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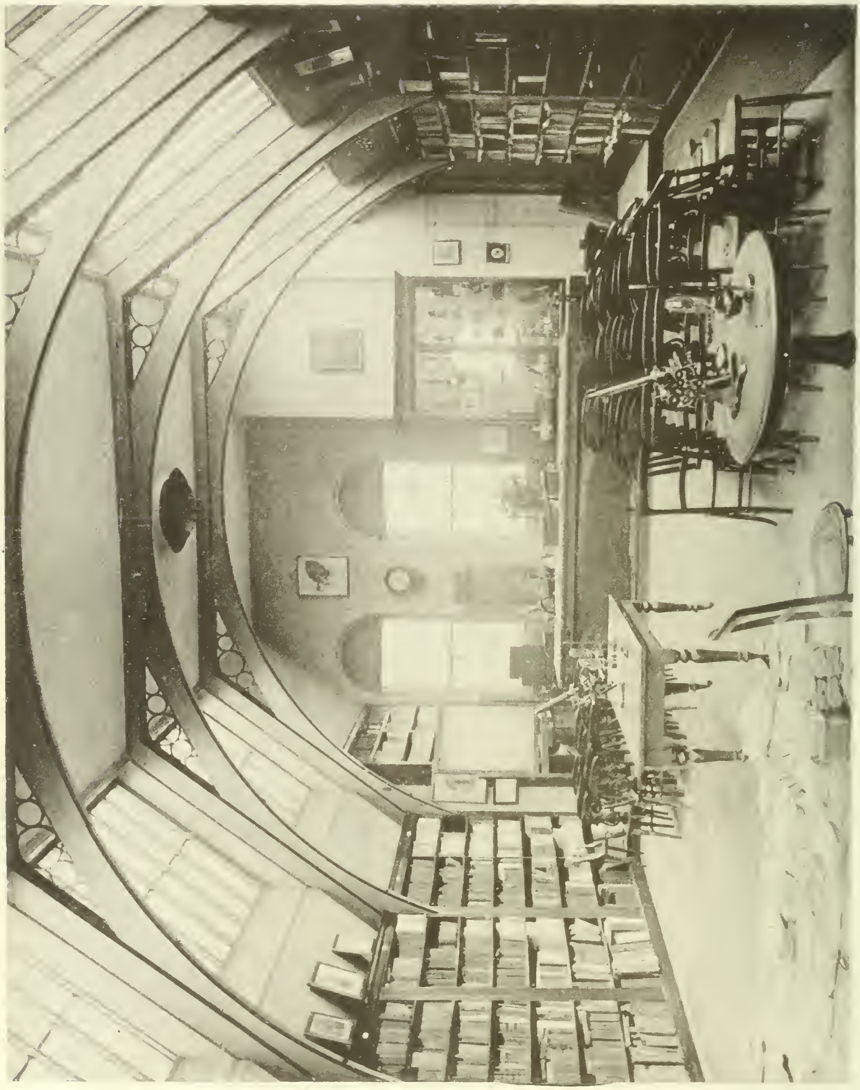

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JOURNAL

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

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CONTENTS.

TRANSACTIONS OF THE SOCIETY.

SUMMARY OF CURRENT RESEARCHES

RELATING TO ZOOLOGY AND BOTANY (PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA), MICROSCOPY, &c., INCLUDING ORIGINAL COMMUNICATIONS FROM FELLOWS AND OTHERS.* 50, 180, 283, 404, 514, 615

ZOOLOGY.

VERTEBRATA.

a. Embryology.

b. **Histology.**

c. General.

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).

Characeæ.

Algæ.

Fungi.

Myxomycetes.

Protophyta.

α. 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.

JUN 1 1898

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

FEBRUARY 1898.

TRANSACTIONS OF THE SOCIETY.

I.—*The Foraminifera of the Gault of Folkestone.* Part X.—Conclusion and Appendices.

By Frederick Chapman, A.L.S., F.R.M.S.

(*Read 20th October*, 1897.)

Plates I. and II.

Sub-family ROTALIINÆ—continued.

Truncatulina d'Orbigny [1826].

Truncatulina refulgens Montfort sp., plate I. figs. 1 *a*, *b*.

Cibicides refulgens Montfort, 1808, Conchyl. Syst., vol. i. p. 122, 31^re genre. *Truncatulina refulgens* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 279, No. 5, pl. xiii. figs. 8–11; Modèle, No. 77. Carpenter, Introd. Foram., p. 201, woodcut fig. xxxii E. Brady, 1865,

EXPLANATION OF PLATES.

Plate I.

Fig. 1.—*Truncatulina refulgens* Montfort sp.: *a*, superior aspect; *b*, inferior aspect. × 60.
„ 2.—*T. lobatula* Walker sp.: *a*, superior aspect; *b*, inferior aspect. × 45.
„ 3.—*T. Wuellerstorfi* Schwager sp.: *a*, superior aspect; *b*, inferior aspect; *c*, peripheral aspect. × 60.
„ 4.—*Anomalina complanata* Reuss: *a*, superior aspect; *b*, inferior aspect; *c*, peripheral aspect. × 60.
„ 5.—*A. ammonoides* Reuss sp.: *a*, superior aspect; *b*, inferior aspect; *c*, peripheral aspect. × 45.
„ 6.—*A. rudis* Reuss sp.: *a*, superior aspect; *b*, inferior aspect; *c*, peripheral aspect. × 45.
„ 7.—*Pulvinulina Hauerii* d'Orbigny sp.: *a*, superior aspect; *b*, inferior aspect; *c*, peripheral aspect. × 60.
„ 8.—*P. elegans* d'Orbigny sp.: *a*, superior aspect; *b*, inferior aspect; *c*, peripheral aspect. × 60.
„ 9.—*P. caracolla* Römer sp.: *a*, superior aspect; *b*, inferior aspect; *c*, peripheral aspect. × 60.
„ 10.—*P. reticulata* Reuss sp.: *a*, superior aspect; *b*, inferior aspect; *c*, peripheral aspect. × 45.
„ 11.—*P. Carpenteri* Reuss sp.: *a*, superior aspect; *b*, inferior aspect; *c*, peripheral aspect. × 45.

Nat. Hist. Trans. Northumb. and Durham, vol. i. p. 105, pl. xii. fig. 9. *T. lobatula* (passing into *refulgens*) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 382, pl. xvi. figs. 18–20. *T. refulgens* Brady, 1884, Chall. Rep., vol. ix. p. 659, pl. xcii. figs. 7–9. Egger, 1893, Abhandl. k. Bayer. Ak. Wiss., vol. xviii. p. 401, pl. xvi. figs. 31–33. *Planorbulina refulgens* Goës, 1894, K. Sven. Vet.-Akad. Handl., vol. xxv. No. 9, p. 89, pl. xv. figs. 775, 776. *Truncatulina refulgens* Rupert Jones, 1896, Monogr. Foram. Crag, pt. iii. p. 302; figured in pt. ii. (1895) pl. v. figs. 31 *a, b*.

The solitary specimen from the Folkestone Gault is not quite so circular in its peripheral contour as in typical specimens, but in other respects it is specifically characteristic. The septa in this specimen are thick, as is also the general structure of the test, in which amongst other points it differs from *T. lobatula*.

T. refulgens has been recorded from the Middle Marl bed or Rancocas formation of New Jersey (Bagg); it is also known from the London Clay, and from Pliocene and Pleistocene beds.

As a living organism it usually occurs in temperate seas at very varying depths.

The Gault specimen was found in zone vii. at Folkestone.

Truncatulina lobatula Walker sp., plate I. figs. 2 *a, b*.

Nautilus lobatulus Walker, 1784, Test. Min., p. 20, pl. iii. fig. 71. *Truncatulina tuberculata* d'Orbigny, 1826, Ann. Sci., Nat., vol. vii.

Plate II.

Fig. 1.—*Pulvinulina spinulifera* Reuss sp.: *a*, superior aspect; *b*, inferior aspect; *c*, peripheral aspect. × 10.
„ 2.—*Rotalia Soldanii* d'Orbigny sp., var. *nitida* Reuss: *a*, superior aspect; *b*, inferior aspect: *c*, peripheral aspect. × 60.
„ 3.—*Spiroloculina nitida* d'Orbigny. × 30.
„ 4.—*Rhizammina indivisa* Brady. × 30.
„ 5.—*Haplophragmium Terquemi* Berthelin. × 120.
„ 6.—*Ammodiscus Millettianus* sp. nov.: *a* and *b*, the lateral surfaces; *c*, peripheral aspect. × 60.
„ 7.—*Textularia complanata* Reuss sp. × 30.
„ 8.—*Marginulina Parkeri* Reuss. × 45.
„ 9.—*Vaginulina truncata* Reuss. An aberrant specimen consisting of two individuals fused at the apertural borders. × 30.
„ 10.—*V. truncata* Reuss. A well-grown individual, with an embryonic form attached to the distal end, on the apertural border. × 30.
„ 11.—*V. recta* Reuss. An aberrant specimen, consisting of two individuals of opposite types (forms B and A) fused together by the distal and proximal ends respectively. × 30.
„ 12.—*V. recta* Reuss. An aberrant specimen, consisting of a perfect individual, and another more or less broken at the attaching surface: *a* and *b* show the two aspects of the specimen at right angles to one another. × 45.
„ 13.—*Vaginulina truncata* Reuss var. *robusta* Berthelin and Chapman (bigeneric form). × 30.
„ 14.—*Sagrina calcarata* Berthelin sp.: *a*, lateral aspect; *b*, oral aspect. × 60.
„ 15.—*Ramulina lævis* Jones. (A better specimen than that figured J. R. Micr. Soc., 1896, pl. xii. fig. 2). × 60.
„ 16.—*Discorbina Vilardeboana* d'Orbigny sp.: *a*, superior aspect; *b*, inferior aspect; *c*, peripheral aspect. × 30.

p. 279, No. 1; Modèle, No. 37. *T. lævigata* Reuss, 1845, Verstein. Böhm. Kreidef., pt. i. p. 37, pl. viii. fig. 71; pl. xiii. fig. 47. *T. lobatula* Carpenter, 1862, Introd. Foram., p. 201, woodcut fig. xxxii B and pl. iv. fig. 5. Brady, 1884, Chall. Rep., vol. ix. p. 660, pl. xcii. fig. 10; pl. xciii. figs. 1, 4, 5; pl. cxv. figs. 4, 5.

This species is very rare in the Gault, only one specimen having been found in the present collection. This specimen is quite typical, and possesses the characteristic thin and conspicuously foraminated test.

As a fossil *T. lobatula* is known from beds as old as the Carboniferous, and it occurs in nearly all fossiliferous strata of later date. Amongst other occurrences it has been previously found in "the Gault of Kent, probably Folkestone" (Rupert Jones in Topley's Memoir on the Weald, p. 424); and has been recorded by Bagg from the Middle Marl beds of New Jersey.

The living specimens of *T. lobatula* appear to be unrestricted as to depth of water, but it attains its best development in fairly shallow water.

At Folkestone this species was found in zone xi., 35 ft. from the top.

Truncatulina Wuellerstorfi Schwager sp., plate I. figs. 3 *a–c*.

Anomalina Wüllerstorfi Schwager, 1866, Novara-Exped., geol. Theil, vol. ii. p. 258, pl. vii. figs. 105 and 107. *Truncatulina Wuellerstorfi* Brady, Challenger Rep., vol. ix. p. 662, pl. xciii. figs. 8 and 9. *Planorbulina Wüllerstorfii* Goës, 1894, Kongl. Svenska Vetenskaps-Akad. Handl., vol. xxv. No. 9, p. 89, pl. xv. fig. 777.

This species is known as a deep-water form from recent deposits.

Fossil specimens have been recorded from the Lower Greensand (Bargate) beds of Surrey (Chapman); from the Middle Marl beds of New Jersey (Bagg); and from the Pliocene strata of Kar Nicobar (Schwager).

T. Wuellerstorfi was found in the Gault in zone xi., 45 ft. from the top, very rare; 35 ft., very rare.

Anomalina d'Orbigny [1826].

Anomalina complanata Reuss, plate I. figs. 4 *a–c*.

Anomalina complanata Reuss, 1851, Haidinger's Naturw. Abhandl., vol. iv. (1) p. 36, pl. iii. fig. 3. *Rosalina complanata* var., Id., 1862, Sitz. d. k. Ak. Wiss. Wien, vol. xlvi. p. 86, pl. xi. figs. 3 *a–c*. *Anomalina complanata* Berthelin, 1880, Mém. Soc. Géol. France, ser. 3, vol. i. No. 5, p. 66, pl. iv. figs. 12*a*–13. *Planorbulina complanata* Sherborn and Chapman, 1886, Journ. R. Micr. Soc., ser. 2, vol. vi. p. 757, pl. xvi. figs. 15 *a–c*.

The test of this species is more regularly and completely involute than in the other forms of the genus occurring in the Gault.

It has been previously noted from the Aptien and Gault beds proper of Germany (Reuss); the Gault of Montcley, Wissant, and the Dept. of l'Aube, France (Berthelin); the Senonien of Lemberg, Galicia (Reuss); and the London Clay of Piccadilly (Sherborn and Chapman).

In the Gault of Folkestone *A. complanata* occurred in zone ii. specimen *a*, rare; zone ii., specimen *b*, rare; zone ii., specimen *c*, rare; zone iii., rare; zone iv., very rare; zone vii., very rare; zone ix., very rare; zone xi., 40 ft. from the top, rare; 12 ft., very rare.

Anomalina ammonoides Reuss sp., plate I. figs. 5 *a–c*.

Rosalina ammonoides Reuss, 1845, Verstein. Böhm. Kreidef., pt. i. p. 36, pl. xiii. fig. 66; pl. viii. fig. 53. Id., 1850, Haidinger's Naturw. Abhandl., vol. iv. p. 36, pl. iv. fig. 2. *Nonionina bathyomphala*, Id., 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 95, pl. xiii. figs. 1 *a* and *b*. *Anomalina intermedia* Berthelin, 1880, Mém. Soc. Géol. France, ser. 3, vol. i. No. 5, p. 67, pl. iv. figs. 14 *a–c*. *Anomalina ammonoides* Brady, 1884, Chall. Rep., vol. ix. p. 672, pl. xciv. figs. 2 and 3. *Planorbulina ammonoides* Sherborn and Chapman, 1886, Journ. R. Micr. Soc., ser. 2, vol. vi. p. 756, pl. xvi. figs. 14 *a–c*. Burrows, Sherborn, and Bailey, 1890, ibid., p. 562, pl. xi. figs. 23 *a* and *b*. *Rosalina ammonoides* Beissel, 1891, Abhandl. d. k. Preuss. geol. Landesanstalt, Heft 3, p. 74, pl. xvi. figs. 1–5. *Discorbina ammonoides* Perner, 1892, Foraminifery Českého Cenomanu (Palæontographica Bohemiæ, No. 1), p. 64, pl. x. figs. 1 *a–c*. *Anomalina ammonoides* Woodward and Thomas, 1893, vol. iii. of Final Rep. Geol. and Nat. Hist. Survey Minnesota, p. 44, pl. D, figs. 28 and 29. Perner, 1897 Foraminifery Vrstev Bělohorských (Palæontographica Bohemiæ, No. iv.), p. 72.

The compressed test, with its narrow and numerous chambers, sufficiently distinguishes this species from its congeners. The earliest figures of the species by Reuss are not very clear, but this is sufficiently atoned for by the later ones of the same author; and the frequency with which it has since been figured (and, concomitantly, the amount of variation in its form) may be in some measure conceived by consulting the above synonymy, which, however, deals principally with the Cretaceous specimens.

Anomalina ammonoides is the commonest species of the genus occurring in Cretaceous beds, and has been found in fossiliferous strata of various ages, and notably from the following: the Lower Greensand (Bargate) beds of Surrey (Chapman); the Gault of Germany (Reuss), of France (as *A. intermedia* Berthelin), of England (Rupert Jones in Topley's Memoir on the Weald); from the Cretaceous Marls of New Jersey (Bagg); from the Red Chalk of Speeton (Burrows, Sherborn, and Bailey); from the Cenomanian of Bohemia (Perner); and from the phosphate beds of Cambridge (G. R. Vine).

