, and in milk. The casein in milk cultures is first coagulated and then dissolved. It does not produce gas or form indol. The germination of spores was observed from samples taken from an old agar culture and sown in gelatin. As the spore enlarged it became less and less refractile. "The rod emerged from one of the poles and grew outwards until the protruded end was as long as the spore-case. By this time the distinction between rod and spore had practically disappeared. A protrusion then appeared at the other end of the spore-case, and growth proceeded in two directions. The spore-case was then thrown off, and this was followed by division of the lengthened rod into two parts. The daughter bacillus from the end last to emerge, slowly bent round until it was at an angle of 45° with the other rod, when it suddenly slipped along the side of the latter. Germination occurred in 3½ hours at laboratory temperature (20°); an hour later there were two cells, and in another four bacilli." The affinities of the microbe are then discussed, and the differences between *B. piscicidus bipolaris* and other organisms alluded to.

Bacillus Pathogenic to Carassius auratus.*— Dr. J. Ceresole describes a bacterium which caused an epizootic among specimens of *Carassius auratus* kept in an aquarium. The principal lesion was an ulcer at the back of the head. Bacterioscopic observations showed the presence of a bacillus 2–2·5 μ long by 0·8–0·9 μ broad. It is motile, stains well, and is easily cultivated. It is a potential anaerobe; its optimum temperature is 18° C. The cultures exhale the decomposition odour. At first the growth is white or yellowish, but later on may become red. Gelatin is liquefied. The virulence of the organism rapidly decreases in artificial cultures. Indol is formed in beef-broth cultures. The bacillus is very pathogenic to rabbits as well as to *Carassius auratus*. It is found in large numbers in the blood of these fish dead of the disease. Other fish inoculated with pure cultures were unaffected. From the appearances found the new microbe is designated the bacillus of ulcerative septicæmia of *Carassius auratus*.

Varieties of Pseudodiphtheria Bacilli.†— Dr. D. Gromakowsky states that there are three kinds of pseudodiphtheria bacilli, which are distinguished by their cultural characters and by their growth in bouillon:—(1) is a relatively thick rodlet of variable length, which does not render bouillon turbid. It resembles Loeffler's bacillus in staining by Neisser's method, and in the acid reaction which it developes in bouillon. Its distinguishing characters are its large size and its cultural appearances. (2) is a rodlet, of medium thickness and length, which after 24 hours at 36° C. renders bouillon markedly turbid and causes a copious deposit. Morphologically and culturally it closely resembles Loeffler's bacillus. Its distinguishing feature is the absence of acid reaction in bouillon and a negative Neisser staining. (3) is a short, thin rodlet which causes only slight cloudiness in the medium and a scanty deposit. It has some resemblance in appearance to Loeffler's bacillus.

* Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900) pp. 305–9.
† Tom. cit., pp. 136–43 (3 figs.).

Bacillus variabilis lymphæ vaccinalis.* — Dr. K. Nakanishi has found from further investigation, that *B. variabilis lymphæ vaccinalis* is a constant habitant of the normal skin of men and animals, and therefore has no ætiological relation to vaccinia or variola. The cultures were therefore contaminated with the real pock-microbes, which at present remain unknown.

Mechanism of Agglutination.†—Mr. R. Greig Smith, after alluding to the views of previous observers regarding the mechanism of agglutination, states that it appears to him that agglutination is caused by the formation of a delicate precipitate on the outer surface of the bacteria and in the fluid in which the bacteria are suspended. This precipitate is flocculated or coagulated by the saline constituents of the medium and of the serum. Since the precipitate is invisible to ordinary microscopical observation and the bacteria are visible, an apparent agglutination of the latter only is seen to take place by the action of active sera.

Fischer's Structure and Functions of Bacteria.‡—Prof. A. Fischer's *Lectures on Bacteria* have been translated into English by Mr. A. Coppen Jones, who has performed his task in a most admirable manner. The *Lectures on Bacteria* were intended to serve as an introduction to the subject and to form a concise compendium of the vast literature of the science. The intention of the author has been fully attained; the outlines are drawn with a firm and masterly hand; and though the text amounts to but 168 pages, nothing necessary to a full comprehension of the subject has been omitted. Besides what is generally accepted, the work includes some novelties, such as the author's own classification of bacteria, and also a suggestion that modes of life might serve as a basis for classification. According to this view, Bacteria might be divided into three biological groups,—the prototrophic, metatrophic, and paratrophic. The prototrophic species are those which require little or no organic compounds for their nutrition, e.g. nitrifying bacteria, bacteria of rod-nodules, sulphur and iron bacteria. The metatrophic include the zymogenic, saprogenic, and saprophile bacteria, and cannot live unless they have organic substances (nitrogenous and carbonaceous) at their disposal. The paratrophic exist only in the tissues and vessels of living organisms and are true (essential) parasites. The scope of the work may be more nearly appreciated from a consideration of the chief topics discussed. The Morphology and Taxonomy are first dealt with, after which the author passes on to the Distribution and Origin, the Physiology of the Nutrition and Respiration of Bacteria. Then come the Influence of physical agents, and the Action of chemicals. These are followed by Bacteria and the circulation of nitrogen in nature, and the Circulation of carbon dioxide in nature; the work concluding with three chapters on Bacteria in relation to disease. Appended are some useful and explanatory notes.

NOVY, F. G.—**Laboratory Work in Bacteriology.**
2nd edition, Ann Arbor, Michigan, 1900, 563 pp.
SYMES, J. O.—**Bacteriology of Every-day Practice.** London, 1900, 8vo.

* Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900), pp. 304–5. Cf. this Journal, *ante*, p. 506.

† Proc. Linn. Soc. N. S. Wales, 1900, pp. 75–83. Cf. this Journal, *ante*, p. 501.

‡ Oxford, Clarendon Press, 1900, 168 pp. text, 29 figs. Cf. this Journal, 1898 p. 231.

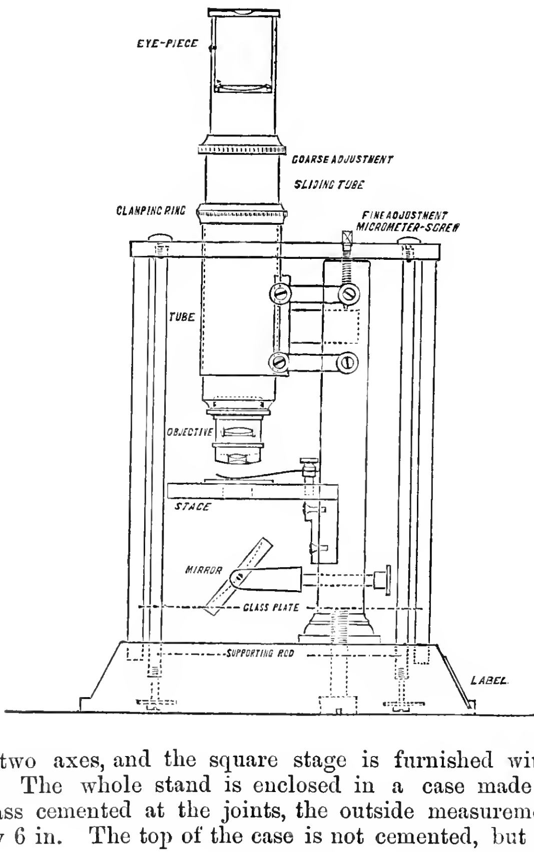
MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

New Exhibition Microscope.†—Figs. 185 and 186 show an arrangement of Microscope permanently set up in the systematic museum of the New York Botanical Gardens. The stand adopted is the Leitz V, the foot being removed and the upright support fastened to a base of hardwood 6 by 6 by 1 in., blackened and with bevelled edges. The mirror

Fig. 185.



swings in two axes, and the square stage is furnished with a wheel diaphragm. The whole stand is enclosed in a case made of sheets of plate-glass cemented at the joints, the outside measurements being $4\frac{3}{4}$ by $4\frac{3}{4}$ by 6 in. The top of the case is not cemented, but is held in

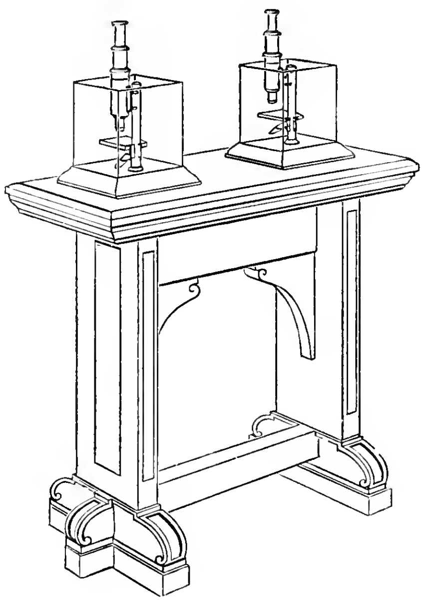
* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Journ. New York Bot. Garden, i. (1900) pp. 139–41 (2 figs.).

its place by four upright rods which pass down through the base and are fastened by nuts, both on the lower side of the base and on the upper side at the top.

The instrument is furnished with fine adjustment only, and the milled head is removed, allowing the top of the case to rest on the head of the support. The square head of the micrometer-screw projects through a small aperture in the plate, and is manipulated by a detachable key kept by an attendant. The upper end of the Microscope body is provided with a clamping-ring which fixes the tube immovably in its place. The ocular is likewise fastened by a set-screw. All joints and openings are

Fig. 186.



sealed with felt in such a manner as to be dust-proof. The instruments are fitted with ocular ii. and objective 3, giving a magnification of 70, but this combination may be changed from time to time. Fig. 185 is a sectional view of the case. The instruments are fastened in pairs to tables of special design (fig. 186), and the objects placed under observation aid in the illustration of exhibits in the cases. Suitable explanations are given by labels placed on the tables at the side of the instrument. The tables are furnished with heavy iron sills to secure stability, and hold the instruments at a height above the floor convenient for the use of the majority of observers.

"London" Microscope.—Figs. 187, 188, represent the "London" Microscope exhibited by Messrs. R. and J. Beck (Ltd.) at the Meeting of the Society on November 21st. There is no special novelty in the construction; it is made on the Continental model; its chief characteristic being its comparatively low price.

Fig. 187.