It is also of common occurrence throughout the Chalk formation, and is well known from many horizons of Tertiary age.

As a recent form, *A. ammonoides* is found both in shallow and deep water.

This species was found in the Gault of Folkestone in zone i., spec. *a*, very rare; zone i., spec. *b*, common; zone ii., spec. *a*, common; zone ii., spec. *b*, common; zone ii., spec. *c*, common; zone iii., common; zone iv., common; zone v., common; zone vi., common; zone vii., common; zone viii., common; zone ix., common; zone x., common; zone xi., 55 ft. from the top, frequent; 50 ft., common; 45 ft., common; 40 ft., common; 35 ft., common; 30 ft., very rare; 25 ft., common; 20 ft., frequent; 12 ft., common; 6 ft., common.

Anomalina rudis Reuss sp., plate I. figs. 6 *a–c*.

Rosalina rudis Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 87, pl. xi. figs. 7 *a–c*. Gümbel, 1868 (1870), Abhandl. m.-ph. Cl. k. Bayer. Ak. Wiss., vol. x. p. 657, pl. ii. figs. 99 *a–c*. *Anomalina rudis* Berthelin, 1880, Mém. Soc. Géol. France, sér. 3, vol. i. No. 5, p. 68, pl. iv. figs. 15 *a–c*. *Discorbina inflata* Perner, 1892, Foraminifery Českého Cenomanu (Palæontographica Bohemiæ, No. 1), p. 65, pl. x. figs. 4 *a–c*.

A. rudis appears to be strictly confined to strata of Gault and Cenomanian ages. It has been recorded from the Gault of N. Germany (Reuss), and of France (Berthelin), and also from the Cenomanian of Bohemia (Perner).

This species is characterised by its fewer and more inflated chambers as compared with *A. ammonoides*. It also closely approaches *A. grosserugosa* Gümbel sp., but differs in being less equilateral than that species, and approximating towards the typical *Truncatulinæ* by the flattening of the superior face of the test. The last chamber of *A. rudis* is often of large size, and greatly inflated. It is possible that this phenomenon has a connection with the fragile brood-chamber of the megalospheric form found in many types of the Foraminifera.

From the Gault of Folkestone *A. rudis* was obtained as follows: Zone i., spec. *b*, frequent; zone ii., spec. *a*, rare; zone ii., spec. *b*, rare; zone ii., spec. *c*, rare; zone iii., frequent; zone iv., frequent; zone v., rare; zone vi., frequent; zone vii., rare; zone ix., very rare; zone x., rare; zone xi., 20 ft. from the top, rare; 12 ft., rare.

Pulvinulina Parker and Jones [1862].

Pulvinulina Hauerii d'Orbigny sp., plate I. figs. 7 *a–c*.

Rotalina Hauerii d'Orbigny, 1846, Foram. Foss. Vienne, p. 151, pl. vii. figs. 22–24. *Pulvinulina Hauerii* Parker and Jones, 1865, Phil. Trans., vol. clv. p. 393; Brady, 1884, Chall. Rep., vol. ix. p. 690, pl. cvi. figs. 6, 7. *Pulvinulina* (*Rotalina*) *Hauerii* Egger, 1893, Abhandl. k. Bayer. Ak. Wiss., Cl. II. vol. xviii. Abth. ii. p. 414, pl. xvii. figs. 29–31.

By the occurrence of this species in the Gault, its geological range is considerably extended. It has been previously noted from Oligocene, Miocene, and Pliocene strata. As a recent form it appears most at home in moderately shallow water.

At Folkestone *P. Hauerii* was found in zone iii., very rare; zone vi., very rare.

Pulvinulina elegans d'Orbigny sp., plate I., figs. 8 *a–c*.

Rotalia (*Turbinulina*) *elegans* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 276, No. 54. *Pulvinulina elegans* Parker, Jones, and Brady, 1871, Ann. and Mag. Nat. Hist., ser. 4, vol. viii. p. 174, pl. xii. fig. 142. *Rotalina pleurostomata* Schlumberger, 1883, Feuille des Jeunes Nat., p. 119, pl. iii. figs. 5, *5a*, *5b*. *Pulvinulina elegans* Brady, 1884, Chall. Rep., vol. ix. p. 699, pl. cv. figs. 4–6. *Epistomina elegans* Rzehak, 1888, Ann. k. k. Naturhist. Hofmus., vol. iii. (3) p. 264, pl. xi. fig. 9. *Pulvinulina elegans*, Sherborn and Chapman, 1889, Journ. R. Micr. Soc., p. 487, pl. xi. figs. 30–32. Egger, 1893, Abhandl. k. Bayer. Ak. Wiss., Cl. II. vol. xviii. Abth. ii. p. 210, pl. xviii. figs. 37–39. Goës, 1894, Kongl. Svenska Vetenskaps-Akad. Handlingar, vol. xxv. No. 9, p. 97, pl. xvi. fig. 808. Id., 1896, Bull. Mus. Comp. Zool. Harvard, vol. xxix. No. 1, p. 76.

This species may be taken as a type around which several of the so-called species of Cretaceous *Pulvinulinæ*, with nearly similar conformation, may be grouped. It is well, however, to bear in mind that the differences of these particular forms are hardly enough in some cases to warrant their having distinct specific names; yet, for the sake of convenience and brevity, they are here retained as species instead of varieties or sub-varieties; and at least some kind of distinction is useful when applied to the study of the zonal distribution of the foraminiferal fauna.

The typical *P. elegans* occurs in the Gault along with the closely allied forms of *P. caracolla* Römer sp., *P. reticulata* Reuss sp., and *P. Carpenteri* Reuss sp.; but the first-named species is distinguished by the inconspicuous septal lines—unlike *P. caracolla*, which has strong surface septation and usually more numerous chambers and whorls on the superior face.

There is a remarkable feature with regard to the *Pulvinulinæ* of the "*elegans*" type, especially of those found in Jurassic and Cretaceous deposits. They possess a supplementary orifice in addition to the normal slit situated on the inferior margin between the junction of the penultimate whorl and the last chamber. This supplementary aperture is a "long, arched, linear slit immediately within the peripheral margin of the final segment on the inferior side and parallel to it—that is to say, an opening between the carinal border and the proper wall of the terminal chamber."* The Gault specimens exhibit this peculiarity in nearly every specimen examined, but owing to the infilling of the aperture it is sometimes at first difficult to discover. With regard to this secondary aperture, in most examples it is seen that only in the last chamber does it remain open, the earlier ones being closed over by the growth of the shell wall. The transparency of the shell, however, allows one to trace these slits round an entire whorl, appearing as a covered and interrupted channel immediately below the periphery. This peculiar feature in the apertural character of the shell has been especially noticed by Terquem, who instituted the genus *Epistomina* for this type; † by Uhlig, who found numerous specimens with the same characters in the Ornatus-clays of Russia (see references in synonymy of this and the succeeding species); and by Rzehak, who records it from the Oligocene limestones of Nieder-hollabrunn, Lower Austria.‡

Pulvinulina elegans has been recorded from many formations, beginning with the Lias. The figures, however, which are given by Jones and Parker in their Chellaston paper § appear to belong more properly to *P. caracolla*, which is also of frequent occurrence in Jurassic strata. The species has been noted from the Lower Green-sand of Surrey, and although apparently unrecorded previously from beds of Gault age, it has been noticed at various horizons in the Chalk, and it is also a well-known fossil in many Tertiary formations.

As a recent form *P. elegans* is unrestricted as to depth, and passes from the typical form in moderately shallow water to the deep-water variety with a thickened test, known as *P. Partschiana* d'Orbigny sp.

Pulvinulina elegans was found in the Gault of Folkestone in zone i., spec. *b*, rare; zone ii., spec. *a*, frequent; zone ii., spec. *b*, frequent; zone ii., spec. *c*, rare; zone iii., frequent; zone iv., rare; zone v., frequent; zone vi., very rare; zone vii., rare; zone ix., frequent; zone x., 55 ft. from the top, very rare; 20 ft., very rare.

Pulvinulina caracolla Römer sp., plate I. figs. 9 *a–c*.

Gyroidina caracolla Römer, 1840–41, Verstein. Norddeutsch. Kreide, p. 97, pl. xv. fig. 22. ***Rotalia elegans*** Jones and Parker, 1860, Quart. Journ. Geol. Soc., vol. xvi. pp. 452, 455, and 457, pl. xx. fig. 46. ***R. caracolla*** Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. Abth. i. p. 84, pl. x. figs. 6 *a–c*. *Pulvinula caracolla* Crick and Sherborn, 1892, Journ. Northampton Nat. Hist. Soc., vol. vii. p. 71, pl. vii. (ii.) figs. 26 *a–c*.

* H. B. Brady, Chall. Rep., vol. ix. pp. 700, 701.

† Bull. Soc. Géol. France, ser. 3, vol. xi. 1883, p. 37, pl. iii. figs. 1–20. Also Terquem, Cinquième Mém. Foram. Oolithique, 1883, p. 373.

‡ Seguenza figures an undoubted *Epistomina*-like *Pulvinulina* allied to *P. reticulata* Reuss sp. from the Tertiaries of Calabria under the name of *Discorbina vestita* Atti R. Accad. Lincei, ser. 3, vol. vi. 1880, p. 148, pl. xiii. fig. 39.

§ Quart. Journ. Geol. Soc., vol. xvi. (1860) pl. xx. fig. 46.

This species appears to be of common occurrence in Jurassic strata (Jones, Parker, Crick and Sherborn); and it has been described from the Middle Hils formation and the Speeton Clay of North Germany (Reuss). The previous records for the Gault are Meux's well-boring, London (C. Moore), and Folkestone (Rupert Jones in Topley's Memoir on the Weald). It is somewhat striking that this form occurs only in the fossil state and never above or below deposits of secondary age.

P. caracolla, in common with others of the "*elegans*" type, exhibits the secondary slit-like aperture.

In the Gault of Folkestone *P. caracolla* was found in zone i., spec. *a*, very rare; zone i., spec. *b*, very rare; zone ii., spec. *c*, frequent; zone iii., common; zone iv., common; zone v., rare; zone vi., very rare; zone viii., very rare; zone ix., frequent.

Pulvinulina reticulata Reuss sp., plate I. figs. 10 *a–c*.

Rotalia reticulata Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. Abth. i. p. 83, pl. x. figs. 4 *a–c*. *Epistomina reticulata* Uhlig, 1883, Jahrb. k. k. geol. Reichsanst., vol. xxxiii. p. 768, pl. vii. figs. 8 and 9.

P. reticulata is another of the forms which has been relegated to Terquem's quasi-genus *Epistomina*. The Gault specimens show the secondary aperture in most of the examples examined.

The geological range of this species is very similar to that of the preceding. It has been described from the *Ornatus* clays of Russia (Uhlig); from the *Millettianus*-clay at the base of the Albian group of North Germany (Reuss); and from the Lower Marl bed, Navesink formation, of New Jersey (Bagg).

P. reticulata was found in the Gault of Folkestone in zone i., spec. *b*, very rare; zone ii., spec. *c*, very rare; zone xi., 55 ft. from the top, very rare.

Pulvinulina Carpenteri Reuss sp., plate I. figs. 11 *a–c*.

Rotalia Carpenteri Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. Abth. i. p. 94, pl. xiii. figs. 6 *a–c*.

The graduations from the carinate variety of *Pulvinulina elegans* to the ornate forms of the group culminate in *P. spinulifera*, and the present species occupies an intermediate position, with its finely serrate or prickly peripheral edge. The secondary aperture is also present in this species, and is well shown in plate I. figs. 11 *b* and *c*.

P. Carpenteri appears to be entirely restricted to the Gault formation, having been recorded from this horizon by Reuss and Rupert Jones.

In my own collection from Folkestone it occurs in zone ii., spec. *c*, rare; zone iv., frequent; zone v. very common; zone vi., common; zone vii., rare; zone viii., frequent; zone ix., common.

Pulvinulina spinulifera Reuss sp., plate II. figs. 1 *a–c*.

Rotalia spinulifera Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. Abth. i. p. 93, pl. xiii. figs. 3 *a* and *b*, 4 *a–c*, 5 *a–c*. *Epistomina spinulifera* Uhlig, 1883, Jahrb. k. k. geol. Reichsanst., vol. xxxiii. p. 768, pl. vii. figs. 5–7. *Pulvinulina spinulifera* Prestwich, 1888, Geology, vol. ii. p. 278, fig. 144 *b*.

Reuss refers to the extreme variability of this species. The peripheral edge of the test is usually scalloped or notched, and the cusps are sometimes greatly produced. The septation is very pronounced; that of the superior surface is often prominent with each riblet notched, in others not so prominent, but with the central areas of the chambers excavate. On the inferior side of the shell the septal ribs are very prominent, sometimes forming keel-like projections. The umbilical boss on the inferior surface is excavated, and has from one to as many as five or six deep depressions. In *P. spinulifera* the secondary aperture is shorter and more gaping than in the preceding species.

On examining the series of specimens of *P. spinulifera* in their sequence of distribution through the Gault beds at Folkestone, one is struck by an evolution in the form. That is to say, from zone i. and onwards to zone vii. they gradually increase in size and strength of ornamentation. Here, and in zone viii., they attain their greatest development; but after this, to zone xi. 55 ft. from the top, they gradually decrease in size, and appear to be absent from the higher zones.

This species was found by Reuss to be the most abundant in the Gault of Folkestone, and this is more or less the case in a few particular horizons. But it is seen to be much restricted in its distribution when the Folkestone Gault is examined throughout.

P. spinulifera has been observed in the *Ornatus*-clays, Oxfordian of Russia (Uhlig); and was originally described from the Gault of Folkestone (Reuss)

It occurs at Folkestone in zone i., spec. *a*, frequent; zone ii., spec. *c*, very rare; zone v., frequent; zone vi., common; zone vii., very common; zone viii., common; zone ix., frequent; zone xi., 55 ft. from the top, common.

Rotalia Lamarck [1804].

Rotalia Soldanii d'Orbigny sp. var. *nitida* Reuss, plate II. figs. 2 *a–c*.

Rotalina nitida Reuss, 1844, Geogn. Skizze Böhmen, vol. ii. pt. i. p. 214. Id., 1845–46, Verstein. Böhm. Kreideform., part i. p. 35, pl. viii. fig. 52; pl. xii. figs. 8, 20. *Placentula nitida* Berthelin, 1880, Mém. Soc. Géol. France, sér. 3, vol. i. No. 5, p. 69, pl. iv. figs. 11 *a–c*. *Discorbina oligostegia* Perner, 1892, Foraminifery Českého Cenomanu (Palæontographica Bohemiæ No. 1), p. 65, pl. x. figs. 5 *a*, *b*.

Rotalia umbilicata var. *nitida*, Id., 1897, Foraminifery Vrstev Belohorských (Palæontographica Bohemiæ, No. IV.), pp. 54, 55 and 72, pl. vii. fig. 25 and woodcut p. 53.

The specific type of the above variety was figured by d'Orbigny from the Vienna Tertiary beds.* The species often recorded from Cretaceous strata as *R. umbilicata* † was held by Dr. Carpenter to be identical with *R. Soldanii*,‡ and in this view he was supported by Dr. H. B. Brady.§

The variety *nitida* is similar to the type form in general outline, but is smaller and more delicate in the structure of the test.

R. Soldanii var. *nitida* has been found in the Gault of France (Wissant) and the Department of l'Aube (Berthelin); and from the lower Pläner-kalk and the Pläner-mergel—Cenomanian and Turonian —of Bohemia (Reuss, Perner).

In the Gault of Folkestone this variety was found in zone i., spec. *b*, rare; zone ii., spec. *a*, rare; zone ii., spec. *b*, rare; zone ii., spec. *c*, very rare; zone iii., rare; zone iv., rare; zone v., frequent; zone vi., frequent; zone vii., frequent; zone viii., frequent; zone ix., rare; zone x., rare; zone xi., 55 ft. from the top, common; 50 ft., common; 45 ft., common; 40 ft., common; 35 ft., common; 30 ft., common; 25 ft., common; 20 ft., common; 12 ft., very common; 6 ft., common.

ADDENDA.

The following species, which were found subsequently, or which required further determination, are now added to the foregoing systematic descriptions :—

Family MILIOLIDÆ.

Sub-family *MILIOLININÆ.*

Spiroloculina d'Orbigny [1826].

Spiroloculina nitida d'Orbigny, plate II. fig. 3.

Spiroloculina nitida d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 298, No. 4 (Soldani, 1795, Testaceographia, vol. i. pt. 3, p. 229, pl. clv. figs. *l l*, *m m*?). *S. rotunda* d'Orb., 1826, ibid., p. 299, No. 14 (Soldani, 1795, Test., vol. i. pt. 3, p. 229, pl. cliv. fig. *h h*). *S. nitida* Parker, Jones, and Brady, 1871, Ann. and Mag. Nat. Hist., ser. iv. vol. viii. p. 248, No. 140, pl. viii. fig. 24. *Spiroloculina* sp. indet., Hantken, 1875, Mitth. Jahrb. k. Ung. geol. Anstalt, vol. iv. p. 20, pl. xiii. fig. 1. *S. nitida* Brady, 1884, Chall. Rep., vol. ix. p. 149, pl. ix. figs. 9, 10. *S. Michalskii* Wisniowski, 1890, Mém. Acad.

* *Rotalina Soldanii* d'Orbigny, 1846, Foram. Foss. Vienne, p. 155, pl. viii. figs. 10–12.

† *Rotalina umbilicata* d'Orbigny, 1840, Mém. Soc. Géol. France, ser. 1, vol. iv. p. 32, pl. iii. figs. 4–6.

‡ Introd. Study Foram., 1862, p. 213.

§ Chall. Rep., 1884, vol. ix. p. 707.

Sci. Cracow (Pamiet. Wydz. III., Akad. Umiej. Krak.), vol. xvii. p. 8, pl. viii. fig. 6. *S. minima*, Id., ibid., p. 9, pl. viii. fig. 7. *S. difficilis*, Id., ibid., p. 10, pl. viii. fig. 8. *S. tenuiseptata* Egger, 1893, Abhandl. k. Bayer. Ak. Wiss., Cl. ii. vol. xviii. pp. 218 and 223, pl. i. figs. 48, 49. *S. (Ophthalmidium) complanata*, Id., ibid., p. 225, pl. iii. figs. 7, 8. *S. nitida* Jones, 1895, Monogr. Crag. Foram., Pal. Soc., p. 112, pl. v. fig. 3, woodcuts figs. 5, 6, p. 103 (woodcut fig. 5 is similar in section to the Gault specimen).

For an extended synonymy of this species see Jones's Monograph of the Crag Foraminifera, 1895. The typical form is characterised by the convex surface of the chambers, which may or may not be further relieved by subordinate limbation. The whole surface of the test is more or less flat, since it belongs to the group of which *S. planulata* Lam. sp. is the type. The Gault specimen is roundly ovate, the Jurassic forms are more often elongate.

S. nitida is known from Jurassic deposits (Terquem, Wisniowski); and it is well distributed through the Tertiary series. The variety from the Crag of Sutton has the outer edges of the last two chambers limbate. As a recent Foraminifer *S. nitida* is found in the shallower waters of the Mediterranean and the Tropics.

The species was found in the Gault of Folkestone in zone x., one specimen.

Family ASTRORHIZIDÆ.

Sub-family *RHABDAMMININÆ.*

Rhizammina H. B. Brady [1879].

Rhizammina indivisa Brady, plate II. fig. 4.

Rhizammina indivisa Brady, 1884, Chall. Rep., vol. ix. p. 277, pl. xxix. fig. 5–7.

"Test free, cylindrical, flexible; consisting of an unbranched chitino-arenaceous tube, often tapering towards the ends. Apertures terminal. Length 1/3 inch, more or less."—H. B. Brady.

The Gault specimen agrees, as far as is possible in a fossil, with the above description. I have also met with several specimens closely comparable with this from the Chalk-marl of Charing, Kent. *R. indivisa* has also been recorded, in a list of American fossil Foraminifera, by Dr. Anthony Woodward, from the Pliocene of Woodford Corners, Deering, Maine.*

Dr. Brady records this species as occurring especially in Globigerina-ooze of moderate depths, so that its appearance in the Gault is not wholly unexpected. Its natural fragility and shape would tend to prevent its ready preservation.

The only specimen was found in zone xi., 50 ft. from the top.

* "Fossil Foraminifera of North America," 'Practical Microscopy,' vol. v. No. 10, 1894, p. 201.

Family LITUOLIDÆ.

Sub-family *LITUOLINÆ.*

Haplophragmium Reuss [1860].

Haplophragmium Terquemi Berthelin, plate II. fig. 5.

Haplophragmium Terquemi Berthelin, 1880, Mém. Soc. Géol. France, sér. 3, vol. i. No. 5, p. 22, pl. ii. fig. 1.

This curious little Foraminifer may be easily overlooked, as M. Berthelin remarks; for it appears like an aggregated mineral flake rather than an organism, until it is viewed in a medium by transmitted light, when its septate character is easily seen.

By the above author this Foraminifer has been compared with *Spiroplecta* as regards the tendency of the chambers to become biserial in their arrangement after the spiral part is completed; but it has a terminal orifice instead of one apically lateral.

H. Terquemi is one of the more or less closely related varieties of the flattened or foliaceous type of *Haplophragmium*, such as *H. foliaceum* Brady, *H. Fontinense* Terquem, and *H. neocomianum* Chapman; and such forms are usually to be found in shallow water deposits which have been laid down with an excess of argillaceous fine sandy material and a paucity of calcareous matter. In passing, it is worth noting that foliaceous forms are in great evidence in such beds as the close-textured fuller's earth of Surrey, and the clays from Wedmore Hill in Somerset.

The species now before us, *H. Terquemi*, was originally described from the Gault of France, from the Department of l'Aube, by Berthelin.

In the Gault of Folkestone it occurs in zone i., spec. *a*, rare; zone i., spec. *b*, rare; zone ii., spec. *a*, rare; zone ii., spec. *b*, common; zone ii., spec. *c*, very common; zone iii., common; zone iv., very common; zone v., rare; zone vi., very rare; zone vii., very rare; zone viii., frequent; zone ix., frequent; zone x., rare; zone xi., 55 ft. from the top, common; 30 ft., rare; 25 ft., frequent; 20 ft., very common; 12 ft., very common; 6 ft., very common.

Sub-family TROCHAMMININÆ.

Ammodiscus Reuss [1861].

Ammodiscus Millettianus sp. nov., plate II. figs. 6 *a–c*.

Test finely arenaceous, discoidal and flattened; consisting of a coiled and irregularly constricted tube, making only one or two convolutions. Externally the suture lines are completely covered by the later growth, and are only visible at certain parts by slight linear depressions. When moistened the form of the interior of the test can be more easily seen. Aperture oblique and slit-like, situated on the peripheral edge of the test. Diameter 1/64 in.; thickness of test 1/380 in.

It gives me much pleasure to associate the name of my friend Mr. F. W. Millett with this species ; and I will take this opportunity of recording my obligations to him for the many useful notes with which he has from time to time furnished me.

A. Millettianus was found at Folkestone in zone iii., frequent ; zone viii., very rare; zone ix. frequent; zone xi., 55 ft. from the top, frequent; 50 ft., rare; 45 ft., frequent; 35 ft., common; 30 ft., rare; 25 ft. frequent; 12 ft., frequent; 6 ft., frequent.

Family TEXTULARIIDÆ.

Sub-family TEXTULARIINÆ.

Textularia Defrance [1824].

Textularia complanata Reuss sp., plate II. fig. 7.

Proroporus complanatus Reuss, 1860, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xl. p. 231, pl. xii. figs. 5 *a*, *b*. *Textularia complanata* Burrows, Sherborn, and Bailey, 1890, Journ. R. Micr. Soc., p. 553, pl. viii. fig. 16.

This species is apparently characteristic of the older Cretaceous deposits. It is recorded by Reuss from the Minimus-clay of the Rhine in Westphalia, and from the Red Chalk of Speeton by Burrows, Sherborn, and Bailey.

In the Gault of Folkestone this species occurs sparingly, and is still rarer than the *Spiroplecta* type which has been previously noticed.*

T. complanata was found in zone v., very rare; zone xi., 45 ft. from the top, very rare.

Family LAGENIDÆ.

Sub-family NODOSARIINÆ.

Marginulina d'Orbigny [1826].

Marginulina Parkeri Reuss, plate II. fig. 8.

Marginulina Parkeri Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. Abth. i. p. 59, pl. v. figs. 14 *a*, *b*. Berthelin, 1880, Mém. Soc. Géol. France, ser. 3, vol. i. No. 5, p. 34.

The above species may be regarded as an elongated form of the type *M. glabra* d'Orbigny. It was originally described by Reuss from

* Journ. R. Micr. Soc., 1892, p. 751, pl. xi. fig. 4.

the Upper Hils formation near Brunswick, and was since found in the French Gault at Montcley (Berthelin).

At Folkestone *M. Parkeri* was found in zone v., frequent.

Vaginulina d'Orbigny [1826].

Vaginulina truncata Reuss (abnormal forms), plate II. figs. 9, 10.

The fusion of two equally well grown individuals of the above species is shown in fig. 9. It appears as if a growing bud of a similar form to the initial one had become attached to the oral end of a perfect specimen, at the stoloniferous line or apertural border.

In fig. 10 we have a further corroboration of this interpretation in which a fully grown individual bears, upon the stolon border at the penultimate and last chambers, an embryonic *Vaginulina.*

Both specimens were found at Folkestone in zone x.

Vaginulina truncata Reuss var. *robusta* Berthelin and Chapman (a bigeneric outgrowth), plate II. fig. 13.

This remarkable example is truly dimorphic (in the old sense of the term); * that is to say, it exhibits two distinct generic types beginning as *Vaginulina* and succeeded by *Frondicularia.*

The vaginuline commencement, after forming four chambers beyond the primordial, takes on the plan of growth of a *Frondicularia* of the *F. archiaciana* type, but slightly broader, and altogether in keeping with the coarse texture of the earlier part,

This specimen was found in zone vii. at Folkestone.

Vaginulina recta Reuss (abnormal forms), plate II. figs. 11 and 12 *a, b.*

The first of the specimens, fig. 11, is singularly interesting on account of the fusion of two individuals of *different forms,* namely B and A (of Schlumberger); or of the microspheric and megalospheric types respectively. The first half of the specimen is a somewhat twisted *Vaginulina recta* with a microspheric commencement and numerous and narrow chambers; the later half is a perfect megalospheric form of *V. recta,* and springs out of the seventh chamber of the parent test. The primordial sphere of the second half is partially enclosed in the last chamber of the first form; and this would lead one to suppose that here we have an actual generation of a megalosphere which, failing to break free, continued to grow on in this dual fashion.

Figs. 12 *a, b* represent a perfect individual of *V. recta,* to which is attached, at the apical end, another of the same species slightly broken

* In consequence of the confusion which may be likely to arise from the different uses of the same term, that is, to mean either a combination of quasi-genera (Jones and Parker), or a dual form of the same species (according to Munier Chalmas and Schlumberger), it is here suggested that the earlier term of dimorphism be substituted by *bigenerism,* with *bigeneric* in an adjectival sense.

at the surface of attachment. The second test is turned through 90 degrees in relation to the earlier portion, the narrow back of the latter being opposed to the lateral surface of the former.

Both specimens were found in zone x. at Folkestone.

Sub-family POLYMORPHININÆ.

Sagrina (*Sagrina*) d'Orbigny [1839]; emend. Parker and Jones [1865].

Sagrina calcarata Berthelin sp., plate II. figs. 14 *a, b.*

Bigenerina calcarata Berthelin, 1880, Mém. Soc. Géol. France, ser. 3, vol. i. No. 5, p. 27, pl. i. figs. 14*a*–16; pl. ii. figs. 2 *a, b.*

This elegant little species is not very common, but it occurs in the finest washings from several zones in the Gault of Folkestone. The species approaches *Sagrina virgula* of Dr. H. B. Brady * in certain points; it is, however, distinct from that form in the character of the commencement, which in *S. calcarata* is biserial, whilst *S. virgula* has the early chamber usually irregularly arranged and sometimes spiral.

M. Berthelin obtained his specimens from the Gault of Wissant and Montcley.

S. calcarata occurs at Folkestone in zone xi., 50 ft. from the top, frequent; 40 ft., very rare; 30 ft., rare; 25 ft., very rare; 12 ft., very rare.

Family ROTALIIDÆ.

Sub-family ROTALIINÆ.

Discorbina Parker and Jones [1862].

Rosalina Vilardeboana d'Orbigny 1839, Foram. Amér. Mérid., p. 44, pl. vi. figs. 13–15. *Discorbina Vilardeboana* Parker and Jones, 1872, Quart. Journ. Geol. Soc., vol. xxviii. p. 115. Brady, 1884, Chall. Rep., vol. ix. p. 645, pl. lxxxvi. figs. 9, 12; pl. lxxxviii. fig. 2. Chapman, 1894, Quart. Journ. Geol. Soc., vol. l. p. 721.

The specimen from the Gault is not very typical nor well developed, but appears to come nearest to the above species. It is always found in shallow water deposits at the present day. As a fossil it has occurred in the Lower Greensand (Bargate Pebble beds) of Surrey.

The specimen found in the Gault at Folkestone was from zone iii.

* Chall. Rep., vol. ix. 1884, p. 58?, pl. lxxvi. figs. 4–10.

APPENDIX I.

The Gault of Folkestone, and its Continental Equivalents.

The Folkestone cliffs offer one of the best opportunities for a systematic study of the Gault Microzoa, with respect to the distribution at different horizons; chiefly on account of the completeness of the exposure of the series at this locality. Indeed, it has already been selected as a basis for zonal subdivision by C. E. De Rance * and F. G. H. Price,† who have rendered this section classic by their researches into the palæontologico-zonal subdivision of the series.

The section at Folkestone is by no means of the maximum thickness.‡ According to the measurements given by Price, it is 99 ft. 4 in., measured from the band of sulphide of iron nodules of zone i.—4 ft. above the bed containing *Ammonites* (*Acanthoceras*) *mammillatus*—up to the base of the Chloritic (glauconitic) Marl.§

The Gault section exposed in the Folkestone cliffs is not seen complete at any one spot, owing to the number of local landslips caused by the sliding of the Lower Chalk upon the impervious and wet surface of the Gault; the latter being often squeezed out and faulted. By careful observation the whole series of Gault strata can be followed, from near the Harbour, where it lies upon the Folkestone beds of the Lower Greensand (Aptian), under Copt Point to the middle of Eastwear Bay. Just south of Martello Tower No. 3 on Copt Point, the top of the Gault is well seen, capped by the Chloritic Marl. Here is also found the curious bed of Greensand ("Middle Greensand" of Griffiths), which runs through zone xi. at 17 ft. 6 in. from the top, and having a thickness of 3 ft. 3 in. below this.

With a cliff-section like this one can take the beds in regular sequence, from the base to the top of the series, noting the various changes that take place in the lithological structure of each bed, concomitantly with the distribution of the microscopic fossil fauna; and this has been attempted in the present work.

It should be borne in mind that the zones here followed cannot be expected to hold good in their details over large areas, and the interest attaching to the distribution of the microscopic organisms will be more from a local standpoint than in its general bearing on Gault strata.

The beds forming the section of the Gault at Copt Point and Eastwear Bay are very variable in lithological character, and they apparently constitute an intermediate type compared with the series in other localities.

The Gault formation becomes more arenaceous towards the west, as in Dorset and Devon, where it represents a more persistently littoral or shore-line deposit; whilst the Gault to the north and east of Folke-

* Geol. Mag., vol. v. (1868) p. 163.

† Quart. Journ. Geol. Soc., vol. xxx. (1874). Also 'The Gault,' 1879.