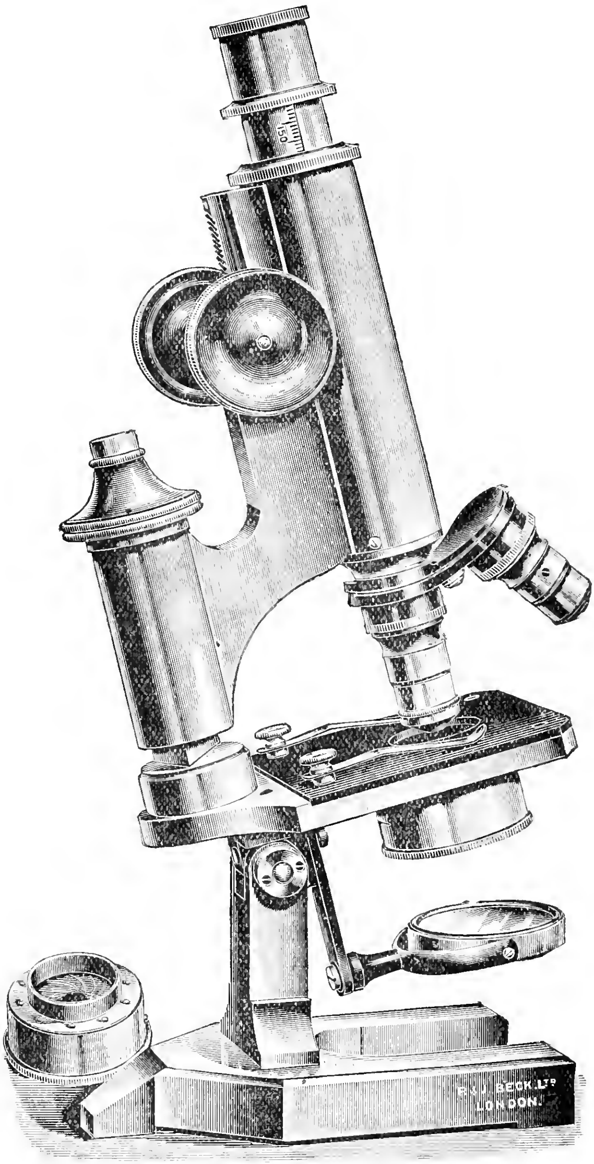
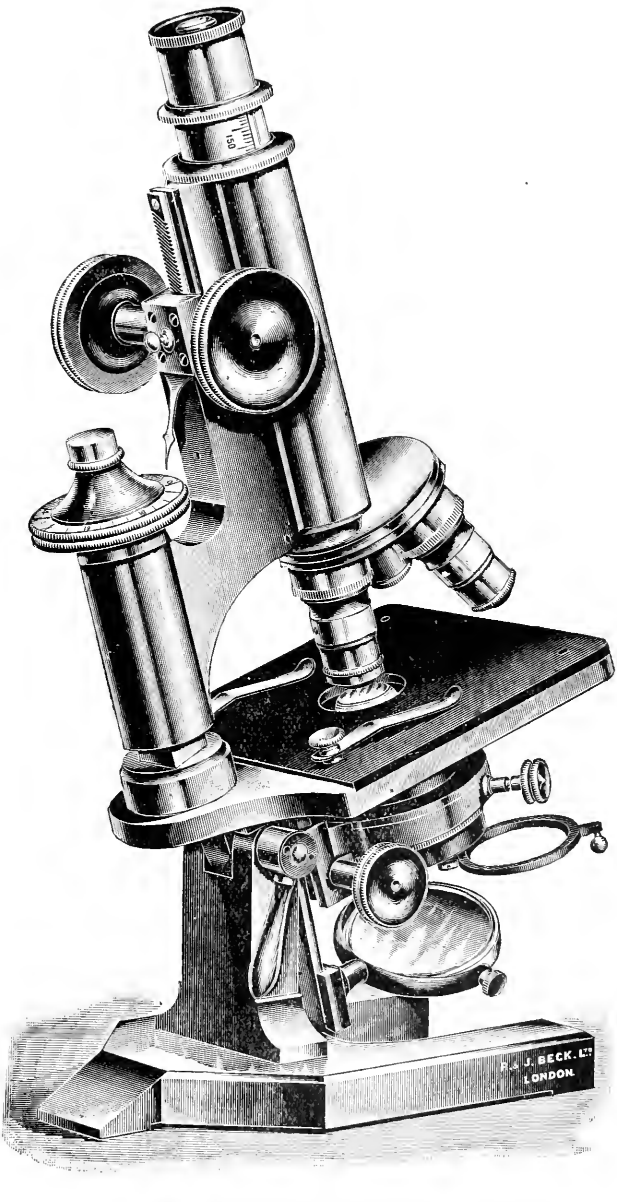


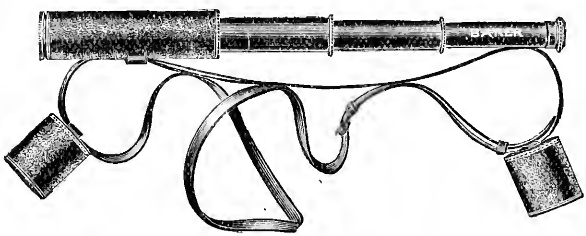
Fig. 188.



Cary's Microscope.*— With regard to this portable Microscope, presented to the Society by Mr. F. Gleadow,† the reference there alluded to has been found by Mr. Parsons in a small book in the Society's Library on "C. Gould's improved pocket compound Microscope," published by Cary, 181 Strand, 1828.

A Naturalist's Telescope.—A telescope capable of focussing objects only a few feet distant has been introduced by Mr. Baker for naturalists and others who require to watch birds, insects, or other animals, and is

Fig. 189.



represented in fig. 189. It is a portable instrument measuring $15\frac{1}{2}$ in. extended and 6 in. when closed; it is fitted with a sling with leather caps. It has an object-glass of 1·2 in. aperture, working at $\frac{f}{8}$, and its power is 15.

Old Microscopes.‡—A collection of twelve old Microscopes has been presented to the New York Botanical Garden Laboratory by Mr. Charles F. Cox. Among these are three Culpepers, a John Cuff, a Wilson's "screwbarrel" by G. Adams, an Ellis' aquatic, a Jones' improved compound, a Chevallier, and a Cary's portable.

(2) Eye-pieces and Objectives.

The Society's Standard Eye-pieces. — The firm of C. Baker, High Holborn, announce, in their Catalogue for 1900, 1901, their adoption of the Society's Standard Eye-pieces.

(3) Illuminating and other Apparatus.

Swift's Substage Condensers. — Figs. 190–192 represent the new substage condensers manufactured by Messrs. Swift. Fig. 190 is the pan-aplanatic condenser with a N.A. of 1·0, back combination clear diameter 0·55, and an aplanatic cone of 0·92. It is a very perfectly corrected combination, and as carefully made as an objective. Fig. 191 is Messrs. Swift's latest form of pan-aplanatic oil-immersion condenser; it has a N.A. of 1·40, and an aplanatic cone of fully 1·30; the back combination has a diameter of 0·65. Fig. 192 represents Swift's apochromatic dry condenser. The combination is made throughout with

* Cf. this Journal, 1898, fig. 82, p. 474. † Cf. this Journal, 1899, p. 673.
‡ Journ. New York Bot. Garden, i. (1900) pp. 68–70.

the new kinds of glass and fluorite. It has a N.A. of 0·95, an aplanatic cone of 0·90; and the back combination a clear diameter of 0·45.

Fig. 190.

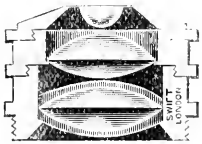


Fig. 191.

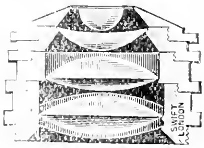
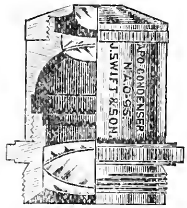
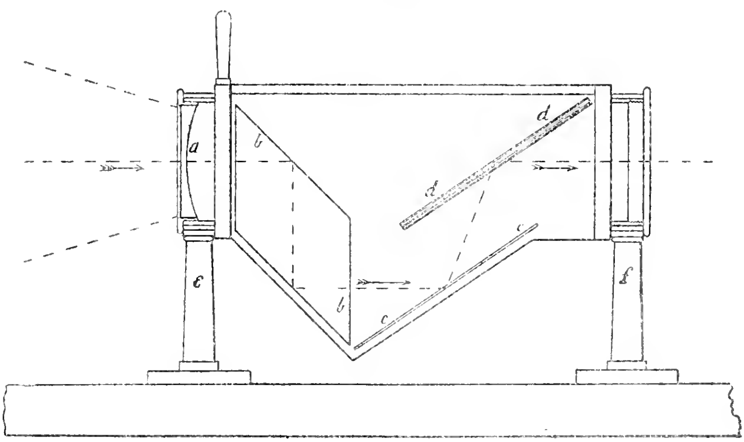


Fig. 192.



Polarised Light without Iceland Spar.* — Mr. J. S. Cheyney has arranged a method of avoiding the use of Iceland spar, thus getting rid of the main item of cost in a large polariscope: yet his beam of light is brilliant, perfectly polarised in any plane, and of any diameter required. Fig. 193 gives a sectional view of his apparatus. The rays from any strong source of light, such as the electric arc or sunlight, are converged by a condenser to the diameter of beam required, and then

Fig. 193.

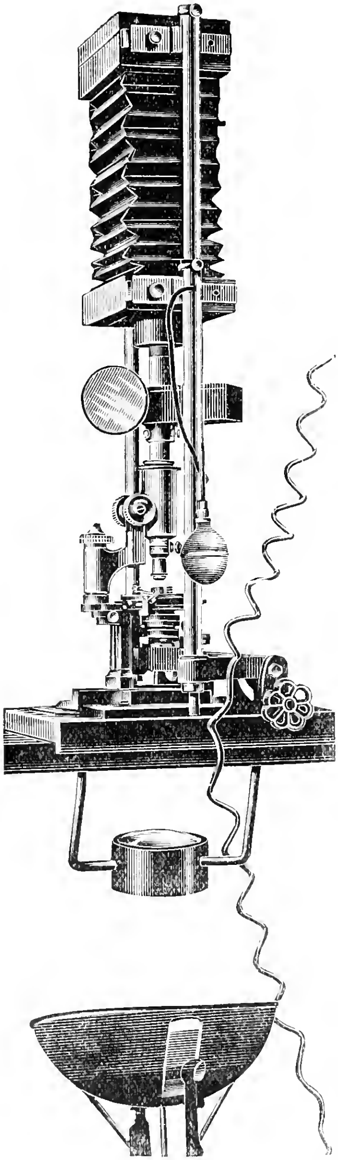


rendered parallel, as usual, by a concave lens *a*. The parallelised beam is received either by a compound totally reflecting prism, with two totally reflecting surfaces, *b*, *b*, or by two right-angled totally reflecting prisms similarly placed; or by two silvered mirrors set at 45° to the direction of the beam. These carry it forward; the two former without loss, the latter with a slight loss from the successive reflections, to impinge upon a silver mirror *c*, *c*, so set as to bring it to the proper angle for complete polarisation by reflection from a bundle of plates of

* Micr. Bull., June 1900, p. 19 (1 fig.).

white glass at *d*, *d*. The beam, now perfectly polarised, may be converged or used parallel as desired. The prisms and mirrors are firmly mounted in a metal frame or box which rotates in the bearings of the supports *e* and *f*, rising from the optical bars of the lantern, and thus, as with the large Nicol or Foucault prism, the plane of polarisation may be turned to any angle with the vertical. This compound polariser is almost exactly the same length as a Nicol of the same clear aperture, and gives very nearly as much light.

Fig. 194.



A very convenient size for the polarisers is a 2-in. aperture; but they may be made 3 or 4 in. in diameter if desired. For experiments where parallel rays only are used, a pair of these compound polarisers give results not inferior to those obtained with the Spottiswoode prisms used by Prof. Tyndall. In general, however, it is better to use as an analyser a Nicol prism of 20 mm. aperture, as recommended by Wright, using the new prism as a polariser only.

(4) Photomicrography.

Scott's Apparatus for Instantaneous Photomicrography.*—Mr. A. C. Scott, of Rhode Island College, has succeeded in obtaining instantaneous photographs of living organisms. A very powerful light is required, and he gets this from an arc light of 2200 watts, which gives about 4000 candle-power. This light is placed at a distance a little greater than the focal length of the condensing lens, so that the intensity of light upon the object and objective is considerably greater than would be the case without the lens. Of course a different position of the lens and light would greatly magnify the intensity of the light, but that is undesirable beyond a certain limit, as the heat would be detrimental to the Microscope objective. The important items of com-

* Journ. App. Micr., March 1900, pp. 797–9 (4 figs.).

bination shutter and view-tube are made to be clamped by means of three thumb-screws to the draw-tube of the Microscope; this apparatus (fig. 194) is fastened on after the ocular has been inserted in the draw-tube. The details will be understood from the following description. Upon a movable brass plate inside a light-tight box, placed just below the camera bellows, is a 90° glass prism mounted in such a way that all of the light which passes through the Microscope is projected upon a piece of ground glass at the end of a cone, which may be lengthened or shortened in order to give correct focus to the object, when it is properly focussed upon the ground glass of the camera directly above the Microscope. Next to the prism is a hole in the brass plate for allowing light to pass from the Microscope directly to the photographic plate, when the prism is moved by means of a spring and pneumatic release; finally there is a sufficient area of the brass plate to cover the opening when exposure has been made. To take a photograph, the microscopic animal is placed in a drop of water upon a suitable glass plate, the light is turned on, and the shutter so set that the object may be focussed upon the ground glass of the cone. The plate-holder is inserted and the dark slide drawn, leaving the plate exposed inside the camera bellows. The movements of the animal are easily seen upon the ground glass, and when the desired position is obtained the shutter is released, the prism moves out of the way, and the light passes to the plate. Although the apparatus has not reached the perfection desired by the inventor, he has had satisfactory results with exposures as short as 1/40 of a second, and considers that 1/100 of a second is attainable with low-power objectives. The magnification has ranged up to 200 diameters.

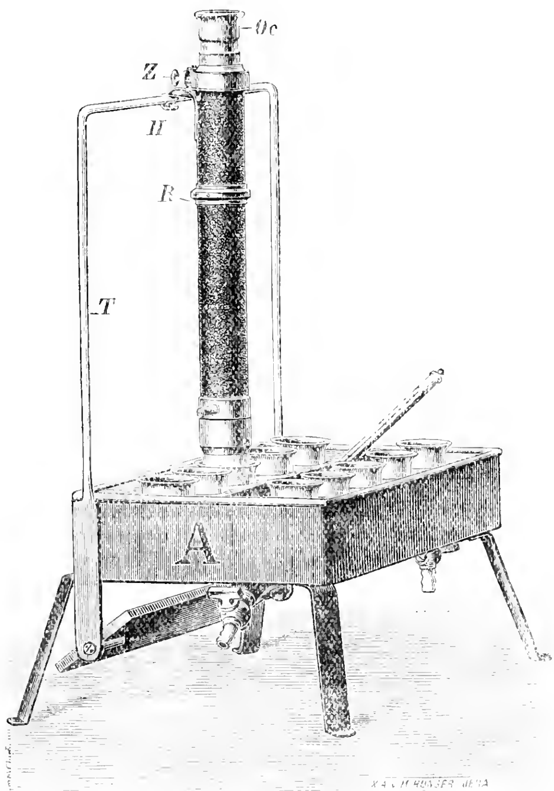
(5) Microscopical Optics and Manipulation.

Zeiss' Immersion Refractometer.—This instrument (figs. 195, 196) is intended for the examination of liquids of low refractive index, such as dilute solutions. The scale value ranges from 1·325 to 1·367. Its nature is that of a special form of Abbe's refractometer, the outer glass prism (which transmits the light to the fluid layer) being made removable, so that the lower end of the instrument may be dipped into the fluid to be examined. At the same time, by means of a special trough. or by careful hand motion, the operator finds a position by which the incident ray suffers total reflection. The advantage is that the refractive index is ascertained with the same ease as its temperature with a thermometer or its specific gravity with a hydrometer. But even more useful is the fact that the removal of the prism causes a much brighter definition of the emergent ray than that from a mere layer of fluid between Abbe's two prisms; a greater telescope magnification becomes therefore possible, as well as a corresponding accuracy of measurement. The hand telescope is of about 10 diameters magnifying power; the prism P is of 63° refractive angle and made of hard glass of refractive index 1·51. The apparatus is so adjusted that at a temperature of 17·5 C., the line for distilled water falls on division 15·0 of the scale. In order to measure the line for any other liquid a micrometer Z is fitted in the ocular. The floor of the trough A is furnished with a suitable window. A pair of Amici prisms at A (fig. 196) neutralise chromatism.

In the case of volatile fluids or others which suffer by exposure to air, the apparatus is modified as shown in fig. 196. A cap M is fitted on to the lower end of the refractometer and then closed by a screw lid D; thus a prism of the given fluid is obtained and the illumination is now through the side of a suitable trough.

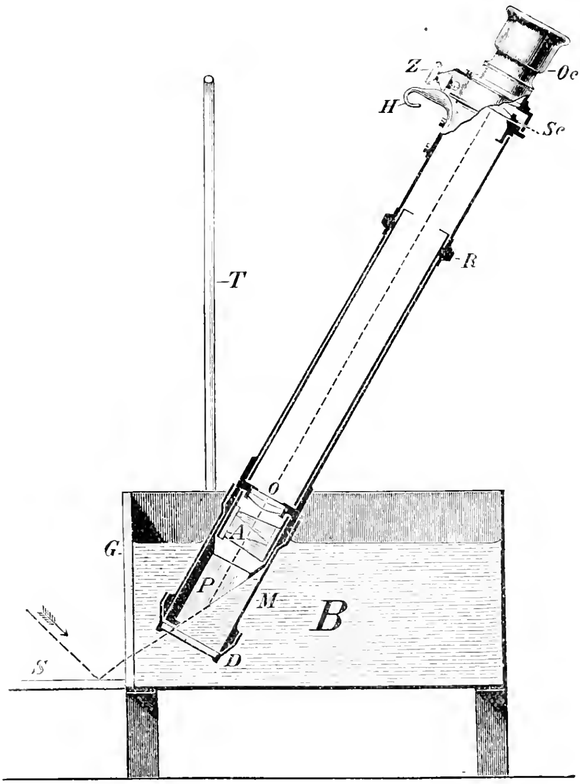
The limit of error in the value of n is $\pm$ 3·7 units of the fifth decimal place.

Fig. 195.



Zeiss' Differential Refractometer.—The object of this instrument, recently reconstructed, is the direct determination of the refractive difference of two fluid prisms of equal refractive angle set up behind one another but sloped in opposite ways. The deviation of such a double prism is directly proportional to the difference of the refractive indices of the two fluids; it is dependent only on the difference of the indices, not on the refractive index itself. The method is practically without limit as regards the magnitude of the index, and is therefore applicable for liquids of high and low index as well as for gases and vapours. The temperature variations, either of the room or of the water-jacket, are practically without influence, since both fluids are equally affected. On the other hand the method offers the advantage of measuring these effects with the greatest accuracy. For measurement it is not necessary that the observation tube should be set in a rigorously invariable position with regard to the double prism. The foregoing peculiarities seem to suggest the especial adaptability of the instrument for many kinds of scientific and technical investigations, such as the determination of

Fig. 196.



alcohol in alcoholic solutions, the degree of concentration of saline solutions, &c.

The instrument is made in two models. Model i. is for ordinary, and Model ii. for more highly accurate (but slower) determinations.

Fig. 197 shows diagrammatically the double prism of Model i. The prism is arranged by placing in a hollow metal cylinder a parallel-sided plane glass plate diagonally, so that it is inclined at 45° to the glass end planes. Thus we have a sort of glass box divided into two independent prismatic chambers by a medial glass diagonal partition inclined at 45° to the two vertical glass ends. The back surface is silvered for reflection. The deviation (really doubled) is read off on a suitable scale (Fig. 200).

Fig. 197.

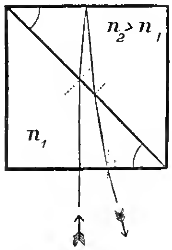
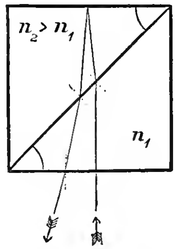


Fig. 198.