‡ The Gault in Kent and Surrey ranges from about 100 to 200 feet in thickness; but at Caterham it has been proved by a well-boring to be 343 feet thick. See Woodward's Geol. of England and Wales, 1887, p. 383.

§ Quart. Journ. Geol. Soc., vol. xxx. (1874) p. 343.

stone partakes of the nature of a deeper* water deposit, usually consisting of dark blue clays in the lower part, whilst the upper part is usually a pale grey marl.

We are indebted, as was previously noticed, to the labours of Messrs. De Rance and Price for the division of the Gault into zones. These authors differ in a few details, and in the method of numbering the zones. In the present work, the latter author's arrangement is followed.†

With regard to the zone xi., in which the Greensand seam occurs, it appears advisable to make a further division. Hitherto the upper 56 ft. 3 in. of pale-grey marl has been referred entirely to zone xi., exceeding in thickness that of all the other ten zones together. Concerning this bed, Mr. A. J. Jukes-Browne has suggested to me the following modification. Zone xi. to be measured from the base given by Mr. Price, ‡ up to the base of the Greensand seam, and giving a thickness of 35 ft. 6 in. The Greensand seam (a glauconitic clay) measuring 3 ft. 3 in. just south of Martello Tower No. 3, to be called zone xii. From the top of the Greensand seam to the base of the Chloritic marl, 17 ft. 6 in., constituting zone xiii.

This subdivision of the extensive thickness of zone xi. will probably facilitate the comparison of their fossil contents. These alterations, I learn from Mr. Jukes-Browne, are fully endorsed by Mr. Price himself.

The various seams of Greensand and lines of nodules seen at Folkestone can rarely be traced for any distance from the locality. The base of the Gault is usually formed by a bed of Greensand; and in the Isle of Wight, notably at Compton Bay, Sandown Bay, and near Bonchurch, a bed of Carstone is well seen. This Carstone bed occurs about the horizon of the *Ammonites* (*Acanthoceras*) *mammillatus* zone of the Lower Greensand, together with the basement bed of the Gault, and these are referred to as the lowest bed of the Gault (Albian Stage) by French geologists.

The bed of Greensand (zone xii.) at Folkestone has also been observed at Eastbourne by Mr. Price.

As an instance of the great variability in the character of certain beds of Gault age, it will only be necessary to refer to the beds of "Red Chalk" at Hunstanton and Speeton, which are probably on the same geological horizon as the upper zones of the Gault; and in this respect it will be instructive to make a comparison between the microzoic faunas of the two deposits.§

With reference to strata of similar age on the Continent, in France the series to which d'Orbigny gave the name "Albien," commences with a sandy layer containing *Am.* (*Acanthoceras*) *mammillatus*; which zone is usually grouped with the Aptian beds of the Lower Greensand by English geologists. In the eastern part of the Paris basin this bed is

* This is used in a comparative sense.

† It will not be necessary to repeat the diagram and measurements of the zones at Copt Point; for this the papers already mentioned by Messrs. De Rance and Price should be consulted. Details of the chief points of interest in the zonal distribution of the Foraminifera are given in the latter part of Appendix IV.

‡ The seam of phosphatic nodules containing *Pecten Raulinianus*.

§ See pp. 22, 40–42.

covered by an argillaceous layer corresponding to our Gault, and in part with the *Minimus*-clay of North Germany.

The following table shows the relation of the Albian beds of France with those of Germany, as given by M. Barrois.

France.		*Germany.*
Zone supérieure	Zone of *Ammonites splendens*—"Flammenmergel"	Upper Gault.
Zone moyenne	Zone of *Am. interruptus* and *Belemnites minimus.*	
Zone inférieure	Zone of *Am. tardefurcatus* and *Am. Millettianus.*	Middle Gault.

The term Gault is used in a much broader sense in Germany than in England. The name was originally applied to the blue clays underlying the Chalk and Upper Greensand in this country; but in Germany, where blue clays extend downwards to beds of Aptian age, the term refers to both the Aptian and Albian stages of d'Orbigny's classification.

The subdivisions of the Gault of North Germany (N. of the West Harz and Brunswick) have been laid down by von Strombeck as follows, in descending order.

ALBIAN STAGE.

UPPER GAULT.

1. *Flammenmergel.* With *Ammonites* (*Schloenbachia*) *inflatus, Am.* (*Hoplites*) *lautus, Am.* (*Hoplites*) *auritus,* and *Avicula gryphæoides.*
2. *Minimus-Thon.* With *Belemnites minimus, Am.* (*Hoplites*) *lautus,* and *Am.* (*Hoplites*) *splendens.*

MIDDLE GAULT.

1. Clay with *Am.* (*Hoplites*) *tardefurcatus.*
2. Clay with *Am.* (*Acanthoceras*) *Millettianus.*

APTIAN STAGE.

LOWER GAULT.

1. White marl with *Belemnites Ewaldi* and *Am.* (*Placenticeras*) *nisus.*
2. Clay with *Am.* (*Acanthoceras*) *Martini* and *Am.* (*Hoplites*) *Deshayesi.*
3. Dark blue clay, poor in fossils.
4. Dark blue tenacious clay with *Belemnites Brunsvicensis.**

The Middle Gault of Germany appears to be entirely unrepresented in England. The equivalent to our own series is the so-called Upper Gault of Germany, with the *Minimus*-clay and the greater part of the Flammenmergel.

* Neues Jahrb., 1857, p. 639; Zeitschr. d. deutsch. Gesellsch., 1861, p. 20; also Kayser-Lake, Text-book of Comp. Geol., 1893, p. 293.

APPENDIX II.

Previous Work on the Foraminifera found in the Gault of England and elsewhere.

For our knowledge of the Foraminifera of the Gault of England, we are in the first place indebted to the work of Prof. A. E. Reuss * who gave, in his monograph on the Foraminifera of the Hils and Gault, a supplement on these organisms from Folkestone.† His study was the result of an examination of a sample of clay which Prof. (then Mr.) T. Rupert Jones had sent for the purpose. In this supplement dealing with Folkestone, Dr. Reuss enumerated 39 species, and compared them in detail with the Foraminifera obtained from similar and older strata (Albian and Aptian) in North Germany. After deducting 4 unnamed forms and 11 newly described species; of the remaining 24 Reuss found 19 (or nearly 80 per cent.) common to the Folkestone Gault and the *Minimus*-clay of North Germany, with which latter formation there is most agreement in the microzoic contents. Of the 19 species from the *Minimus*-clay, Reuss found 5 peculiar to that stratum, 2 in that and the beds immediately underlying it, and 1 restricted to the *Minimus*-clay and the Flammenmergel. Nine of the species passed into the Upper Cretaceous series.

From time to time lists of Gault Foraminifera have appeared, largely based upon the researches of Prof. T. Rupert Jones, and further augmented by Reuss's list.‡

The Foraminifera of the Gault from Meux's well-boring, Tottenham Court Road, London, have been enumerated by Chas. Moore, and 31 species are recorded.§

As regards the Red Chalk of Yorkshire, Norfolk, and Lincolnshire, the Foraminifera have been carefully worked out by Messrs. Burrows, Sherborn, and Bailey,‖ and they will presently be compared with the Gault facies.

From France we have an elaborate and valuable monograph on the Foraminifera of the Albian stage of Montcley in the Department of Doubs, by M. Berthelin.¶ This author described many new forms, most of which I have since met with in the Gault of Folkestone. Altogether there are 98 species enumerated.

For the Gault beds of Northern Germany we have the very complete

* 'Die Foraminiferen des Norddeutschen Hils und Gault,' Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. Abth. 1, 1862, pp. 5–100, pls. i.–xiii.

† Op. cit., pp. 88–95, pl. xii. figs. 5–14 and pl. xiii.

‡ See Morris' 'Catalogue of British Fossils,' 2nd ed., 1854, pp. 32–44, for references to English Gault Foraminifera, compiled by T. R. Jones. Also 'Memoir on the Weald,' Topley, 1875, Geol. Surv. Mem., pp. 433 and 434, for lists of Gault Foraminifera furnished by Prof. T. R. Jones.

§ Quart. Journ. Geol. Soc., vol. xxxiv. (1878) pp. 917–8.

‖ Journ. R. Micr. Soc. for 1890, pp. 549–66, pls. viii.–xi.

¶ 'Mémoire sur les Foraminifères Fossiles de l'Étage Albien de Montcley (Doubs),' Mém. Soc. Géol. France, ser. 3, vol. i. No. 5, 1880, pp. 1–84, pls. i.–iv. (xxiv.–xxvii.)

and exhaustive study by Reuss on the Foraminifera of the Hils clay and Gault formations, reference to which has already been made; and upon the tables given by Reuss, M. Berthelin has made some interesting analyses of the foraminiferal facies of the various divisions of the two areas in Germany and France. By the comparisons there made, M. Berthelin found twice as many species of the Foraminifera pass into the Upper Cretaceous beds as into the Aptian beds below the Gault.

Partly coincident in age with the Gault of the above-mentioned areas are the Greensands of New Jersey. For our knowledge of the Foraminifera of these beds we are indebted to A. E. Reuss,* A. Woodward,† and R. M. Bagg.‡ The last-named author has given a list of 94 species, in which some noteworthy forms, usually considered peculiar to the uppermost beds of the Chalk in Europe, have occurred. The same author has latterly given short lists of the Foraminifera to accompany the stratigraphical details of New Jersey, Delaware, and Maryland, by W. B. Clark.§

Of works dealing with the Foraminifera from strata immediately below and above the Gault in Europe, it will only be necessary to briefly mention some of the more important. To that of Reuss, in which he treats of the Hils formation and the Speeton clay of North Germany (Aptian), reference has already been made. Dr. R. Haeusler gives the species found in the Gault (Aptian and Albian) of St. Croix.‖ The present writer has described the Microzoa of the Bargate beds (Aptian) of Surrey.¶ The Foraminifera of the beds above the Gault have been elucidated by G. R. Vine,** who has published a list of these organisms from the Cambridge Greensand (possibly derived from an equivalent to zones x.–xiii. of the Gault); whilst the Cenomanian beds of Bohemia have received very careful attention from Dr. Jaroslav Perner.††

The literature of the Foraminifera relating to the Upper Cretaceous beds of the Turonian and Senonian stages is very extensive, and references to the chief works will be found by consulting the previous parts of this series of papers.

* 'Die Foraminiferen des senonischen Grünsandes von New Jersey,' Sitzungsb. d. k. Ak. Wiss. Wien, vol. xliv. (1861) pp. 334–40, pl. vii. figs. 3-7, pl. viii.

† 'Synopsis of the Cretaceous Foraminifera of New Jersey,' Journ. New York Micr. Soc., vol. vi. No. 2, 1890; vol. x. No. 4, 1894.

‡ 'The Cretaceous Foraminifera of New Jersey,' Johns Hopkins Univ. Circulars, vol. xv. No. 121, 1895, pp. 10–12.

§ 'Upper Cretaceous Formations of New Jersey, Delaware, and Maryland,' Bull. Geol. Soc. America, vol. viii. (1897) pp. 315–58.

‖ 'Die Lageninen der schweizerischen Jura- und Kreide-formations,' Neues Jahrb. für Min., vol. i. 1887, pp. 177–89, pls. iv. and v.

¶ 'The Bargate Beds of Surrey and their Microscopic Contents,' Quart. Journ. Geol. Soc., vol. l. 1894. The Foraminifera on pp. 693–724, pls. xxxiii. and xxxiv.

** 'Notes on the Polyzoa and the Foraminifera of the Cambridge Greensand,' Proc. Yorkshire Geol. and Polytechnic Soc., N.S., vol. ix. pt. i. 1885 (1886) pp. 10–29, pls. i. and ii.

†† 'Ueber die Foraminiferen des Böhmischen Cenomans [Foraminifery Českého Cenomanu'], Česká Akad. Cisaře Frantiska Josefa, Prague, 1892 (Palæontographica Bohemiæ, No. 1).

APPENDIX III.

Distribution Tables of the Foraminifera from the Gault of Folkestone.

In drawing up the following tables of species from Folkestone, a few additional occurrences have been added to levels in which the species had not been discovered at the time of publishing the descriptions in the foregoing parts of this work.

In addition to this, it is necessary to make some alterations in the determination of a few species, as follows :—

Ophthalmidium tumidulum Brady, *Cornuspira cretacea* Reuss, *C. involvens* Reuss, and *C. foliacea* Philippi sp.* The specimens from the Gault which were referred to the above-named species were thought originally to be porcellanous in shell structure, since the test appears of a chalky white colour by reflected light. On submitting them, however, to conditions which render them translucent, they in each case proved to be composed of arenaceous material, the component quartz-grains being of excessive minuteness, averaging $\cdot 004\ \mu$ in diameter. It is this fine arenaceous structure, with its glazed external surface, which gives the porcellanous appearance to the specimens. Although in the porcellanous groups these forms have been separated into the four so-called species, when removed to the arenaceous group they so fill up gaps in a long series dominated by the same type, that they cannot reasonably be included under more than one specific form—that of *Ammodiscus incertus* d'Orb. sp. So much for the imperfect character of Rhizopodal nomenclature.

Trochammina concava.† It is interesting to note the close relationship between *T. inflata* Montagu sp., var. *macrescens* Brady ‡ and the above, as has been pointed out to me by my friend Mr. Millett. As far as I have noticed, the variety *macrescens* is nearly devoid of arenaceous material, and consists usually of a chitinous test.

The specimens from the Gault of France and England which have been placed under *Bulimina polystropha* Reuss by M. Berthelin,§ and later by myself,|| are without doubt the same form as that described by Dr. Egger from the Miocene of Lower Bavaria.¶ This discrepancy has probably arisen from the non-agreement of the original figure and description of *Bulimina polystropha* given by Reuss, the figure showing a smooth test, while the specimen is described as having a rough surface.**

Frondicularia pinnæformis †† had already been figured and described by Dr. Perner from the Cenomanian of Bohemia, under the name of

* See this Journal for 1891, pp. 574 and 575, pl. ix. figs. 10-13.

† See this Journal for 1892, p. 327, pl. vi. figs. 14 *a, b*.

‡ Ann. and Mag. Nat. Hist., ser. iv. vol. vi. 1870, p. 290, pl. xi. figs. 5 *a–c*.

§ Mém. Soc. Géol. France, 1880, ser. 3, vol. i. No. 5, p. 30, pl. ii. figs. 3 *a, b*.

|| See this Journal for 1892, p. 756, pl. xii. fig. 11.

¶ *Bulimina pygmæa* Egger, 1857, Neues Jahrb. f. Min., p. 284, pl. xii. figs. 10, 11.

** Verstein. Böhm. Kreidef., pt. ii. (1845) p. 109, pl. xxiv. figs. 53 *a, b*. [For further details on this point see Quart. Journ. Geol. Soc., vol. l. (1894) pp. 701-2.]

†† See this Journal for 1894, p. 156, pl. iii. figs. 9–11.

F. Fritschii;* and therefore the latter name stands by priority. The species has also been found in the Turonian of Bohemia by Perner.†

Marginulina aspera.‡ This name has already been used for another type by Terquem; § it is therefore here proposed to alter the name of the Gault species to *asperula.*

Cristellaria nodosa Reuss sp. || Costa has figured a form,¶ to which Mr. Millett draws my attention; it is comparable to Reuss's species, and has priority of publication. It will be necessary, therefore, to retain the form under Costa's name, as *Cristellaria lobata.*

In the table of species, the fistulose varieties of the *Polymorphinæ* are denominated by the new names proposed by Prof. Rupert Jones and the present writer in a paper on the 'Fistulose *Polymorphinæ*,' published subsequently to the descriptions of the fistulose varieties given in this work.**

In the following Tabulation of the Red Chalk Foraminifera (pp. 40–42) we have 86 species. Of these 52, or a little more than 60 per cent., have been found in the Gault of Folkestone. In the Lower Gault (zones i.–vii.) 38 Red Chalk forms occur; whilst in the Upper Gault (zones viii.–xiii.) we find 48 species common to this and the Red Chalk; or 44 per cent. and nearly 56 per cent. respectively.

As the result of an examination of Chalk-marl from Eastwear Bay (Bed ii. of Price), which I have made for this present work,†† there are only 25 species, or 29 per cent. of the Foraminifera from this horizon, common to the Red Chalk. It therefore seems conclusive that the conditions under which the Red Chalk (speaking of it in a general sense) was deposited are nearly the same as were existent during the formation of the Upper Gault of Folkestone. There is a marked absence of shallow-water and coarsely grown arenaceous Foraminifera in the Red Chalk, quite unlike the assemblage found in the Chalk-marl.

* Perner, 'Foraminifery Českého Cenomanu' (Pal. Bohemiæ, No. 1), 1892, p. 58, pl. vii. figs. 1 *a–d*.

† 'Foraminifery Vrstev Belohorských' (Palæontographica Bohemiæ, No. 4), 1897, p. 68, pl. iv. figs. 13–15 [with vars. *pseudocanaliculata* and *interrupta*].

‡ See this Journal for 1894, p. 162, pl. iv. fig. 18.

§ Mém. Ac. Imp. Metz, vol. xliv. (1863) p. 401, pl. viii. figs. 14 *a, b*.

|| See this Journal for 1896, p. 4, pl. i. figs. 5 *a, b*.

¶ *Robulina lobata* Costa, 1856, Atti Accad. Pontcniana vol. vii. fas. 2, pl. xx. fig. 14.

** Journ. Linn. Soc. London, Zoology, vol. xxv. (1896) pp. 497–516.

†† I have refrained from using the series of Foraminifera from the Chalk detritus of Charing for comparison here, as it is possible that there may be fossils from higher horizons included in it.

Distribution Tables of the Foraminifera from the Gault of Folkestone.

No.	Zones	I.		II.			III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.							XII.	XIII.		Range in Time.	No.
	Species.	(*a*) Greensand seam.	(*b*) 5 ft. up.	(*a*) Crushed band.	(*b*) 11 ft. up.	(*c*) 13 ft. up.									55 ft. down.	50 ft. down.	45 ft. down.	40 ft. down.	35 ft. down.	30 ft. down.	25 ft. down.	20 ft. down (Greensand).	12 ft. down.	6 ft. down.		
1	*Nubecularia depressa* sp. n.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	..	Gault	1
2	,, *nodulosa* sp. n.	..	..	..	..	..	..	r	f	..	..	..	..	r	r	f	c	..	c	..	c	..	..	vr	,, ...	2
3	*Biloculina undulata* sp. n.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	,, ...	3
4	*Spiroloculina nitida* d'Orb.	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	..	..	Mid-Jurassic—Recent	4
5	,, *asperula* Karrer	..	..	..	..	vr	..	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	..	Miocene—Recent	5
6	*Miliolina venusta* Karrer sp.	..	..	..	..	..	..	..	..	..	..	..	..	vc	vc	vc	f	f	f	f	vc	c	c	vr	Gault—Recent	6
7	,, *tricarinata* d'Orb. sp. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	..	..	vr	..	..	..	..	,, ,, ...	7
8	,, *Ferussacii* d'Orb. sp. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	r	..	..	..	vc	c	,, ,, ...	8
9	,, *agglutinans* d'Orb. sp. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	vr	vr	..	,, ,, ...	9
10	*Rhizammina indivisa* Brady	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	,, ,, ...	10
11	*Reophax lageniformis* sp. n.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	vr	Gault	11
12	,, *ampullacea* Brady	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	f	..	Gault—Recent	12
13	,, *fusiformis* Will. sp.	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	..	vr	,, ,, ...	13
14	,, *scorpiurus* Montfort	..	..	..	..	..	..	..	..	..	..	..	..	r	..	..	..	..	..	..	..	..	..	..	Oolite—Recent	14
15	,, *Folkestoniensis* sp. n... ..	..	..	..	..	..	..	..	..	..	..	..	..	vc	..	..	..	..	..	..	..	..	..	..	Gault	15
16	,, *cylindracea* sp. n.	..	..	..	..	..	..	..	..	..	..	..	..	c	..	..	..	..	..	..	..	..	..	..	,, ...	16
17	*Haplophragmium glomeratum* Brady ..	..	..	..	..	c	r	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	..	f	..	Gault—Recent	17
18	,, *Terquemi* Berthelin	r	r	r	c	vc	c	vc	r	vr	vr	f	f	r	c	..	..	..	..	r	f	vc	vc	vc	Gault	18
19	,, *nonioninoides* Reuss	..	c	..	c	vc	r	vc	vc	f	vc	c	c	vc	c	c	vc	c	c	vc	c	..	c	c	Lower Greensand—Gault ..	19
20	,, *elegans* sp. n. ..	..	..	..	..	..	..	..	..	..	..	..	vr	..	vr	..	..	..	..	..	..	..	..	..	Gault	20
21	,, *acutidorsatum* Hantken.	..	vr	..	f	c	vc	f	f	vr	r	r	vr	f	f	f	r	f	f	vr	vr	..	..	..	Lower Greensand—Recent ..	21
22	,, *latidorsatum* Born. sp.	vr	vr	c	f	f	r	..	f	..	..	f	vr	vr	vr	..	r	..	vr	..	..	..	vc	vc	Gault—Recent	22
23	,, *latidorsatum* var. *papillosa* var. n.	..	..	..	..	..	..	..	..	..	..	..	..	r	..	..	..	..	..	..	..	..	..	..	Gault	23
24	,, *æquale* Römer sp. ..	..	vr	f	f	r	vc	vc	..	vr	vr	..	..	r	..	..	..	..	..	..	..	..	..	vr	Lower Greensand—Upper Chalk	24
25	,, *agglutinans* d'Orb. sp.	..	..	..	..	vr	vr	..	..	..	..	..	..	..	..	..	vr	..	vr	..	..	..	vr	..	Carboniferous—Recent	25
26	,, *nanum* Brady ..	..	vr	..	..	vr	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	Gault—Recent	26
27	,, *globigeriniforme* P. and S. sp.	..	..	..	..	..	r	..	vr	..	vr	..	vr	..	..	..	..	..	vr	..	..	..	vr	..	,, ,, ...	27
28	*Placopsilina cenomana* d'Orb. ..	..	..	..	..	..	..	..	..	..	..	..	..	r	..	..	..	..	..	..	f	..	..	..	Carboniferous—Recent	28
29	,, *vesicularis* Brady ..	..	..	..	..	..	..	..	..	..	r	..	..	..	..	..	..	..	..	..	..	..	..	..	Gault—Recent	29
30	*Haplostiche Sherborni* sp. n.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vc	..	..	,, Chalk Marl	30
31	*Thurammina albicans* Brady	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	vr	..	..	..	..	..	Jurassic—Recent	31
32	*Hormosina globulifera* Brady	vr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Gault—Recent	32
33	*Ammodiscus incertus* d'Orb. sp. ..	..	..	..	..	f	vr	c	vr	vr	..	..	vr	vr	f	c	vr	c	r	f	vr	..	f	r	Carboniferous—Recent	33

No.	Species.	I. (a) Greensand seam.	I. (b) 5 ft. up.	II. (a) Crushed band.	II. (b) 11 ft. up.	II. (c) 13 ft. up.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI. 55 ft. down.	XI. 50 ft. down.	XI. 45 ft. down.	XI. 40 ft. down.	XI. 35 ft. down.	XI. 30 ft. down.	XI. 25 ft. down.	XII. 20 ft. down (Greensand).	XIII. 12 ft. down.	XIII. 6 ft. down.	Range in Time.	No.
34	*Ammodiscus tenuis* Brady	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	..	r	vr	r	..	..	..	vr	Gault—Recent	34
35	„ *gordialis* J. and P. sp.	..	..	..	..	vr	..	..	..	..	..	..	..	..	vr	vr	..	vr	..	..	r	..	..	..	Carboniferous—Recent	35
36	„ *Millettianus* sp. n.	..	..	..	..	..	f	..	..	..	..	vr	f	..	f	r	f	..	c	r	f	..	f	f	Gault	36
37	*Trochammina concava* sp. n.	..	..	..	..	..	r	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	„	37
38	*Textularia minuta* Berth.	..	..	..	..	..	c	f	f	..	..	..	vr	vr	f	..	c	vc	c	c	c	vc	c	f	Lower Greensand—Gault	38
39	„ *sagittula* Defrance	..	..	..	..	..	..	vr	vr	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	„ Recent	39
40	„ *gramen* d'Orb.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	..	vr	..	„ „	40
41	„ *trochus* d'Orb.	..	vr	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	„ „	41
42	„ *turris* d'Orb.	..	vr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	„ „	42
43	„ *conica* d'Orb.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	c	c	f	vc	r	f	f	c	vr	Gault—Recent	43
44	„ *agglutinans* d'Orb.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	c	..	..	vr	..	vr	..	..	Carboniferous—Recent	44
45	„ *parallela* Reuss	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	c	..	..	..	..	..	..	..	Gault	45
46	„ *prælonga* Reuss	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	f	..	..	r	c	..	..	..	Lower Greensand—Chalk	46
47	„ *complanata* Reuss sp.	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	Gault—Chalk Marl	47
48	*Verneuilina triquetra* Münst. sp.	vr	..	..	..	..	..	..	c	..	..	r	..	vr	r	f	c	f	f	f	..	..	..	..	Lower Greensand—Recent	48
49	„ *variabilis* Brady	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	vr	..	..	f	vr	..	..	..	..	Gault—Recent	49
50	„ *pygmæa* Egger sp. (non *Bulimina polystropha* Reuss)	..	..	..	..	..	vr	..	..	..	..	..	..	..	vr	r	c	c	c	c	c	vc	vc	f	„ „	50
51	*Tritaxia tricarinata* Reuss	..	..	..	..	..	..	..	vr	..	vr	..	..	vc	..	vr	vr	..	f	c	f	vr	vc	c	Lower Greensand—Recent	51
52	„ *pyramidata* Reuss	..	..	..	..	..	..	..	..	..	r	vr	..	c	..	c	..	..	..	f	f	c	c	c	Gault—Chalk	52
53	*Spiroplecta annectens* P. and J. sp.	..	..	..	..	..	..	..	c	..	..	..	..	..	..	..	f	..	..	vr	f	..	..	..	Lower Greensand—Recent	53
54	„ *complanata* Reuss sp.	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	Gault	54
55	„ *prælonga* Reuss sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	f	..	..	..	c	..	..	..	„	55
56	„ *anceps* Reuss sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	vr	..	..	..	..	..	..	..	„	56
57	*Gaudryina filiformis* Berth.	vr	vr	..	r	vr	r	r	vr	..	vr	..	vr	..	vr	..	..	..	r	..	vr	..	..	..	Lower Greensand—Recent	57
58	„ *pupoides* d'Orb.	..	c	f	..	..	vr	vr	..	vr	..	vr	f	vc	..	vc	vc	r	vc	vc	vc	..	f	..	„ „ „	58
59	„ *rugosa* d'Orb.	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	f	c	..	vr	..	vr	..	..	..	Gault—Recent	59
60	„ *oxycona* Reuss	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	c	vr	„ Upper Chalk	60
61	„ *dispansa* sp. n.	..	..	..	..	..	..	..	..	..	..	vr	..	r	..	..	..	r	..	..	..	..	..	..	„ Chalk Marl	61
62	*Valvulina conica* P. and J.	vr	..	..	..	..	..	..	vr	..	..	..	..	..	..	vr	vr	..	r	..	vr	..	..	..	Lower Greensand—Recent	62
63	„ *fusca* Will. sp.	..	..	..	..	..	vr	..	..	..	r	..	..	r	..	..	..	..	..	..	..	..	..	..	„ „ „	63
64	*Bulimina Orbignyi* Reuss	..	vr	..	..	..	..	..	..	..	..	c	r	c	..	..	vr	..	..	..	..	c	f	f	Gault—Chalk	64
65	„ *obliqua* d'Orb.	..	..	..	..	..	..	..	..	..	..	f	..	f	vr	..	vr	..	..	..	f	vc	..	..	„ „	65
66	„ *Presli* Reuss	..	..	..	..	..	..	..	..	r	vc	f	c	c	vc	vr	f	c	r	f	c	c	r	c	„	66
67	„ „ var. *sabulosa* var. n.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vc	vc	vc	„ Chalk Marl	67

No.	Zones ..	I.		II.			III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.							XII.	XIII.		Range in Time.	No.
	Species.	(*a*) Greensand seam.	(*b*) 5 ft. up.	(*a*) Crushed band.	(*b*) 11 ft. up.	(*c*) 13 ft. up.									55 ft. down.	50 ft. down.	45 ft. down.	40 ft. down.	35 ft. down.	30 ft. down.	25 ft. down.	20 ft. down (Greensand).	12 ft. down.	6 ft. down.		
68	*Bulimina Murchisoniana* d'Orb. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	v r	c	r	v r	..	r	f	r	Lower Greensand—Chalk ..	68
69	,, *obtusa* d'Orb.	..	..	..	..	..	..	..	..	..	..	..	..	..	v r	..	v r	..	..	..	..	..	..	v r	,, ,, ,, ..	69
70	,, *brevis* d'Orb...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	v r	f	..	..	c	c	,, ,, ,, ..	70
71	,, *pyrula* d'Orb.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	..	f	..	v r	..	Lias—Recent	71
72	,, *affinis* d'Orb.	..	..	..	..	..	..	..	v r	..	..	..	v r	..	v r	..	..	..	v r	..	..	c	c	c	Lower Greensand—Recent ..	72
73	*Bolivina textilarioides* Reuss	..	c	v c	f	f	c	f	r	..	..	..	f	r	..	f	c	c	f	f	f	v c	c	f	,, ,, ,, ..	73
74	*Pleurostomella obtusa* Berthelin ..	..	f	v r	v r	..	..	..	f	..	..	v r	..	..	..	v r	r	v r	..	v r	f	c	f	..	Gault	74
75	,, *alternans* Schwager ..	..	f	v r	..	..	..	..	v r	..	..	..	..	..	v r	v r	..	r	..	..	v c	c	f	..	,, —Recent	75
76	*Lagena globosa* Montagu sp.	..	..	..	..	..	..	..	..	..	..	v r	..	..	v r	..	..	..	..	..	..	..	..	..	Silurian—Recent	76
77	,, *apiculata* Reuss	..	v r	v r	..	..	..	v r	v r	..	v r	..	..	v r	r	f	v c	v r	r	f	f	..	r	v r	Lias—Recent	77
78	,, ,, var. *emaciata* Reuss	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	..	..	..	..	..	..	..	Gault	78
79	,, *lævis* Montagu sp.	..	..	..	..	..	..	v r	v r	..	..	..	..	..	..	..	..	..	v r	r	..	..	..	..	Silurian—Recent	79
80	,, *gracillima* Seguenza sp. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	..	Gault—Recent	80
81	,, *aspera* Reuss	..	..	..	..	..	v r	..	..	..	..	..	..	..	..	..	f	..	..	..	..	..	r	..	Carboniferous—Recent	81
82	,, *hispida* Reuss	..	..	v r	..	..	c	v c	v c	r	v c	..	..	..	..	f	v r	v r	r	v r	r	..	r	..	Lower Lias—Recent	82
83	,, *sulcata* Walker and Jacob sp.	..	..	..	..	v r	..	v r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Silurian—Recent	83
84	,, *acuticosta* Reuss	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Lower Greensand—Recent ..	84
85	,, *gracilis* Williamson	..	..	v r	..	..	v r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	v r	..	..	Gault—Recent.	85
86	,, *alifera* Reuss	..	..	..	..	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	..	..	..	..	,, Oligocene	86
87	,, *striatopunctata* P. and J. ..	..	..	..	..	..	..	v r	..	..	..	..	..	..	v r	..	..	..	..	v r	..	..	..	..	,, Recent	87
88	,, *marginata* Walker and Boys ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	v r	..	,, ,, ...	88
89	,, *quinquelatera* Brady var. *inflata* var. n.	..	..	v r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	,, ...	89
90	*Nodosaria (G.) humilis* Römer ..	..	..	..	..	..	..	..	v r	..	..	..	..	v r	..	..	..	v r	..	..	..	..	..	..	Lias—Lower Eocene	90
91	,, (*G.*) *mutabilis* Reuss sp. ..	..	..	..	..	..	v r	..	..	v r	..	..	..	..	..	..	..	..	..	..	..	r	..	v r	Neocomian—Chalk	91
92	,, (*G.*) *cylindracea* Reuss ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	..	..	v r	..	..	f	..	Gault—Chalk	92
93	,, *radicula* L. sp. var. *Jonesi* Reuss.	..	..	..	..	..	..	..	..	..	..	..	v r	..	v r	r	c	..	..	v r	..	..	v r	..	,, ...	93
94	,, *oligosteyia* Reuss	..	..	..	..	..	..	..	..	..	v r	..	..	..	v r	..	v r	..	..	..	..	..	..	..	Lias—Recent	94
95	,, (*D.*) *expansa* Reuss sp. ..	..	..	..	v r	..	v r	..	..	..	..	..	..	..	..	..	v r	..	v r	..	..	..	..	..	Gault—Chalk	95
96	,, (*D.*) *farcimen* Reuss after Soldani.	..	..	..	..	..	..	..	..	..	..	r	..	f	..	..	v r	..	..	..	..	..	..	v r	Permian—Recent	96
97	,, (*D.*) *soluta* Reuss sp. ..	..	f	..	v r	..	..	..	..	..	..	..	..	v r	..	c	..	..	..	r	f	.	v r	..	Lias—Recent	97
98	,, ,, var. *discrepans* Reuss.	..	..	..	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	..	..	..	..	..	Gault—Chalk	98
99	,, ,, var. *pulchella* var. n.	..	..	..	..	..	..	..	..	..	..	..	v r	..	..	..	..	v r	..	..	..	..	..	..	,, ...	99