In Model ii., the metal cylinder K is divided horizontally by a partition in the axis of the cylinder. There are now two glass plane parallel-sided vertical partitions set at 45° to the end vertical glass

Fig. 199

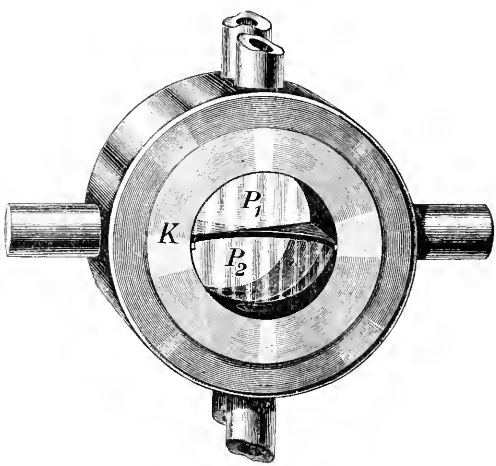
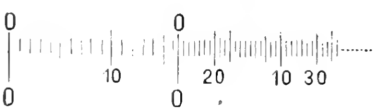


Fig. 200.



planes, but set so as to produce the deviation in opposite directions (figs. 197 and 198). The horizontal partition is cut away so as to place the two front compartments in communication; the two rear compartments are also similarly in communication. The deviation is now the sum of those produced by each double prism, and is in reality the true deviation magnified four times. Fig. 199 is a perspective view of this prism combination.

FIG. 201.

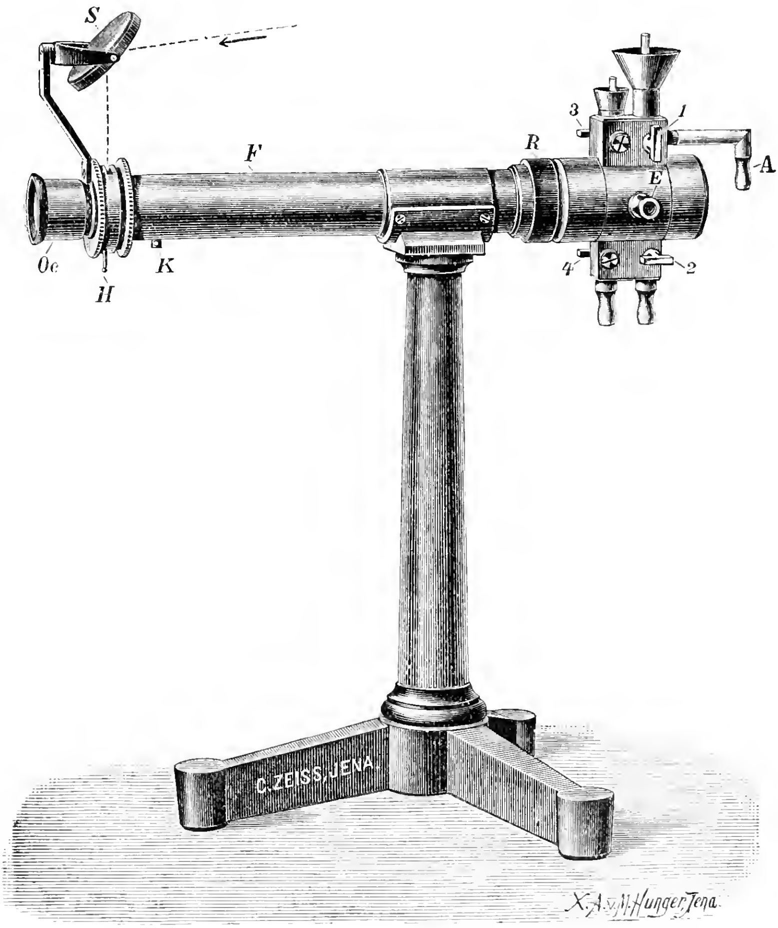


Fig. 201 gives a general view of the instrument. A is a tube for admitting a stream of water of known temperature.

If ϕ be the refractive angle of the prism (ϕ has been made 45°), f the focus of the telescope measured in millimetres, w the value of a scale interval also in millimetres, A the scale reading, then the refractive difference (Δn) is given by

$$\Delta n = \frac{w\,A}{2\,f} \tan \phi \quad \text{(Model i.)}$$

and

$$\Delta n = \frac{w\,A}{4\,f} \tan \phi \quad \text{(Model ii.).}$$

If the optical constants should be: $\phi = 45°$, $f = 204$ mm., and $w = 0 \cdot 2$ mm., then for every uncertainty of $\pm 0 \cdot 1$ of the scale reading, a corresponding uncertainty of $\pm 4 \cdot 9$, or $\pm 2 \cdot 5$ units of the fifth decimal place is produced in the value of Δn.

(6) Miscellaneous.

Thompson's Optical Tables and Data.—These are intended by their compiler, Dr. Silvanus P. Thompson, for the use of opticians, and his name is an ample guarantee for the efficiency of the collection. The tables number 93 in all, and the following list will give an idea of their character. Nos. 1–13, Logarithmic relations of British and metric measures. 14, 15, Velocity of light, and wave-lengths. 16–26, Refractive indices of various glasses, liquids, and minerals. 27–56, Spherometer, optical formulæ, lenses, prisms, combinations. 57–64, Chromatic and spherical aberration. 65–68, Magnification. 69–71, Eye and presbyopia. 72, 73, Refractive indices of fluids used in Microscopy, tube-length of Microscopes. 74, Magnifying power of Microscopes, standard screw. 75, 76, Numerical aperture. 77–80, Resolving power of objectives, depth of vision, and penetrating power. 81, Diffraction. 82, Distance of optical lantern from screen. 83, 84, Reduction and enlargement. 85–93, Eye-sensation to different lights, photometry, colours of thin films. The tables are preceded, wherever necessary, by full explanatory sections, and are accompanied by diagrams. The print is clear, and the book is likely to be an indispensable auxiliary to all interested in practical optics. The publishers are Messrs. E. & F. N. Spon.

Resolution of Striæ.*—Dr. R. H. Ward, of Troy, N.Y., recommends, for the resolution of striæ, &c., the old method of obtaining oblique light by the decentralisation of the substage condenser.

The late Mr. Herbert R. Spencer.—We regret to have to record the death, on February 7th, in the 51st year of his age, of Mr. Herbert R. Spencer, Superintendent of the Spencer Lens Company. Mr. Spencer was born in the little rural village of Canastota, N.Y., where his father, Mr. Charles A. Spencer, had established, in a rude workshop, a manufactory of Microscope objectives of such excellence that they soon attracted the attention of the scientific world, and obtained the highest award from the Paris Exhibition. In 1873, the Spencer workshop at Canastota was destroyed by fire, including nearly all the tools and machinery. In 1875, the firm moved to Geneva, N.Y., where, for about two years, they were connected with the Geneva optical works. Mr. Spencer's father died in 1879. After several changes, in 1890, Mr. Herbert R. Spencer settled in Buffalo, N.Y., in partnership with Mr. Frederick R. Smith; and, in 1895, became Superintendent of the "Spencer Lens Company" of Buffalo. The foregoing particulars have been furnished to us by Dr. John A. Miller, of Niagara University, Buffalo, from a biographical sketch of the late Mr. Spencer, by Dr. George E. Blackman.

SCALES, F. SHILLINGTON—**Microscopy for Beginners.**
[A series of articles.] *Science-Gossip*, July 1900 *et seq.*

* Trans. Amer. Micr. Soc., 1900, p. 111.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Nutrient Media of "Standard" Reaction.† — Dr. J. W. H. Eyre contributes a valuable article on the standardisation of nutrient media by exact titration methods. After a short historical review of the chief methods adopted in the past for obtaining media of definite composition and reaction, the author deals with the indicators, the reaction of the raw materials, neutralising solutions, the optimum reaction, and the preparation of standard media. The procedure for standardising media is as follows:—

Solutions required.— $\frac{n}{10}$ NaOH, accurately standardised. $\frac{n}{1}$ NaOH, accurately standardised; 0·5 p.c. solution of phenolphthalein in 50 p.c. alcohol (in bottle with pipette holding 0·5 ccm. through the cork).

Apparatus required.—25 ccm. burette graduated in tenths of a ccm. 25 ccm. measure or pipette. Bohemian glass flask, fitted as a wash-bottle, filled with distilled water and kept boiling on a tripod stand. Several 60 ccm. Erlenmeyer flasks or conical beakers. Some squares of white blotting-paper.

Method.—The burette is filled with $\frac{n}{10}$ NaOH; 25 ccm. of the fluid medium are measured out into one of the flasks or beakers, the measures rinsed out with a small quantity of boiling distilled water from the wash-bottle and added to the medium already in the flask, then half a cubic centimetre of the phenolphthalein solution run in. To this colourless fluid $\frac{n}{10}$ NaOH is added cautiously from the burette until the end-point is reached, as indicated by the development of a pinkish tinge. A control, a second, or even a third may be titrated, but such is the sharpness of the end-point, that after a little experience with this indicator there will not be a greater difference than 0·1 ccm. of the $\frac{n}{10}$ NaOH between the several estimations, and as a matter of fact, it is almost impossible to overshoot the end-point of even the first titration by more than 0·2 ccm. of the decinormal solution. From these estimations, the amount of $\frac{n}{1}$ NaOH requisite to neutralise the remainder of the medium can be easily calculated; and from this figure is deduced the amount that is necessary to add to the remainder of the medium, in order that it may still remain acid to phenolphthalein to the extent of 1 p.c.; in other words, have a reaction of + 10.

The differences in technique between this method and that recommended by the Americans are:—

(1) The use of 25 ccm. of medium instead of 5 ccm. of medium + 45 ccm. boiling distilled water.

* 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.

† Brit. Med. Journ., 1900, ii. pp. 921–3.

(2) The use of $\frac{n}{10}$ NaOH in the place of $\frac{n}{20}$ NaOH.

(3) Regarding the first appearance of a pinkish tinge as the end-point, instead of producing a purple red by an excess of alkali.

(4) And, as a result of (3), adopting a reaction of + 10 instead of + 15.

(5) And finally, in adding only sufficient $\frac{n}{1}$ NaOH to leave the medium of the desired acidity, rather than adding enough to render the medium neutral to phenolphthalein, and producing the desired reaction by the subsequent addition of $\frac{n}{1}$ HCl.

(2) Preparing Objects.

Method for Paraffin Infiltration.* — Mr. C. M. Thurston has employed the following procedure for paraffin infiltration with great success. The essential feature of the method consists in applying heat to the upper surface of the paraffin and of such an intensity as to melt only the paraffin for a sufficient depth to submerge the tissues to be infiltrated. The object lies on the unmelted paraffin, and recedes from the heat if the heat increase and the paraffin melt deeper.

Glass cups (4 cm. in diameter by 5 cm. deep) are filled with melted paraffin which is allowed to cool. The cups are then placed under a copper plate, which is supported over a flame by a tripod or retort-stand. The flame should be at such a distance and of such intensity as to melt the paraffin 1 or 2 cm. deep.