No.	Zones	I.		II.			III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.							XII.	XIII.		Range in Time.	No.
	Species.	(a) Greensand seam.	(b) 5 ft. up.	(a) Crushed band.	(b) 11 ft. up.	(c) 13 ft. up.									55 ft. down.	50 ft. down.	45 ft. down.	40 ft. down.	35 ft. down.	30 ft. down.	25 ft. down.	20 ft. down. (Greensand).	12 ft. down.	6 ft. down.		
100	*Nodosaria (D.) gracilis* d'Orb. sp. ..	..	..	vr	..	..	vr	r	..	r	..	....	vr	vr	..	vr	r	..	..	..	..	..	..	vr	Gault—Chalk	100
101	,, *(D.) Lorneiana* d'Orb. sp.	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	vr	vr	..	..	..	vr	..	..	..	,, ,, ...	101
102	,, *(D.) pauperata* d'Orb. sp.	..	..	..	..	..	r	vr	..	..	r	....	....	..	vr	..	f	..	..	..	r	..	vr	..	Lias—Recent	102
103	,, *(D.) consobrina* d'Orb. sp.	..	..	..	..	..	vr	..	vr	..	..	r	..	..	..	f	..	vr	r	vr	f	..	vr	..	Gault—Recent	103
104	,, *(D.) cylindroides* Reuss sp.	..	..	..	..	..	..	..	vr	..	..	....	....	vr	..	..	r	..	..	..	vr	..	..	..	,, Chalk	104
105	,, *(D.) hamulifera* Reuss ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	Neocomian—Gault	105
106	,, *(D.) xiphioides* Reuss ..	..	..	..	..	..	..	..	vr	..	..	....	....	..	..	..	..	..	..	..	..	..	..	..	Lower Greensand—Gault ..	106
107	,, *(D.) legumen* Reuss ..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	f	..	r	r	..	..	..	..	..	Gault—Chalk	107
108	,, *(D.) Roemeri* Neugeboren sp.	..	vr	..	..	..	..	vr	..	..	vr	....	....	f	f	..	vr	..	f	f	f	vr	f	vr	Lower Greensand—Recent ..	108
109	,, *(D.) communis* d'Orb. ..	..	..	..	..	..	vr	..	r	..	f	..	f	..	c	c	r	f	c	f	vc	..	f	..	Permian—Recent	109
110	,, *(D.) mucronata* Neug. sp.	..	..	..	..	..	..	..	vr	..	..	....	....	vr	..	..	..	..	..	vr	vr	..	vr	..	Oolite—Recent	110
111	,, *(D.) costellata* Reuss ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	Gault—Chalk	111
112	,, *(D.) raristriata* sp. n. ..	..	..	..	..	..	..	..	..	..	..	....	....	..	r	..	r	vr	..	vr	..	..	..	vr	,, ...	112
113	,, *hispida* d'Orb.	..	f	..	..	..	..	c	f	..	f	..	..	..	..	..	f	..	..	..	..	..	..	..	Lias—Recent	113
114	,, *perpusilla* sp. n.	..	..	..	..	..	r	..	vr	..	..	....	....	..	..	vr	..	..	..	..	..	..	..	..	Gault	114
115	,, *bambusa* sp. n.	..	..	..	..	..	..	..	r	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	..	,, ...	115
116	,, *(D.) intercellularis* Brady ..	..	..	..	..	..	vr	..	..	..	..	....	....	..	..	..	..	..	..	..	r	..	..	..	,, —Recent	116
117	,, *sceptrum* Reuss	..	vr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Neocomian—Gault	117
118	,, *internotata* sp. n.	..	vr	..	..	..	vr	..	vr	..	..	....	....	..	..	vr	r	..	vr	vr	..	..	..	..	Gault	118
119	,, *(D.) tubifera* Reuss ..	..	f	..	..	..	f	vr	vr	r	..	vr	..	..	r	vr	f	f	f	..	..	vr	..	..	Neocomian—Gault	119
120	,, *(D.) Zippei* Reuss	..	..	..	..	..	..	..	vr	..	vr	....	vr	vr	c	r	r	..	f	vr	vr	vr	vr	vr	Gault—Chalk	120
121	,, *(D.) paupercula*	..	vr	..	vr	..	r	c	c	..	f	..	f	..	..	..	..	..	..	vr	..	..	f	vr	,, ,, ...	121
122	,, *(D.) Fontannesi* Berthelin sp.	..	..	r	..	..	f	r	vr	r	..	....	vc	vc	vr	f	..	..	f	..	..	..	f	..	Lower Greensand—Gault ..	122
123	,, *(D) obscura* Reuss	..	f	..	vr	..	r	..	..	vr	vr	f	vr	vc	c	r	r	r	vr	f	f	r	..	..	,, ,, Chalk ..	123
124	,, *inflata* Reuss	..	..	..	..	..	..	..	vr	..	..	....	r	..	vr	..	..	..	..	..	r	..	vr	..	Gault—Chalk	124
125	,, *(D.) tenuicosta* Reuss ..	..	f	..	..	..	r	..	..	f	r	f	f	c	..	f	f	vr	r	r	vr	vr	c	..	Neocomian—Chalk	125
126	,, *prismatica* Reuss	..	r	..	r	vr	c	r	c	vr	vr	....	....	f	f	..	r	..	vr	..	..	vr	f	vr	,, Gault	126
127	,, *orthopleura* Reuss	..	..	..	vr	..	vr	vr	c	vr	f	c	f	vc	f	c	f	f	c	c	c	f	r	c	Gault	127
128	,, *tetragona* Reuss	..	..	..	..	..	..	vr	..	..	vr	....	....	r	..	..	..	..	vr	..	..	..	vr	r	Aptian—Gault	128
129	*Lingulina nodosaria* Reuss	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Neocomian—Gault	129
130	,, *semiornata* Reuss	..	vr	..	..	..	vr	..	vr	vr	..	....	....	vr	vr	vr	f	vr	r	r	f	..	..	..	Lower Greensand—Chalk Marl	130
131	*Frondicularia Loryi* Berthelin ..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	..	..	..	..	..	Gault	131
132	,, *denticulocarinata* sp. n.	..	..	..	..	..	..	..	..	..	..	....	....	vr	vr	..	..	vr	vr	..	..	..	..	..	,, ...	132
133	,, *Archiaciana* d'Orb. ..	..	vr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Gault—Recent	133
134	,, *gaultina* Reuss ..	vr	..	..	..	..	..	..	vr	..	..	....	....	r	..	..	..	..	..	..	..	..	..	..	,, (and Red Chalk)	134

	Zones	I.		II.			III.	IV.	V.	VI.	VII.	VIII.
No.	Species.	(a) Greensand seam.	(b) 5 ft. up.	(a) Crushed band.	(b) 11 ft. up.	(c) 13 ft. up.						
135	*Frondicularia inversa* Reuss	..	..	..	..	..	..	..	..	..	..	..
136	,, *Fritschi* Perner (non *pinnæformis* Chapman)	..	..	..	..	..	..	..	..	..	..	..
137	,, *Karreri* Berthelin sp...	..	..	..	..	..	..	..	f	..	c	vr
138	,, *strigillata* Reuss ..	..	..	..	..	..	..	..	..	vr	vr	..
139	,, *lanceola* Reuss.. ..	..	..	..	..	..	..	..	..	..	..	..
140	,, *Ungeri* Reuss	..	..	..	..	..	..	..	vr	..	vr	..
141	,, *Parkeri* Reuss	..	..	..	..	..	..	..	r	r	r	..
142	,, *planifolia* sp. n. ..	..	..	..	..	..	..	..	..	vr	r	..
143	,, *Guestphalica* Reuss ..	..	..	..	..	..	..	..	..	..	..	..
144	,, *microdiscus* Reuss ..	..	..	..	..	..	..	..	..	..	..	..
145	,, *quadrata* sp. n. ..	..	..	..	..	..	..	..	..	..	..	..
146	,, *perovata* sp. n.	..	..	..	..	..	..	..	..	..	..	..
147	,, *Cordai* Reuss	..	..	..	vr	..	..	..	..	..	vr	..
148	*Flabellina didyma* Berth. sp.	..	..	..	..	..	vr	..	vr	..	r	..
149	*Rhabdogonium tricarinatum* d'Orb. sp. var. *acutangulum* Reuss	..	..	..	..	..	..	..	..	..	..	..
150	,, *excavatum* Reuss ..	..	..	..	..	..	..	..	..	..	..	..
151	,, *Maertensi* Reuss ..	..	..	..	..	..	..	..	..	..	..	..
152	*Marginulina glabra* d'Orb.	..	..	..	..	..	..	..	..	..	..	..
153	,, *inæqualis* Reuss	..	..	..	..	..	r	vr	vr	..	..	..
154	,, *Parkeri* Reuss	..	..	..	..	..	..	..	f	..	..	..
155	,, *hamulus* sp. n.	..	vr	..	..	..	..	..	..	..	..	..
156	,, *linearis* Reuss	..	..	..	..	..	f	..	..	..	..	..
157	,, *debilis* Berthelin.. ..	..	..	..	..	..	c	vr	c	vr	vr	..
158	,, *Folkestoniensis* sp. n. ..	..	..	..	..	..	..	..	vr	..	..	..
159	,, *asperula* sp. n.	..	..	..	..	..	..	..	..	..	..	..
160	,, *tenuissima* Reuss ..	..	..	..	..	..	..	..	..	..	..	..
161	,, *æquivoca* Reuss ..	..	vr	f	vr	..	vc	vc	f	vr	r	r
162	,, *striatocostata* Reuss ..	..	..	..	..	..	vc	vc	..	..	..	..
163	,, *Munieri* Berthelin ..	..	..	..	..	..	..	..	vr	..	..	..
164	,, *robusta* Reuss	vr	vr	..	..	vr	..	..	vr	..	..	..
165	,, *Jonesi* Reuss	..	..	..	..	..	f	..	..	..	..	..
166	*Vaginulina recta* Reuss	..	..	vr	..	..	f	f	c	vr	vr	..
167	,, ,, var. *tenuistriata* var. n.	..	..	..	..	..	..	..	r	r	f	..
168	,, *strigillata* Reuss sp. ..	..	..	..	..	..	..	..	..	..	..	vr

No.	IX.	X.	XI.							XII.	XIII.		Range in Time.	No.
			55 ft. down.	50 ft. down.	45 ft. down.	40 ft. down.	35 ft. down.	30 ft. down.	25 ft. down.	20 ft. down (Greensand).	12 ft. down.	6 ft. down.		
135	..	f	..	..	..	..	..	..	..	..	..	..	Gault—Chalk	135
136	r	vc	c	..	c	r	vr	f	r	..	..	..	,, Chalk (Turonian) ..	136
137	..	vr	r	..	vr	..	..	..	..	..	..	..	,, ...	137
138	..	vr	f	..	vr	..	..	..	..	..	..	..	,, Chalk ?	138
139	..	..	..	..	..	..	..	..	..	vr	..	..	,, Chalk	139
140	..	c	r	..	r	f	c	f	r	r	r	f	,, ...	140
141	vr	c	r	r	f	vr	..	..	..	vr	..	vr	,, ...	141
142	..	r	..	..	..	..	..	..	..	..	..	..	,, ...	142
143	..	..	..	..	..	..	..	..	..	f	vr	..	,, ...	143
144	..	r	..	..	vr	..	..	..	..	vr	..	..	,, ...	144
145	..	vr	..	..	..	..	..	..	..	..	..	..	,, ...	145
146	vr	..	..	vr	vr	..	..	..	..	..	vr	..	,, ...	146
147	vr	f	r	vr	r	..	..	..	..	..	..	..	Gault—Chalk	147
148	vr	f	c	..	f	..	vr	..	vr	..	vr	r	,, ...	148
149	..	vr	vr	vr	..	..	vr	..	..	..	c	vc	Neocomian—Gault (and Red Chalk)	149
150	..	c	f	r	f	r	r	r	r	..	vc	vc	Gault—Chalk Marl	150
151	vr	..	..	..	..	..	..	..	..	..	..	..	Neocomian—Gault	151
152	..	..	..	..	vr	vr	..	..	..	..	..	..	Rhætic—Recent	152
153	..	r	..	..	..	r	..	vr	..	..	r	..	Gault—Chalk Marl	153
154	..	..	..	..	..	..	..	..	..	..	..	..	Neocomian—Gault	154
155	..	..	..	..	..	..	..	..	..	..	vr	..	Gault	155
156	..	..	..	..	..	..	..	vr	..	..	..	..	Lower Greensand—Gault ..	156
157	..	vr	vr	c	c	..	r	vr	r	..	..	..	,, ,, ,, ..	157
158	..	vr	..	vr	..	..	vr	..	r	..	..	..	Gault	158
159	..	..	..	..	..	..	..	..	..	..	..	vr	,, ...	159
160	..	..	vr	..	vr	..	vr	vr	..	..	vr	..	,, ...	160
161	vr	vr	vr	vr	..	..	..	..	vr	..	..	..	Lower Greensand—Gault ..	161
162	..	vr	..	..	..	vr	..	..	vr	..	..	..	Neocomian—Recent	162
163	..	vr	..	vr	f	f	..	..	..	..	..	..	Lower Greensand—Gault ..	163
164	..	r	f	..	..	..	..	..	..	..	..	..	Neocomian—Gault	164
165	..	..	f	vr	f	r	r	f	c	..	vr	vr	,, Chalk Marl ..	165
166	r	vc	vc	vc	c	c	c	c	c	vr	f	r	Gault—Chalk Marl	166
167	r	vc	..	vr	..	..	r	vr	vr	..	f	r	,, ...	167
168	..	vc	..	..	..	..	..	..	..	..	..	..	Lias—Chalk (Turonian)	168