Aceto-picric and Formalin Fixatives.—M. C. Garnier † states that a mixture of formalin and picric and acetic acids gave good results for fixing gland-tissue. The formula is:—Saturated aqueous solution of picric acid 30 parts, formalin 10 parts, acetic acid 2 parts.

Herren E. O. Haltgren and O. A. Andersson ‡ recommend the following mixture which they have used for the adrenals of cats, rabbits, and dogs:—5 p.c. solution of potassium bichromate 50 grm., absolute alcohol 40 grm., formalin 10 grm.

(3) Cutting, including Imbedding and Microtomes.

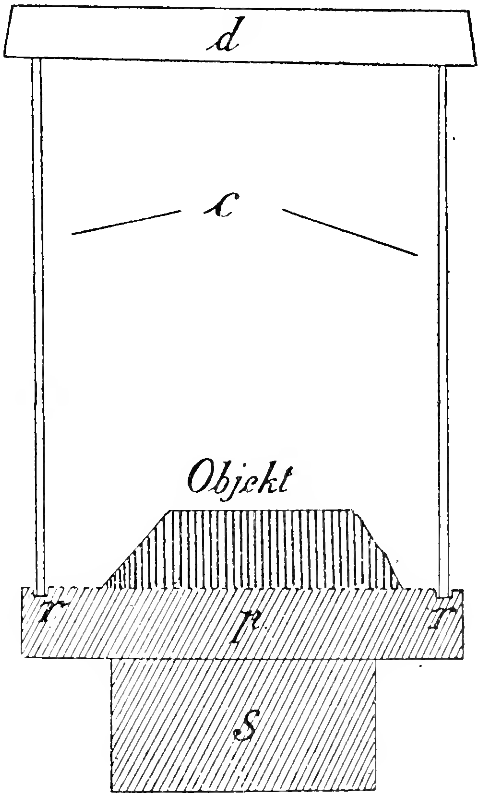
New Method for Imbedding in Celloidin.§ — Mr. E. M. Stepanow has found that the following mixture answers well for imbedding in celloidin:—Dry thin celloidin shavings 1·5 grm., oil of cloves 5 ccm., ether 20 ccm., absolute alcohol added, drop by drop, up to 1 ccm. The dehydrated object is soaked in 4–5 ccm. of this solution in a tightly stoppered bottle for 3–6 hours or more. The stopper is then removed to allow of slow evaporation, and afterwards the object is exposed freely. As the mixture thickens the object clears up. When the mixture is sufficiently thickened and the imbedding completed, the object may be cut by the wet or dry method, or may be transferred to benzol in which

* Journ. Applied Microscopy, iii. (1900) pp. 897–8.
† Journ. Anat. et Physiol., xxxvi. (1900) pp. 22–94.
‡ Skandinav. Arch. f. Physiol., ix. No. 2, p. 5. See Zeitschr. f. wiss. Mikr., xvii. (1900) p. 215.
§ Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 185–91.

the mass gradually hardens and may be preserved for an indefinite period. Objects prepared by the last procedure may be transferred to anise oil, to paraffin, to cedar oil for dry cutting, or to 80 p.c. alcohol for wet cutting.

Method of Orienting and Imbedding in Paraffin.*—Mr. M. T. Denne describes a process which allows of a number of objects being oriented rapidly and fixed in position before infiltration. The imbedding is done in postal or specimen tubes, and the object is cemented to the

Fig. 202



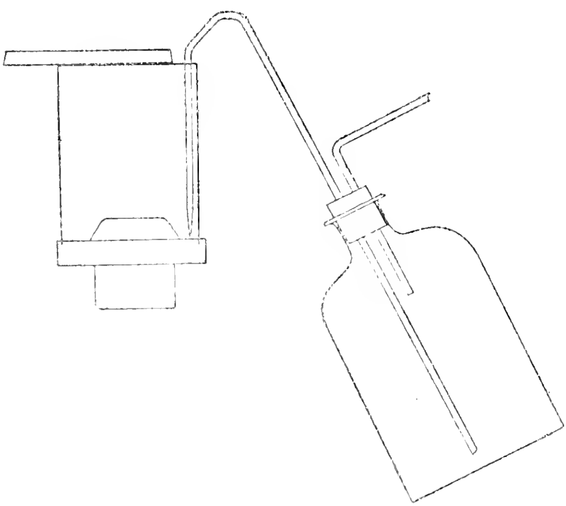
centre of a paper disk rather less in diameter than the bore of the tube, and carried when in the bath by a wire holder. The cement is a solution of celloidin in equal parts of ether and alcohol, to which as much oil of cloves is added as will give the mixture the consistency of thick honey. The holders are made of brass wire, bent twice at right angles, and curved at the upper end to form handles. A thin sheet-brass disk loosely fitting the tube is soldered between the angles. The piece is

* Journ. Applied Microscopy, iii. (1900) pp. 888-90 (1 fig.).

drained on filter paper, placed on a small drop of cement in the centre of a paper disk, and oriented. When in the desired position, some xylol is applied at the joint with a pipette to fix the object. Directions are then given for imbedding in paraffin.

Apparatus for keeping Celloidin Blocks moist and perforated Capsules for Staining Celloidin Sections.*—Dr. J. J. Streiff describes a convenient device for keeping celloidin blocks moist. To the piece S (fig. 202) is fixed the plate *p* by means of four screws. On the plate the object imbedded in celloidin is fixed in the usual way, and a series of ten sections are cut. A glass cylinder, the edge of which is smeared with vaselin, is then placed in the groove *r r* on the plate. The jar thus made is filled with 80 p.c. alcohol and covered with a lid. In this way the object can be kept moist for a long time. The fluid can be withdrawn rapidly by means of the apparatus shown in fig. 203, the working of which is self-evident and does not require description.

Fig. 203.



For staining and washing the sections, the author uses perforated capsules. These have a diameter of 5 cm., and the sides are 3 cm. high. In the bottom are four holes, 2 mm. wide, and in the sides are two holes near the bottom $2\frac{1}{2}$ mm. wide. The capsules are numbered from 1–10. The idea of these perforated capsules is not new, but they deserve mention on account of the trouble saved. The ten capsules are placed in a large pan containing the staining or other fluid, which flows in or out according as the capsules are placed in the pan or lifted out therefrom.

* Arch. f. Mikr. Anat. u. Entwick., lvi. (1900) pp. 949–6 (3 figs.).

(4) Staining and Injecting.

New Staining Mixture.* — Dr. A. Pappenheim recommends the following stain for bone-marrow, gonorrhœal, and other suppurative secretions, and spermatosomata hominis; viz. a mixture of a saturated aqueous solution of two basic pigments, containing 3–4 parts methyl-green and 1–1·5 parts pyronin.

Method for Preparing Neutral Picrocarmin.† — Herr J. W. van Wyhe prepares a neutral picrocarmin by the following simple and rapid method. It is best to start on an old strong carmin solution, composed of 30 grm. carmin dissolved in a mixture of 2 parts of distilled water and 1 part 10 p. c. ammonia. When two years old it is sufficiently ripe. The mixture may, however, be rapidly ripened by boiling 10 grm. carmin with 10 ccm. ammonia and 20 ccm. peroxide of hydrogen. 25 ccm. of the carmin solution are mixed with 100 ccm. of 96 p.c. alcohol and the solution filtered. The precipitate on the filter is washed with 100 ccm. of 96 p.c. alcohol, and dried for 24 hours in a thermostat at 40°–45° C. The ammonia-carmin obtained in this way is completely soluble in aqueous solutions of ammonium picrate. This salt may be purchased, or made as follows:—9 grm. of picric acid are dissolved in 100 ccm. 96 p.c. alcohol, and 15 ccm. ammonia added. The solution is evaporated to dryness in a thermostat at 60°.

The best proportion between ammonia-carmin and ammonia picrate is 0·5 p.c. of the former to 1 p.c. solution of the latter. The solution is invariably alkaline, but by boiling in a water-bath for a quarter of an hour it is rendered neutral. The fluid lost is to be replaced by the addition of distilled water. One per cent. chloral (Hoyer) may be added as antiseptic.

Method for Staining with Neutral Eosin-methylen-blue.‡ — M. E. Laurent first describes how to prepare the neutral stain. One gramme of potassium-eosin and 1 grm. of medicinal methylen-blue are dissolved each in one litre of water. Then to 1000 ccm. of 1 per thousand eosin solution, 882 ccm. of 1 per thousand methylen-blue are added, and the mixture allowed to stand for 24 hours. The mixture is, however, now purchasable. When required for use one part of the mixture and four parts of water are boiled and then cooled down. While still warm the object to be stained is immersed therein for from half an hour to six hours. If any precipitate be found on cover-glass films it is brushed off, and the preparation then treated with xylol before mounting in balsam. Sections are washed in 96 p. c. and then differentiated in absolute alcohol. This step takes from two minutes to some hours. Instead of alcohol, anilin oil and xylol (3–1), or anilin oil and alcohol (1–3) may be used.

Staining the Malaria Parasite.§—Dr. R. Ruge finds that the red-methylen-blue staining (Romanowski-Ziemann) of the malaria parasite

* Biol. Centralbl., xx. (1900) p. 373. See Centralbl. Bakt. u. Par., 1 Abt., xxviii. (1900) p. 403.

† Konink. Akad. van Wetenschappen te Amsterdam, Proc., Feb. 1900. See Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 200–1.

‡ Centralbl. f. Allgem. Pathol. u. pathol. Anat., xi. (1900) pp. 86–87.

§ Zeitschr. f. Hygiene, xxxiii. part 2. See Centralbl. Bakt. u. Par., 1te Abt., xxviii. (1900) pp. 403–4.

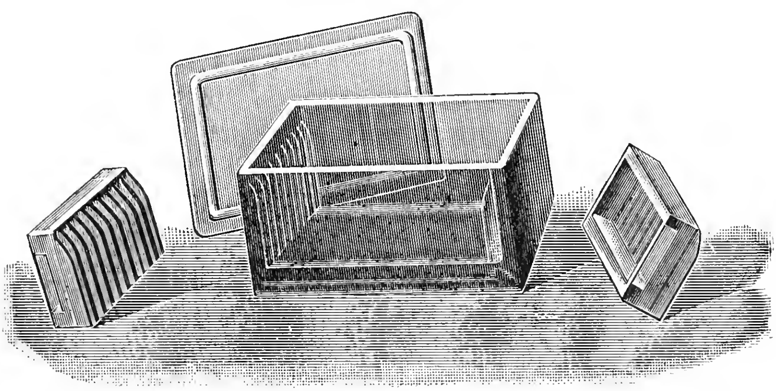
can be easily obtained by simply heating the solution gently several times. Precipitation is avoided by freely diluting the staining solution. By the addition of eosin (in quantity more than half necessary for saturation) the stippling of the red corpuscles affected by parasites was brought out.

New Method for Staining Tubercle Bacilli.* — Dr. R. C. Rosenberger advises a moderately thick film of sputum which is stained in the usual way with phenol-fuchsin. The film is then contrast stained and decolorised by treating it for one or two or more minutes with a mixture of sweet spirits of nitre and methylen-blue, malachite-green, Bismarck brown, and gentian-violet. The preparation is then washed with water. For sections the time required is longer (5 minutes). They are then washed, nearly dried, immersed in carbol-xylol for 2 or 3 minutes, and then mounted in balsam.

The smegma bacillus is decolorised by this method.

Microscopical Injections with Albumen-Ink.†—Dr. O. Grosser recommends a method which appears to be very suitable for injecting freshly killed small animals. White of egg is beaten up and afterwards filtered through dry filter-paper. A stick of indian ink is then rubbed up with the filtrate on a stone or on ground glass. Only a few drops of the fluid are used at a time. The colour should be dark grey and the consistence such that it will pass easily through the canula. The advantages of this medium are that the albumen is coagulated by the fixatives used, and therefore does not drop out or swell up. The best fixatives are Müller's fluid or picric acid in conjunction with formalin.

Fig. 204.



Glass Staining Troughs.‡—Prof. P. Schiefferdecker, after pointing out the defects of stoneware staining troughs, states that glass vessels

* Journ. Applied Microscopy, iii. (1900) pp. 898–900.
† Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 178–81 (1 pl.).
‡ Tom. cit., pp. 167–8 (1 fig.).

of the same shape (fig. 204) give very satisfactory results. The troughs are made for slides of the English size, but other patterns are provided for by means of grooved slips which are supplied with the trough. A tight fitting lid is also supplied if required. The trough may be used for staining, as a bath, and as a moist chamber.

Stain for Neuroglia.* — Dr. Yamagiwa has devised the following modification of Stroebe's method for axis-cylinder, and applies it to the demonstration of neuroglia fibres which are stained red. The tissue is fixed in Müller's fluid and after-hardened in alcohol. Celloidin sections are then stained with a saturated alcoholic solution of eosin for 12 hours or more, and afterwards with saturated aqueous solution of anilin-blue for 4–6 hours. The sections are then differentiated in alcohol made alkaline by the addition of a few drops of 1 p.c. KHO. The sections are then washed in water and afterwards in weak alcohol, after which they are dehydrated in absolute alcohol, cleared up in oleum origanum, and mounted in balsam.

6) Miscellaneous.

Micro-structure of Bronzes.† — Mr. A. E. Outerbridge, jun., concludes, as the results of some experiments with various bronzes under the influence of different etching fluids, as well as of similar etching fluids employed for a longer or shorter time :—

"(1) Variations in treatment of specimens cause variations in the results which may be misleading, and it would, therefore, seem to be desirable that some uniform system should be adopted by all investigators in this field.

"(2) The rate of cooling of a mass of metal affects the micro-structure, so that two specimens of the same ladle of metal are taken :— one from a small casting quickly cooled, the other from a large casting slowly cooled ; or two photomicrographs taken from different portions of the same specimen may show variations in micro-structure that may lead to error.

"It is desirable, therefore, that some uniform size of specimens should be selected by micro-metallurgists as a standard with which to make comparisons."

Mr. Outerbridge is also of opinion that structure is affected by "method and time of etching."

Herr Heyn, of the Royal Micro-metallurgical Department at Charlottenburg (Prussia), agrees in the main with the former statements about the micro-structure varying with the rate of cooling, &c. ; but denies that it is in any way changed by the character of the etching. By using different etching fluids and marking their effects, the observer is able to acquire a knowledge of the various properties peculiar to the different elements of which the structure of a metal is composed, and thus to form a general idea of the micro-structure as a whole. He thinks that the establishment of standard methods would at present, in many cases, tend to misunderstandings.

* Virchow Archiv., clx. (1900) pp. 358–65 (1 pl.).

† Micr. Bull., Feb. 1900, pp. 2, 3; and Journ. Franklin Institute, Jan. and June 1899.

Apparatus for Drawing Objects Natural Size.* — Mr. H. Bausch describes an apparatus (figs. 205, 206) for drawing objects. The optical parts are attached to a horizontal arm supported by a cylinder which sheaths and is freely movable up and down upon an upright post, and which is fixable by a side-screw. The eye-piece consists of a combination of right prisms, and is attached to the horizontal arm opposite the supporting post. Rectangular mirrors, rigidly fixed to each end of the bar,

Fig. 205.

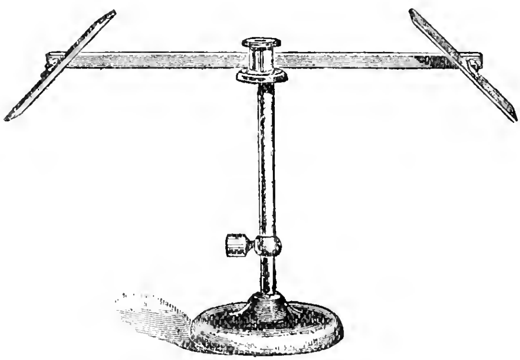
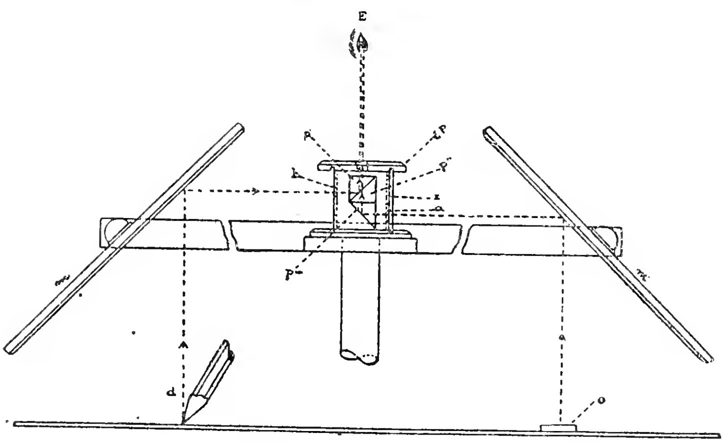


Fig. 206.



are inclined at an angle of 45° to the horizontal. The optical parts of the eye-piece consist of a cube formed by cementing two right prisms together, the facing surfaces, with the exception of a very small area in the centre, being silvered, thus forming a diagonal mirror through the cube, the mirror being pierced at its centre by a small hole. To the lower side of the cube is cemented a third right prism with its diagonal

* Journ. Applied Microscopy, iii. (1900) pp. 891–3 (2 figs.).

surface silvered. When it is desired to make a drawing, the object is placed under one of the mirrors and the paper under the other. An accurate outline is easily traced, and the drawing will be the natural size of the object as long as both object and paper are on the same horizontal plane. Modulating glasses for equalising the illumination of the two sides are supplied with the apparatus.

Modified Sedimentation Method for Demonstrating the Presence of Bacteria.*—Dr. E. Strasburger recommends the addition of two parts alcohol to one part fluid (urine, fæces diluted with water, &c.) when centrifuging for bacteria. This addition lowers the specific gravity of the fluid and facilitates the deposit of bacteria. The device is stated to be specially adapted for tubercle bacilli in stools.

New System of Obtaining Directing Marks on Microscopical Sections for Reconstruction by Wax-plate Modelling.†—In the method described by Prof. J. T. Wilson, the lines of direction are constituted by actual definite strands of organised material imbedded in the substance of the paraffin block itself and in the closest and most intimate relation to the object to be reconstructed. The materials used are the root-bundles of the human cauda equina. These, kept straight by means of a weight, are stained with osmic acid and imbedded in paraffin. For the imbedding a glass base-plate and a pair of imbedding bars are needed. The glass plate should not be more than 2 or 3 mm. thick, and on the centre part of its upper surface should be drawn or engraved a square with sides measuring 2 cm. The outline should be blackened. On the under surface of the plate deeply engraved lines are ruled parallel to two of the sides of the quadrilateral. It is convenient to have these lines at alternating intervals of 1 and 2 mm. The imbedding bars must be rectangular throughout, with plane surfaces, and the length of the arms should correspond to the dimensions of the quadrilateral engraved on the base-plate.

Two pieces of sufficient length are placed parallel to each other on the glass plate and fixed thereto by means of heat. Over these the imbedding chamber is made. The object, oriented in the usual way, is now in immediate apposition with the two black parallel lines, and these lines have a definite relation to the sides of the paraffin block and to the object. The steps of the process are detailed with great care and minuteness; but for these the original should be consulted.

Biochemical Arsenic Reaction.‡—Herr G. Marpmann describes at some length and with approval the biochemical test for arsenic. This test is well adapted for detecting arsenic in small quantities, e.g. hundredth part of a milligram, and in organic solutions. The most convenient method is to inoculate sterilised bread-pap with a pure culture of Penicillium, and moisten with the suspected fluid. A garlicky odour arises in from 24 to 48 hours if arsenic be present. Selenium, tellurium, and phosphorus give off characteristic odours with some resemblance to garlic, but with a little practice and a normal nose the peculiar arsenic

* Münchener med. Wochenschr., 1900, No. 16. See Bot. Centralbl., lxxxiii. (1900) p. 237. † Zeitschr. f. wiss. Mikr., xvii. (1900) pp. 169–77.

‡ Zeitschr. f. angew. Mikr., vi. (1900) pp. 143–53 (1 fig.). Cf. this Journal, 1899, p. 239.

odour is easily perceived and distinguished from somewhat similar smells. For detecting the presence of arsenic in urine, the residue, after treatment with nitric-sulphuric acid, should be saturated with ammonia, and then a few cubic centimetres of magnesia mixture added. After standing for 24 hours the sediment is washed into the culture flask.

Besides species of Penicillium and Aspergillus, the Mucorinæ also give the reaction. The author mentions that *P. brevicaule* exhibits macroscopic differences on different media such as apple, pear, potato, bread.