No.	Species.	Zones .. .. I.		II.			III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.							XII.	XIII.		Range in Time.	No.
		(*a*) Greensand seam.	(*b*) 5 ft. up.	(*a*) Crushed band.	(*b*) 11 ft. up.	(*c*) 13 ft. up.									55 ft. down.	50 ft. down.	45 ft. down.	40 ft. down.	35 ft. down.	30 ft. down.	25 ft. down.	20 ft. down (Greensand).	12 ft. down.	6 ft. down.		
169	*Vaginulina truncata* Reuss	..	..	..	v r	..	f	r	r	r	r	r	f	v c	..	..	r	f	..	..	..	v r	r	f	Neocomian—Chalk Marl ..	169
170	„ „ var. *robusta* Berth. and Chap.	..	..	..	..	..	..	..	v r	..	c	v r	r	v c	c	c	c	c	c	c	c	c	f	v r	Gault	170
171	„ *gaultina* Berthelin ..	..	..	..	..	..	v r	v r	r	..	f	v r	r	v c	f	..	..	..	v r	v r	v r	..	..	..	„ —Chalk	171
172	„ *arguta* Reuss	..	..	..	..	..	..	..	..	..	..	..	..	r	r	v r	r	..	..	..	r	r	f	r	„ (and Red Chalk)	172
173	„ *striolata* Reuss	..	..	..	..	..	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	..	..	..	„	173
174	„ *comitina* Berthelin ..	..	..	..	..	..	..	..	..	..	..	..	..	f	..	..	..	v r	..	v r	v r	..	r	r	„	174
175	„ *sparsicostata* Reuss ..	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Neocomian—Gault	175
176	„ *discors* F. Koch	..	..	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	..	..	..	..	..	v r	„ „	176
177	„ *Biochei* Berthelin ..	..	v r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	v r	Gault	177
178	„ *Priceana* sp. n.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	„	178
179	*Cristellaria linearis* Reuss	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	v r	..	..	..	..	..	..	Neocomian—Gault	179
180	„ *striata* sp. n.	..	..	..	..	..	v r	..	..	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	Gault	180
181	„ *exilis* Reuss	..	..	..	..	..	v r	..	..	..	..	..	..	..	..	..	..	r	..	..	..	..	v r	..	Neocomian—Gault	181
182	„ „ var. *crispata*, var. n.	..	v r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Gault	182
183	„ *parallela* Reuss	..	..	..	..	..	r	..	v r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Neocomian—Gault	183
184	„ *cymboides* d'Orb.	..	..	..	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	..	..	..	v r	..	„ Tertiary	184
185	„ *humilis* Reuss	..	v r	..	v r	..	..	..	..	..	..	..	..	..	..	r	..	..	..	..	..	..	..	..	„ Gault	185
186	„ *crepidula* F. and M. sp. ..	..	v r	v r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	Lias—Recent	186
187	„ *Schloenbachi* Reuss	..	r	..	..	..	..	..	..	..	..	..	..	v r	v r	..	..	..	..	..	v r	..	v r	..	Neocomian—Recent	187
188	„ *costulata* sp. nov.	..	..	..	..	..	..	..	v r	..	..	..	v r	..	..	..	..	..	..	..	..	..	..	..	Gault	188
189	„ *gladius* Philippi sp. ..	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Lias—Tertiary	189
190	„ *Bronni* Romer sp... ..	..	..	..	v r	v r	..	..	v r	..	r	..	..	f	..	..	..	..	..	..	..	..	..	..	„ Gault	190
191	„ *lituola* Reuss	..	v r	..	..	..	..	..	..	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	Gault—Chalk (Turonian) ..	191
192	„ *navicula* d'Orb.	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	v r	v r	..	..	..	..	..	..	..	„ Chalk	192
193	„ *sulcifera* Reuss	..	f	..	..	..	v r	..	..	..	..	..	r	..	..	..	v r	v r	..	..	..	..	..	..	Lower Greensand—Gault ..	193
194	„ *triangularis* d'Orb. ..	..	..	..	..	..	..	v r	v r	..	..	v r	..	..	..	..	..	..	v r	..	..	..	..	v r	Gault—Chalk	194
195	„ *trunculata* Berthelin ..	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	..	..	..	v r	..	..	..	v r	„	195
196	„ *oligostegia* Reuss	..	..	v r	r	r	v r	..	v r	..	..	..	v r	..	v r	..	..	r	..	..	..	..	..	..	Lower Greensand—Chalk ..	196
197	„ *tripleura* Reuss	..	v r	..	..	v r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Gault	197
198	„ *scitula* Berth.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	„	198
199	„ *latifrons* Brady	..	..	..	..	..	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	..	..	..	„ —Recent	199
200	„ *Bononiensis* Berth. ..	..	..	..	..	v r	v c	f	..	v r	..	..	v r	r	c	r	f	v r	c	v r	f	r	v r	..	„	200
201	„ *Italica* Defrance sp. ..	..	r	v r	..	..	..	v r	..	..	..	..	v r	v r	..	..	..	..	..	..	..	v r	v r	..	Lower Greensand—Recent ..	201
202	„ *vestita* Berth.	..	..	..	..	..	v r	..	v r	..	v r	..	..	v r	f	f	..	f	r	r	..	..	v r	..	„ „ Chalk Marl ..	202

No.	Species.	I. (a) Greensand seam.	I. (b) 5 ft. up.	II. (a) Crushed band.	II. (b) 11 ft. up.	II. (c) 13 ft. up.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI. 55 ft. down.	XI. 50 ft. down.	XI. 45 ft. down.	XI. 40 ft. down.	XI. 35 ft. down.	XI. 30 ft. down.	XI. 25 ft. down.	XII. 20 ft. down (Greensand).	XIII. 12 ft. down.	XIII. 6 ft. down.	Range in Time.	No.
203	*Cristellaria complanata* Reuss ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	f	f	Lower Greensand—Chalk (Turonian)	203
204	„ *Bradyana* sp. n.	..	..	..	..	..	..	..	..	..	..	....	....	v c	..	v r	r	v r	f	..	v r	..	..	..	Gault	204
205	„ *planiuscula* Reuss	..	..	v r	v r	..	r	v r	v r	..	..	..	..	..	v r	..	..	..	..	..	v r	v r	..	v r	Neocomian—Gault	205
206	„ *turgidula* Reuss	..	..	..	..	..	v r	v r	..	..	..	....	....	..	..	..	..	v r	..	..	..	..	..	f	Gault	206
207	„ *circumcidanea* Berth. ..	..	f	..	v r	..	r	..	..	..	..	..	v r	v r	v r	..	v r	..	v r	..	..	..	..	..	„	207
208	„ *subalata* Reuss	..	v r	..	..	v r	..	..	..	..	..	....	v r	..	..	..	..	..	..	..	..	..	..	..	Neocomian—Eocene	208
209	„ *secans* Reuss, var. *angulosa* var. n.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	Gault	209
210	„ *lobata* Costa sp.	..	..	..	..	..	..	..	..	..	..	....	....	..	..	..	..	..	..	..	..	v r	..	v r	Neocomian—Tertiary	210
211	„ *convergens* Bornemann ..	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	„ Recent	211
212	„ *gibba* d'Orb	..	f	..	..	..	r	v r	f	..	v r	v r	....	r	r	r	r	f	r	..	r	..	f	r	Lias—Recent	212
213	„ *rotulata* Lam. sp... ..	r	r	r	v r	v r	f	c	r	..	..	r	..	v r	..	v r	..	..	..	..	v r	f	f	r	Jurassic—Recent	213
214	„ „ var. *macrodiscus* Reuss	..	..	..	v r	f	v r	r	r	r	v r	....	....	v r	..	r	f	r	r	r	f	r	f	r	Neocomian—Gault (and Red Chalk)	214
215	„ *gaultina* Berthelin ..	v r	f	r	r	..	v c	c	r	v c	f	f	c	c	v r	f	f	f	c	f	c	v c	f	c	Gault—Chalk	215
216	„ *sternalis* Berth.	..	v r	..	v r	r	r	..	v r	f	..	r	....	r	r	r	v r	..	f	v r	v r	..	v r	v r	„	216
217	„ *diademata* Berth... ..	r	r	..	..	v r	r	..	v r	c	r	r	r	c	r	v r	v r	v r	r	f	r	r	r	..	„ Chalk Marl	217
218	*Polymorphina lactea* W. and J. sp. ..	..	..	..	..	..	..	..	..	..	..	....	....	..	..	..	v r	..	v r	..	..	..	..	..	Oolite—Recent	218
219	„ „ var. *acuplacenta* Jones & Chapman	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	v r	v r	Gault	219
220	„ *gibba* d'Orb.	..	..	..	..	..	..	..	..	..	..	....	....	..	..	..	r	v r	..	..	v r	..	r	c	Oolite—Recent	220
221	„ „ var. *acuplacenta* Jones & Chapman	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	f	..	..	..	..	..	..	v r	Gault—Pliocene	221
222	„ *gutta* d'Orb.	..	..	..	..	..	..	..	..	..	..	....	....	..	v r	..	v r	..	..	..	..	..	..	..	Neocomian—Tertiary	222
223	„ „ var. *diffusa* Jones and Chapman	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	f	r	Gault	223
224	„ *fusiformis* Romer sp. ..	..	..	..	..	..	v r	..	v r	..	..	....	....	..	..	r	f	v r	v r	v r	r	..	f	..	Lias—Recent	224
225	„ „ var. *horrida* Reuss	..	..	..	..	..	..	..	v r	..	..	..	..	..	..	r	..	..	..	..	v r	v r	v r	..	Gault—Oligocene	225
226	„ *sororia* Reuss	..	..	..	..	..	r	..	..	..	..	....	v r	..	..	v r	v r	..	v r	r	r	v r	v r	..	„ Tertiary	226
227	„ „ var. *acuplacenta* Jones & Chapman	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	v r	..	„ Recent	227
228	„ „ var. *cuspidata* Brady	..	..	..	..	..	..	..	v r	..	..	....	....	..	..	..	..	..	..	..	..	..	..	r	Neocomian—Recent	228
229	„ *angusta* Egger	..	..	..	..	..	v r	v r	..	..	v r	..	..	..	..	..	..	..	..	..	..	..	..	..	Gault—Recent	229
230	„ *communis* d'Orb. ..	..	..	..	..	..	..	..	..	..	..	....	....	..	..	..	v r	..	..	..	..	..	..	f	Lias—Recent	230
231	„ *compressa* d'Orb. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	v r	..	..	..	..	..	..	..	„ „	231

No.	Species.	I. (a) Greensand seam.	I. (b) 5 ft. up.	II. (a) Crushed band.	II. (b) 11 ft. up.	II. (c) 13 ft. up.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI. 55 ft. down.	XI. 50 ft. down.	XI. 45 ft. down.	XI. 40 ft. down.	XI. 35 ft. down.	XI. 30 ft. down.	XI. 25 ft. down.	XII. 20 ft. down (Greensand).	XIII. 12 ft. down.	XIII. 6 ft. down.	Range in Time.	No.
232	*Sagraina asperula* sp. n.	..	c	..	..	..	r	..	c	..	vr	..	..	..	..	..	..	..	..	..	..	..	..	..	Gault	232
233	„ *calcarata* Berth. sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	f	..	vr	..	r	vr	..	vr	..	„	233
234	*Ramulina lævis* Jones	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	vr	..	..	..	..	..	..	Gault—Recent	234
235	„ *globulifera* Brady	..	vr	..	..	..	r	..	..	..	..	vr	..	f	vr	vr	f	r	f	..	..	r	vr	f	Mid-Jurassic—Recent	235
236	„ *aculeata* Wright	..	..	..	..	..	..	r	..	..	..	..	..	vr	c	c	c	r	vr	r	f	r	c	f	Jurassic—Tertiary	236
237	„ *cervicornis* Chapman sp. ..	..	..	..	..	..	vr	..	..	..	f	..	..	f	..	..	..	..	..	..	..	vr	..	..	Gault	237
238	*Vitriwebbina lævis* Sollas sp.	..	..	..	..	..	..	..	..	..	f	..	..	..	..	vr	..	..	..	..	..	..	..	..	Gault—Chalk (Turonian) ..	238
239	„ *Sollasi* Chapman ..	vr	..	..	..	..	vr	..	f	..	f	..	..	r	..	..	..	..	..	..	..	f	..	..	„ „ „	239
240	„ „ var. *gonoidea* var. n.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	Gault	240
241	„ *tuberculata* Sollas sp. ..	..	..	..	..	..	..	..	..	..	r	..	..	..	..	..	..	..	..	..	..	..	..	..	„ —Cenomanian	241
242	*Globigerina bulloides* d'Orb.	..	..	..	..	..	..	vr	..	vr	..	..	..	..	vr	..	r	r	..	vr	c	..	f	c	Lower Greensand—Recent ..	242
243	„ *cretacea* d'Orb.	..	f	f	..	f	c	f	c	c	c	c	c	c	vc	vc	exc	exc	exc	exc	exc	exc	c	f	„ „ „ ..	243
244	„ *æquilateralis* Brady ..	..	r	vr	..	..	vr	f	r	..	..	r	vr	..	..	..	vc	c	vc	vc	c	f	..	..	Gault—Recent	244
245	*Sphæroidina bulloides* d'Orb.	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	„ „	245
246	*Spirillina tuberculata* Brady	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	vr	..	..	..	..	..	..	..	„ „	246
247	*Discorbina rugosa* d'Orb. sp.	..	..	..	..	..	vr	..	vr	..	..	..	..	..	f	vr	vr	..	vr	..	..	r	vr	..	Lower Greensand—Recent ..	247
248	„ *globularis* d'Orb. sp. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	Gault—Recent	248
249	„ *orbicularis* Terq. sp. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	..	..	..	..	..	..	..	..	..	Lower Greensand—Recent ..	249
250	„ *turbo* d'Orb. sp.	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	..	..	..	..	„ „ „ ..	250
251	„ *pileolus* d'Orb. sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	„ „ „ ..	251
252	„ *Vilardeboana* d'Orb. sp. ..	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	„ „ „ ..	252
253	*Truncatulina refulgens* Montf. sp. ..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	..	..	..	..	..	Gault—Recent	253
254	„ *lobatula* Walker sp. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	..	..	..	..	Carboniferous—Recent	254
255	„ *Wuellerstorfi* Schwager sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	vr	..	vr	..	..	..	..	..	Lower Greensand—Recent ..	255
256	*Anomalina complanata* Reuss	..	..	r	r	r	r	vr	..	..	vr	..	vr	..	..	..	..	r	..	..	..	..	vr	..	Aptian—Eocene	256
257	„ *ammonoides* Reuss sp. ..	vr	c	c	c	c	c	c	c	c	c	c	c	c	f	c	c	c	c	vr	c	f	c	c	Lower Greensand—Recent ..	257
258	„ *rudis* Reuss sp.	..	f	r	r	r	f	f	r	f	r	..	vr	r	..	..	..	..	..	..	..	r	r	..	Gault—Cenomanian	258
259	*Pulvinulina Hauerii* d'Orb. sp. ..	..	..	..	..	..	vr	..	..	vr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	„ Recent	259
260	„ *elegans* d'Orb. sp.	..	r	f	f	r	f	r	f	vr	r	..	f	..	vr	..	..	..	..	..	..	vr	..	..	Lias—Recent	260
261	„ *caracolla* Römer sp. ..	vr	vr	..	..	f	c	c	r	vr	..	vr	f	..	..	..	..	..	..	..	..	..	..	..	„ Gault	261
262	„ *reticulata* Reuss sp. ..	..	vr	..	..	vr	..	..	..	..	..	..	..	..	vr	..	..	..	..	..	..	..	..	..	Oolite—Gault	262
263	„ *Carpenteri* Reuss sp. ..	..	..	..	..	r	..	f	vc	c	r	f	c	..	..	..	..	..	..	..	..	..	..	..	Gault	263
264	„ *spinulifera* Reuss sp. ..	f	..	..	..	vr	..	..	f	c	vc	c	f	..	c	..	..	..	..	..	..	..	..	..	Oolite—Gault	264
265	*Rotalia Soldanii* d'Orb. sp. var. *nitida* Reuss	..	r	r	..	vr	r	r	f	f	f	f	r	r	c	c	c	c	c	c	c	c	vc	c	Gault—Chalk (Turonian) ..	265

Comparative Table of the Red Chalk, the Gault, and the Chalk Marl Foraminifera.

A few emendations in square brackets have been made in the nomenclature by the author, which will facilitate the correlation of the two facies.