Distribution of Alkali in Vegetable Tissue.* — Herr A. C. Hof demonstrates the presence and location of alkali in vegetable tissue by the method adopted by Prof. Ehrlich in animal histology. The reaction is applicable only to dry tissues, and is monochromatic. The pigment used is iodine-eosin which forms a deep red aqueous solution, but is not soluble in ether, chloroform, or toluol. On the other hand, when acid is added, the precipitate is but slightly soluble in water, though easily in organic solvents. When a dry tissue is treated with the acid ethereal solution, the parts containing alkali are stained deep red owing to chemical union of the free pigment acid and the tissue alkali. The solution is made by adding to the alkaline solution of iodine-eosin a corresponding quantity of acid and shaking the precipitate up with ether. The supernatant ethereal solution of iodine-eosin-acid is then ready for use. After ascertaining that the glass vessels, &c. are free from alkali, the sections are immersed in the staining fluid. Those parts where alkali is present are at once stained. They are then transferred to pure ether, which is renewed until the ether remains quite clear. The still wet specimen is then at once mounted in *neutral* balsam, the ordinary balsam being quite useless for the purpose. The morphotic elements of preparations treated in the foregoing manner retain their shape perfectly, and show in those places where alkali is present a deep red staining, the non-alkaline parts remaining uncoloured.

Labelling Blocks and Slides.†—Mr. C. M. Thurston labels celloidin and paraffin blocks in the following way. The number or name is written on one end of an oblong piece of filter-paper ; on the other end is placed a drop of egg-albumen, and this end is pressed on the surface of the block opposite that to be sectioned. The albumen is coagulated sufficiently well to fix the label firmly enough for ordinary purposes.

The author ‡ labels slides and cover-glasses by writing on them with a fluid composed of equal parts of egg-albumen and glycerin to which enough lampblack has been added to pigment it sufficiently. The solution flows readily from a steel pen. The writing is then fixed in the flame.

BEHRENS, H.—**Mikrochemische Technik.** 2nd edition, Hamburg, 1900, 8vo, 68 pp.

HANAUSEK, T. F.—**Lehrbuch der Mikroskopischen Technik.** Stuttgart, 1900, part i. 8vo, 160 pp. and 105 figs.

* Bot. Centralbl., lxxxiii. (1900) pp. 273–80 (1 pl.).
† Journ. Applied Microscopy, iii. (1900) p. 894. ‡ Tom. cit., p. 900.

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 17TH OF OCTOBER, 1900, AT 20 HANOVER SQUARE, W. THE PRESIDENT (W. CARRUTHERS, ESQ., F.R.S.) IN THE CHAIR.

The Minutes of the Meeting of June 20th 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 Society were voted to the donors.

	From
Fischer, Alfred, The Structure and Functions of Bacteria. Translated from the German by A. Coppen Jones. (8vo, Oxford, 1900)	*The Publishers.*
Jörgensen, Alfred, Micro-organisms and Fermentation. Translated by Alex. K. Miller and A. E. Lennholm. 3rd edition. (8vo, London, 1900)	*The Publishers.*
Lee, Arthur Bolles, The Microtomist's Vade-Mecum. 5th edition. (8vo, London, 1900)	*The Author.*
Percival, John, Agricultural Botany. (8vo, London, 1900)	*The Publishers.*

The President said he could speak for Prof. Percival's book as being original both as to the text and as to the drawings. It was a valuable contribution to the subject of agricultural botany.

Dr. Hebb brought before the notice of the Meeting a sample box of Microscopic Stains prepared by Messrs. Burroughs and Wellcome. The stains were in a solid form, each "soloid," as they are termed, containing a definite amount of the staining reagent. The manipulation of the soloids is simple, as they only need dissolving to be ready for use. The advantages of this form of preparation are simplicity and economy. The most used microscopic stains and reagents, such as gentian-violet, fuchsin, methylen-blue, Gram's iodine, Bismarck-brown, are to be had in this convenient form.

Mr. C. Beck exhibited a new pattern instrument which was called the London Microscope. It was a small Student's Microscope with nothing specially novel about it except its cheapness. It had a rack-and-pinion coarse adjustment, most perfect micrometer screw fine adjustment, vulcanite top stage, iris diaphragm in sliding tube, and spiral substage fitting. It was of the Continental form, and there was nothing original about it except the method of manufacture, by which it was produced at about 20 per cent. less cost than anything they had been able to produce before.

In reply to inquiries, Mr. Beck said that the price complete, as shown, with eye-piece, two objectives, and double nose-piece, in case, would be 6*l.* 1*s.* 6*d.*

Mr. F. W. Watson Baker being asked to say something in explanation of the series of exhibits which he had arranged that evening, thought the descriptive labels placed beside each Microscope would enable the slides to speak for themselves. There were twenty-five of these, illustrating the Structure and Development of the Skin, all except seven being human.

Mr. Vezey said that the Society was very greatly indebted to Mr. Watson Baker for giving this very excellent exhibition at comparatively short notice. Being the first Meeting of the Session, the Council found themselves rather short of communications, and to make the evening a more interesting one Mr. Baker had very kindly undertaken to help them in this way.

The President said that their thanks were due to Mr. Baker for getting together this interesting and instructive exhibition.

Mr. Karop said he had only been able to give a casual glance at a few of the specimens exhibited, and he regretted that there was no one present to discuss the subject; because several new points had recently been recognised by histologists in the structure of the skin, and it was rather a pity that the opportunity should be lost of having these demonstrated by some one who had made a study of this important and complicated tissue system.

The thanks of the Society were then unanimously voted to Mr. Watson Baker for his exhibition, and to Messrs. Watson for the use of the number of Microscopes under which the preparations were shown.

The President said the Council had been lately considering what methods could be adopted for rendering their Library more useful to the Fellows of the Society. They found that the first thing to be done would be to have a complete and carefully compiled catalogue. The funds at the disposal of the Society did not admit their incurring any great expense in such work, but he believed it would be a valuable education and a great scientific gain to any Fellow who had the time and would undertake the work. He did not know anything that would be more instructive than to go critically over such a collection of books, journals, and separate memoirs as they possessed. In addition to the increase of his own knowledge so gained, he would at the same time confer a very great benefit upon the Fellows of the Society. He hoped some Fellow, in response to this appeal of the Council, would feel able to take up the work. He had himself some experience in making catalogues, and should be very glad to advise as to the best methods of procedure.

Mr. Vezey said that since their last meeting the Society had lost by death a Fellow who was very well known to many—Mr. Richard

Smith—who had been a friend of his for the last thirty years. He at one time devoted his attention largely to the study of diatoms, and was continually devising new contrivances for use in connection with the Microscope; he had also done some good work in the way of photomicrography. In later years he had undertaken important investigations in the germination of wheat. He made a large number of observations and experiments in connection with this subject, and published a book relating to it, of which it was to be regretted that there was no copy in the Society's Library. Mr. Smith regularly attended the Meetings of the Society, and was a very enthusiastic microscopist, who did a great deal to extend the usefulness of the instrument. Mr. Smith was probably best known to some as the inventor and patentee of Hovis flour for bread and biscuits.

The President said he regretted to have to announce that the Society had also recently lost several other of its Fellows by death—Mr. Alexander J. Currie, Mr. J. B. Morgan, Mr. Charles Coppock, well known to them from his former connection with the firm of Smith and Beck, and Mr. Edward George, who was one of his earliest London friends. Forty years ago Mr. George held a responsible position in a City bank, in connection with which he continued to discharge his duties till his sudden death last week. The President, early in his acquaintance with Mr. George, suggested to him to purchase a Microscope. A new field of interest was opened up to him. His morning and evening walks supplied him with many objects of interest. He purchased books to help him in understanding the specimens he found, and he in this way acquired a valuable library of scientific works. After some years of general work, he directed his attention specially to Algæ, and in his summer holidays he arduously gave himself to the collection of specimens. He had a sharp eye and a remarkable appreciation of the specific characters of the Algæ. For two or three years he gave himself to the collection and study of Mosses. Dr. Braithwaite acknowledges the help he received from Mr. George's collections. But he returned again to his work among the Algæ, and gave the spare time of his later years to the collection and study of these plants. In the October number of the *Journal of Botany*, Mr. Batters, in his paper on New British Marine Algæ, describes from the collection made by Mr. George at the Scilly Islands in 1899, a new genus, and names the species after Mr. George—*Rhodophysema Georgii*. Besides this, he added in that year three species new to the British flora, and one that had not been before found in England. Mr. George was singularly retiring. Though a fairly regular attender of the Society's meetings, it is doubtful if he was known to more than one or two Fellows. Mr. Batters says of him in the article to which reference has been made, "Mr. George's fine collection of marine Algæ, with its sets of magnificent specimens, the reward of assiduous collecting continued for many successive years, is but little known to botanists; but it is in vain that I have repeatedly urged my friend to publish his notes."

Mr. F. W. Millett's paper, Part IX., of his Report on the Recent Foraminifera of the Malay Archipelago, was taken as read.

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

Dr. R. G. Hebb:—Soloid Microscopic Stains of Burroughs, Wellcome and Co.

Messrs. R. and J. Beck:—The "London" Microscope.

Mr. F. W. Watson Baker:—Series of twenty-five Microscopic Slides, eighteen of them illustrating the structure of the human skin, seven that of the skin of other animals, viz.:—Nos. 1–4. Development. 5–7. Vertical sections. 6, 7. Blood-vessels. 8–10. Nerve system. 11–14. Perspiration ducts and glands. 15. Inflammation. 16, 17. Hairs *in situ*. 18, 19. Pigment. 20–25. Skins of various animals.—No. 1. Formation of hair (3 months fœtus). 2. Hand of fœtus (4 months). 3. Fœtal scalp (6 months). 4. Finger of child, longitudinal section. 5. Skin of heel, layers differentiated. 6. Skin of thigh. 7. Section of skin, injected. 8. Tactile corpuscles in papillæ. 9. Tactile corpuscles in skin of finger. 10. Pacinian body in subcutaneous tissue. 11. Meibomian glands in eyelid. 12. Surface of skin showing pores. 13. Perspiration ducts and glands. 14. Perspiration ducts and glands, isolated. 15. Inflamed skin. 16. Section of scalp, horizontal. 17. Scalp of negro, vertical. 18. Pigment cells in skin of negro. 19. Pigment cells in skin of frog. 20. Skin of rabbit. 21. Skin of dog's back. 22. Skin of horse. 23. Cat's lip. 24. Skin of sheep. 25. Skin of alligator. Papier-mâché and plaster models of skin: Vertical section, 200 times enlarged, showing the three principal layers, sebaceous and sweat glands, hair-roots, muscles, arteries, and veins.

New Fellow:—Mr. Edward B. Stringer, B.A., was elected an *Ordinary Fellow* of the Society.

MEETING

Held on the 21st of November, 1900, at 20 Hanover Square, W. The President (W. Carruthers, Esq., F.R.S.) in the Chair.

The Minutes of the Meeting of 17th of October last were read and confirmed, and were signed by the President.

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

	From
Galt, Hugh, The Microscopy of the Starches. (8vo, London, 1900)	*The Publishers.*
Thompson, Silvanus P., Optical Tables and Data. (8vo, London, 1900)	*The Publishers.*

The President said it would be gratifying to the Fellows of the Society to learn that the appeal which he made at the previous Meeting had been responded to by Mr. Radley, who had already made considerable progress in the preparation of the catalogue then suggested.

It was being carefully prepared, and when complete would be a very useful guide to the contents of the Library. The funds of the Society did not admit of their publishing at present a catalogue, so that Mr. Radley was preparing a card catalogue arranged in a series of small boxes easy of reference and easy to incorporate in their proper places the additions to the Library. He was sure the Fellows of the Society would feel grateful to Mr. Radley for so readily and at a considerable expenditure of time undertaking this important work.

Mr. Nelson exhibited and described an Erect-image Dissecting Microscope by Leitz, sent by Messrs. Baker. This instrument was figured in the Journal of the Society for August last,* but had not been shown at any of their Meetings. The erection of the microscopic image effected by means of Porro prisms, was first described by Ahrens in the Journal in 1888,† and this method has since been brought into use and made better known by its application to field glasses. The instrument before the Meeting was valuable as a dissecting Microscope; it was fitted with hand-rests, was strongly made, and supplied with three objectives each having a very long working distance. It packed up into a small box, and would be found a serviceable and portable instrument.

Mr. A. N. Disney exhibited a Diffraction plate on which the gratings were ruled not in parallel lines but in concentric circles, by which the diffraction bands were separated with great clearness. The rulings were about 7000 to the inch. He also showed a steel brooch, the surface of which had been ruled in the same way. He believed the process was to be applied to the ornamentation of buttons, shirt-studs, &c., but the method by which the lines were produced was at present secret. The articles were of English manufacture, and had been lent to him by Messrs. Townson and Mercer.

Mr. C. F. Rousselet exhibited an Electric Lamp for use with the Microscope. He said it was well known that the ordinary electric lamp was quite unsuitable for microscopic work: the incandescent loop filament spread out in different planes and in such a way that it could not be placed in the focus of a bull's-eye condenser, so that even for low powers the result was unsatisfactory. As the use of the electric light in private houses was becoming more general, it had always seemed to him a pity that this convenient illuminant should not be available for use with the Microscope. He had, however, lately found a lamp which had not the defects mentioned, and which after six months' trial he had found very satisfactory for work with low and medium powers, and he desired therefore to bring it to the notice of the Fellows. It was called the "Focus lamp" and was manufactured by the Edison and Swan Company, originally, he believed, for projection work. In this lamp the filament was a closely wound elongated spiral of six turns, the edge view of which, when incandescent, nearly resembled the edge of the flame of a half-inch paraffin lamp-wick; and by placing this edge of the filament in the focus of a bull's-eye condenser, a very brilliant light was

* Journ. R.M.S., 1900, p. 509. † Op. cit., 1888, p. 1020, fig. 161.

obtained for low powers, and especially for dark-ground illumination. The ordinary oil lamp had a candle-power of 3 to 3½, whilst this lamp had a candle-power of 8, and any greater power was quite unnecessary. It was mounted with a brass collar terminal for use with the ordinary bayonet-joint holder.

The greatest advantage was obtained when used for dark-ground illumination, when all minute details such as fine hairs, cilia, &c., were shown remarkably well. For transmitted light with low and medium powers it was best used without the bull's-eye, it being then only necessary to rack up the condenser very slightly in order to get rid of the image of the incandescent filament. He did not, of course, pretend that this lamp would replace the edge of the flame for very critical work with high powers; but for ordinary work with low powers up to the half-inch he could recommend it as most efficient, and very convenient for those who had the electric light laid on in their houses.

Mr. Rousselet, in reply to a question by Mr. J. J. Vezey, said that he was accustomed always to use this lamp with a shade.

The thanks of the Society were then cordially voted to those gentlemen who had brought the various instruments for exhibition.

The President said the Society had arranged for an exhibition that evening of a peculiarly interesting character, being a set of slides prepared by the late Dr. W. B. Carpenter in connection with his investigations into the Shells of the Mollusca. An additional exhibition had also been provided by Mr. B. B. Woodward, who had given much attention to this subject, and now exhibited some valuable preparations. It was interesting to see Mr. Woodward pursuing the studies of his distinguished uncle, Dr. Samuel P. Woodward, whose Manual of the Mollusca was a model introduction to the knowledge of this group, far in advance of the days in which it was published, and not yet replaced by any later handbook. He could not express the pleasure and benefit he obtained as a student from Dr. Woodward's manual.

Mr. B. B. Woodward drew attention to a series of slides he had brought illustrating shell structure, some of which he thought were extremely fine and showed great care and skill on the part of the mounter, who was one of the formatories at the Natural History Museum.

Mr. J. J. Vezey, at the request of the President, read a short abstract he had copied from the Report of the British Association for 1846, page 82, being a *resumé* of the original communication made to that Association by the late Dr. W. B. Carpenter, on "Shell Structure." Mr. Vezey said he knew nothing of the subject himself, but thought it would enable the Fellows better to understand the slides exhibited on the table if they knew the points which Dr. Carpenter intended to illustrate when he prepared the specimens, though he believed the views then expressed had been modified since the first paper was read on the subject.

Prof. Chas. Stewart, being asked by the President to say a few words on the subject before them, said that years ago he was much interested in the subject, but it was a very long time since he did any work in connection with shell structure. Ideas had changed with regard to the nature of shell formation, and he thought very few people would now be found to hold that shell was formed by the calcification of the cells of the mantle membrane. It was formed, no doubt, by the cells, but not out of them; each cell formed its own portion, and each layer as it was thrown off contributed its traces to the markings of the shell. Then the tubular structure, which they sometimes heard about, was purely the result of the invasion of the shell by fungoid growths. Taking as an illustration the common Pinna shell, Prof. Stewart, by means of drawings on the board, explained how its structure was built up. He thought that though the sections usually shown under the Microscope, both vertical and horizontal, were useful and interesting in their way, they must be supplemented by other methods if a correct idea was to be obtained, the best way being to break the shell and to examine the fractured surfaces. In the Pinna the nacreous layer only extended over a small portion of the interior of the shell, and if a piece was cut out showing the growing edge of the nacre, and this was examined with the binocular, it would be found to show the transition between the nacre and prismatic layers, and would confirm the desirability of giving attention to the free and undisturbed structure. Whether his preparations were now in good condition to show this he could not say, as they had a tendency to effloresce if exposed to damp, but if good he should be very pleased to bring them up to the next Meeting for exhibition. When carbonate of lime was associated with colloid material, it had a tendency to form spheres, and if they examined the shell of a large oyster such as came up from the deeper portions of the sea, they would find these spherical bodies in some of its layers. The value of the fracture in ascertaining structure was particularly evident when they were examining the shells of the Gastropods—the formation of which was shown by drawings on the board. He did not, however, wish it to be thought that he despised a balsam mount or a ground section, but these should be supplemented by other ways. The reproduction of the shell when broken was also very remarkable and well worth observing. If a large snail was taken and a piece was broken out of the shell so as not to injure the animal inside, they would find that in the course of seven or eight hours the hole would be closed by a thin film of organic matter. In a few hours more little spheres and crystals would appear on this, scattered at first sparsely but soon becoming thicker, until at last the layer became solid, and finally lined by a layer similar to that of the uninjured shell. When called upon by the President to say something, he felt bound to obey; but though there was nothing very new in what he had said, he hoped some one might have got a hint or two which would be of use in following up the subject.

The President was sure the Fellows present were very much indebted to Prof. Stewart for his instructive demonstration.

The hearty thanks of the Society were then, upon the motion of the President, voted to Prof. Stewart for his remarks, and to Mr. B. B. Woodward for bringing up his very interesting collection.

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

The Society:—A series of microscopic slides to illustrate Shell-Structure:—*Avicula*, horizontal section; *Avicula*, nacre; *Cardium cardissa*; *Corbuta tunicata*; *Glycemeris*, external layer; *Glycemeris*, internal layer; *Hippurites*, vertical section; *Lima scabra*, corrugated structure; *L. scabra*, tubular structure; *Mya arenaria*; *Myodora striata*, internal layer; *M. striata*, cellular structure; *Perna ephippium*, horizontal section; *Pinna*, fossil, oolite, vertical and horizontal sections; *Pinna ingens*, horizontal section decalcified; *Pinna nigrina*, horizontal and vertical sections; *Pinna*, prisms separated by disintegration of membrane; *Pleurorhyncus hibernicus*; *Solenomya australis*, external and internal layers; *Spondylus*, internal and external layers; *Thracia*, external and internal surfaces; *Unio occidens*, cellular layer; *Vulsella*, horizontal section.

Mr. A. N. Disney:—A circular Diffraction Grating and an Iridescent Brooch.

Mr. E. M. Nelson:—Leitz' prism Erect-image Dissecting Microscope.

Mr. C. F. Rousselet:—An Electric Lamp for microscopic work.

Mr. B. B. Woodward:—A series of slides illustrating Shell Structure.

New Fellows.—The following were elected *Ordinary* Fellows of the Society:—Messrs. Henry Dobson, Joseph William Williams, William Wyatt.

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.

L.

M.

N.

O.

P.

S.

T

U.

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
1/30	·846666
1/35	·725714
1/40	·634999
1/45	·564444
1/50	·508000
1/55	·461818
1/60	·423333
1/65	·390769
1/70	·362857
1/75	·338666
1/80	·317500
1/85	·298823
1/90	·282222
1/95	·267368
1/100	·254000
1/150	·169333
1/200	·127000
1/250	·101600
1/300	·084667
1/350	·072571
1/400	·063500
1/450	·056444
1/500	·050800
1/550	·046182
1/600	·042333
1/650	·039077
1/700	·036286
1/750	·033867
1/800	·031750
1/850	·029882
1/900	·028222
1/950	·026737

in.	µ
1/1000	25·399978
1/2000	12·699989
1/3000	8·466659
1/4000	6·349994
1/5000	5·079996
1/6000	4·233330
1/7000	3·628568
1/8000	3·174997
1/9000	2·822220
1/10000	2·539998
1/15000	1·693332
1/20000	1·269999
1/25000	1·015999

245