No.	Species given in the Paper on the Red Chalk Foraminifera by Burrows, Sherborn, and Bailey.	Red Chalk of			Gault, Folkestone.		Chalk Marl, Folkestone.
		Speeton.	Flamborough Head.	Hunstanton.	Upper.	Lower.	
1	*Spiroloculina papyracea* Burrows, Sherborn, and Bailey	..	×	..	..	..	..
2	,, *tenuis* (Czjzek); also *Miliolina* sp. [= young form of same]	×	..	..	..	..	..
3	*Cornuspira cretacea* Reuss } probably same *Ammodiscus incertus* (d'Orb.) } form as in Gault	×	..	..	×	×	..
4	,, *gordialis* (Jones and Parker) ..	×	..	..	×	×	..
5	,, *tenuis* Brady	..	..	..	×	×	..
6	*Textularia attenuata* Reuss	×	..	..	..	..	..
7	,, *pygmæa* Rss. [altered to *T. minuta* Berth.]	..	×	×	×	×	×
8	,, *agglutinans* d'Orb.	×	..	..	×	..	..
9	,, *gramen* d'Orb.	×	..	..	×	..	×
10	,, *trochus* d'Orb.	×	..	×	×	×	×
11	,, *turris* d'Orb.	×	..	×	..	×	×
12	,, *complanata* Reuss	×	..	..	×	×	×
13	,, sp. [= *T. prælonga* Reuss] ..	×	..	..	×	..	×
14	*Verneuilina propinqua* Brady	×	..	..	..	..	..
15	,, *triquetra* (Münster)	×	..	..	×	×	..
16	*Spiroplecta biformis* P. and J.	×	..	..	..	..	..
17	*Gaudryina pupoides* d'Orb.	×	..	..	×	×	×
18	*Bulimina affinis* d'Orb...	×	..	..	..	..	×
19	,, *Presli* Reuss	×	..	×	×	×	×
20	*Bolivina textilarioides* Reuss	×	..	..	×	×	..
21	,, *Beyrichi* Reuss var. *alata* Seg. ..	×	..	..	..	..	..
22	*Pleurostomella subnodosa* Reuss	×	..	..	..	..	..
23	,, *alternans* Schwager	×	..	..	×	×	×
24	*Lagena globosa* (Mont.)	×	..	..	×	..	..
25	,, *lævis* (Mont.)	×	..	×	×	×	..
26	,, *apiculata* Reuss	×	..	×	×	×	..

No.	SPECIES given in the Paper on the Red Chalk Foraminifera by Burrows, Sherborn, and Bailey.	Red Chalk of			Gault, Folkestone.		Chalk Marl, Folkestone.
		Speeton.	Flamborough Head.	Hunstanton.	Upper.	Lower.	
27	*Lagena apiculata* var. *emaciata* Reuss ..	×	..	..	×	..	..
28	„ *cincta* Seguenza	×	..	..	..	..	..
29	*Nodosaria* (*G.*) *lævigata* d'Orb.	×	..	..	..	..	..
30	„ (*G.*) *obtusissima* Reuss	×	..	..	..	..	..
31	„ (*G.*) *cylindracea* Reuss	×	..	..	×	..	..
32	„ (*G.*) *candela* Egger	×	..	..	..	..	..
33	„ *simplex* Silvestri [*N. oligostegia* Reuss]	×	..	..	×	×	..
34	„ *longiscata* d'Orb.	×	..	..	..	..	..
35	„ *calomorpha* Rss.	..	..	×	..	..	..
36	„ *limbata* d'Orb.	..	..	×	..	..	..
37	„ *obscura* Rss.	×	..	..	×	×	×
38	„ *prismatica* Rss.	×	..	..	×	×	×
39	„ (*D.*) *soluta* Rss.	×	..	..	×	×	×
40	„ (*D.*) *communis* d'Orb.	..	×	×	×	×	×
41	„ (*D.*) *brevis* d'Orb.	×	..	..	..	..	..
42	„ (*D.*) *filiformis* d'Orb.	×	..	..	..	..	..
43	„ (*D.*) *marginulinoides* Rss. ..	×	..	..	..	..	..
44	„ (*D.*) *mucronata* Neug.	×	..	..	×	×	..
45	„ (*D.*) *abnormis* Rss.	×	..	..	..	..	..
46	*Lingulina carinata* d'Orb. [*L. nodosaria* Rss.]	..	..	×	..	×	..
47	*Frondicularia biformis* Marsson	×	..	..	..	..	..
48	„ *Gaultina* Rss.	×	..	..	×	×	..
49	„ *Archiaciana* d'Orb.	..	..	..	..	×	..
50	*Rhabdogonium tricarinatum* d'Orb. [var. *acutangulum* Rss.]	×	..	..	×	..	..
51	„ *minutum* Rss. [*R. excavatum* Rss.]	×	..	..	×	..	×
52	*Marginulina glabra* d'Orb.	×	..	..	×	..	..
53	„ *inæqualis* Reuss	×	..	..	×	×	×
54	„ *variabilis* Neug...	×	..	..	..	..	..
55	*Vaginulina eurynota* Rss. [= *V. truncata* Rss.]	×	..	..	×	×	×
56	„ *recta* Rss.	×	..	..	×	×	×
57	„ *arguta* Rss.	×	..	..	×	..	..

No.	SPECIES given in the Paper on the Red Chalk Foraminifera by Burrows, Sherborn, and Bailey.	Red Chalk of			Gault, Folkestone.		Chalk Marl, Folkestone.
		Speeton.	Flamborough Head.	Hunstanton.	Upper.	Lower.	
58	*Vaginulina legumen* (L.)	×	..	..	..	..	..
59	*Cristellaria rotulata* (Lam.) [var. *macrodiscus* Rss.]	×	×	×	×	×	..
60	„ *cultrata* (Montf.) [*C. gaultina* Berthelin]	×	×	..	×	×	×
61	„ *gibba* d'Orb.	×	..	..	×	×	×
62	„ *Italica* (Defr.)	×	..	×	×	×	..
63	„ *lata* Rss.	×	..	..	..	..	..
64	„ *variabilis* Rss.	×	..	..	..	..	..
65	„ *multisepta* Rss.	..	×	..	..	..	..
66	„ *crepidula* (F. and M.) [*C. complanata* Rss.]	×	..	×	×	×	..
67	„ *Marcki* Rss.	×	..	..	..	..	..
68	„ *cymboides* d'Orb.	×	..	..	×	..	..
69	*Polymorphina lactea* (W. and J.)	×	..	..	×	..	..
70	„ *communis* d'Orb. [*P. compressa* d'Orb.]	×	..	..	×	..	..
71	„ *amygdaloides* Rss. [pl. xi. fig. 12 = *P. lactea* W. and J.; pl. xi. fig. 13 = *P. problema* d'Orb.]	×	..	..	..	..	..
72	„ *gibba* d'Orb.	×	..	..	×	..	..
73	„ *horrida* Rss. [*P. fusiformis* (Römer) var. *horrida* Rss.]	×	..	..	×	×	..
74	„ sp. [*P. sororia* Rss.]	×	..	..	×	×	×
75	*Uvigerina* sp.	×	..	..	..	..	..
76	*Ramulina aculeata* d'Orb. [Wright]	×	..	..	×	×	×
77	*Globigerina bulloides* d'Orb.	×	×	×	×	×	×
78	„ *cretacea* d'Orb.	×	..	×	×	×	×
79	„ *Linneana* d'Orb.	×	×	×	..	..	..
80	*Orbulina universa* d'Orb.	×	..	..	..	..	..
81	*Sphæroidina bulloides* d'Orb.	×	..	..	..	×	..
82	*Truncatulina variabilis* d'Orb.	×	..	..	..	..	..
83	*Planorbulina* [*Anomalina*] *ammonoides* Rss.	×	×	×	×	×	×
84	*Pulvinulina Menardii* (d'Orb.)	×	..	..	..	..	..
85	*Anomalina grosserugosa* (Gümbel)	×	..	×	..	..	..
86	*Polystomella macella* (F. and M.)	×	..	..	..	..	..

APPENDIX IV.

Summary of Results on the Zoological and Zonal Distribution of the Folkestone-Gault Foraminifera.

The Zoological Distribution.

There are 265 species and varieties of Foraminifera herein recorded from Folkestone, which are distributed, according to Dr. H. B. Brady's classification, as follows:—

The Family of the Miliolidæ is represented by 4 genera, viz. *Nubecularia* (2 new spp.); *Biloculina* (1 new sp.); *Spiroloculina* (2 spp.); and *Miliolina* (4 spp.).

The Family of the Astrorhizidæ,—1 genus, viz. *Astrorhiza* (1 sp.).

The Family of the Lituolidæ,—8 genera, viz. *Reophax* (6 spp.—2 of them new); *Haplophragmium* (10 spp. and 1 var.—1 sp. and 1 var. new); *Placopsilina* (2 spp.); *Haplostiche* (1 sp. new); *Thurammina* (1 sp.); *Hormosina* (1 sp.); *Ammodiscus* (4 spp.—1 new); and *Trochammina* (1 sp. new).

The Family of the Textulariidæ,—9 genera, viz. *Textularia* (10 spp.); *Verneuilina* (3 spp.); *Tritaxia* (2 spp.); *Spiroplecta* (4 spp.); *Gaudryina* (5 spp.—1 new); *Valvulina* (2 spp.); *Bulimina* (8 spp. and 1 var. new); *Bolivina* (1 sp.); and *Pleurostomella* (2 spp.).

The Family of the Lagenidæ,—13 genera, viz. *Lagena* (12 spp. and 2 vars.—1 var. new); *Nodosaria* [including *Glandulina* and *Dentalina*] (36 spp., 4 of them new, and 3 vars., 1 new); *Lingulina* (2 spp.); *Frondicularia* (17 spp., 4 of them new); *Flabellina* (1 sp.); *Rhabdogonium* (2 spp. and 1 var.); *Marginulina* (14 spp., 3 of them new); *Vaginulina* (11 spp., 1 of them new, and 2 vars., 1 of them new); *Cristellaria* (36 spp., 3 of them new, and 3 vars. 2 of them new); *Polymorphina* (8 spp. and 6 vars.); *Sagrina* (2 spp., 1 of them new); *Ramulina* (4 spp.); and *Vitriwebbina* (3 spp. and 1 new var.).

The Family of the Globigerinidæ,—2 genera, viz. *Globigerina* (3 spp.); and *Sphæroidina* (1 sp.).

The Family of the Rotaliidæ,—6 genera, viz. *Spirillina* (1 sp.); *Discorbina* (6 spp.); *Truncatulina* (3 spp.); *Anomalina* (3 spp.); *Pulvinulina* (6 spp.); and *Rotalia* (1 var.).

Notes on the Zonal Distribution.

The members of the Family of the *Miliolidæ* are for the greater part confined to the uppermost beds of the Gault, occasional specimens only being found in beds lower than zone x. As with nearly all the species of the Foraminifera herein described, there is no particular sequence according to age of these small divisions of the strata, the ruling factor in the distribution being probably the existing conditions under which the bed was deposited; and therefore we find a nearly similar repetition of the facies when the same lithological aspect recurs.

Miliolina venusta Karrer sp. is by far the commonest species of the porcellanous group occurring in the Gault of Folkestone, and is found consecutively from zone x. up to the top of zone xiii. at 6 ft. below the Chloritic marl.

The Family of the *Astrorhizidæ*. The only representative is *Astrorhiza indivisa* Brady, and the solitary specimen occurred in zone xi. at the level of 50 ft. from the top. The incoherent nature of the tests of many of these forms possibly explains their general absence from the older fossiliferous strata.

The Family of the *Lituolidæ*. The genus *Reophax* appears to be restricted to the Upper Gault, and especially favours zone x. The genus *Haplophragmium* is a ubiquitous one in the Gault, and many of the species recorded are well distributed throughout. Some other genera, as *Placopsilina*, *Haplostiche*, *Thurammina*, *Hormosina*, and *Trochammina*, are of very occasional occurrence; but *Ammodiscus*, represented by four species, is commonly met with above zone ii.

The Family of the *Textulariidæ*. The genus *Textularia* comprises some species, as *T. minuta* Berthelin, *T. sagittula* Defr., *T. trochus* d'Orb., and *T. complanata* Reuss sp., which are found scattered irregularly through the Gault; whilst a few others, as *T. gramen* d'Orb., *T. conica* d'Orb., *T. agglutinans* d'Orb., *T. parallela* Reuss, and *T. prælonga* Reuss, range through zones xi., xii., and xiii. It is also worth noting that whilst *T. agglutinans* is found at three levels only, in zones xi. and xii., another form easily to be confounded with it, but having a triserial commencement, namely *Gaudryina pupoides* d'Orb., has a range extending throughout the thirteen zones of the Gault, in some of which, unlike *T. agglutinans*, it is very common. The genera *Tritaxia*, *Spiroplecta*, and *Bulimina* begin to make an appearance in zone v. and continue to the top of the Gault. Of the *Buliminæ* it is interesting to notice that *B. Presli* Reuss, which is perhaps the most characteristic of the Gault species of the genus, begins at zone v., and continues more or less common up to the topmost level; and it is accompanied in the last three levels of zones xii. and xiii. (12 ft. and 6 ft. down) by a coarsely arenaceous variety named *sabulosa*. The single species of *Bolivina*, *B. textularioides* Reuss, is found commonly throughout the Gault.

The Family of the *Lagenidæ*. This comprises by far the largest number of the Gault Foraminifera. The genus *Lagena* is well represented; but with the exception of *L. apiculata* Reuss, and *L. hispida* Reuss, they are altogether rare. The genus *Nodosaria*, in common with *Cristellaria*, comprehends the largest number of species and varieties in any one genus of the Gault Foraminifera. The most abundant forms of this genus are *N.* (*D.*) *communis* d'Orb., *N. prismatica* Reuss, and *N. orthopleura* Reuss. It is strikingly shown in this genus that there are many more of the Gault species peculiar to the Upper Gault, and further, generally passing into the Chalk above, than there are peculiar to the Lower Gault, and passing downwards. This significant fact was shown by Dr. Reuss in his work on the North German Gault Foraminifera, and was clearly demonstrated by M. Berthelin in his comparisons between the Rhizopodal faunas of the several geographical areas. The *Nodosariæ* which I have found only in the Lower Gault are *N. sceptrum* Reuss and *N.* (*D.*) *xiphioides* Reuss; whilst those peculiar to the Upper Gault are *N.* (*G.*) *cylindracea* Reuss, *N. radicula* (*L.*) var. *Jonesi* Reuss, *N.* (*D.*) *farcimen* Reuss, *N.* (*D.*) *soluta* Reuss, and its variety *pulchella* nov., *N.* (*D.*) *costellata* Reuss, and *N.* (*D.*) *raristriata* nov. The *Frondiculariæ* are not very conspicuous before zone v. is reached; at zone x. they approach the maximum, 12 species being there found out of a total of 17 species. *Rhabdogonium* begins to make its appearance in zone ix., and two of the forms continue to the top. *Marginulina* is well represented by *M. debilis* Berth., which begins in zone iii. and continues to the top of zone xi. at 25 ft. down; also *M. æquivoca* Reuss, with a somewhat extensive range, and the allied forms *M. striatocostata* Reuss and *M. Jonesi* Reuss. The more conspicuous forms of *Vaginulina* as regards abundance are *V. recta* Reuss, extending throughout, with its variety *tenuistriata* nov., commencing at zone v., *V. truncata* Reuss with its variety *robusta* Berth. and Chap., and *V. gaultina* Berth., the last-named extending from zones iii. to xi. The genus *Cristellaria* comprises 39 forms, many of which are found only sparingly at various levels in the Gault; but several species call for special remark. Of the ensiform or elongate *Cristellariæ*, *C. Bononiensis* Berthelin is perhaps most frequently met with. On the other hand, those of the *C. rotulata* type are often exceedingly common, and as a rule are generally distributed. Three species, viz. *C. rotulata* Lam. sp., *C. gaultina* Berthelin, and *C. diademata* Berthelin, occur in all the zones of the Gault, although not in every level examined. The *Polymorphinæ*, although found sparingly in the Lower Gault, beginning at zone iii., find their particular habitat in the three upper zones. Of the two species of *Sagrina*, *S. asperula* nov. is restricted to zones i., iii., v., and vii., whilst *S. calcarata* Berth. sp. was found only in zones xi. and xiii. The *Ramulinæ* are sparingly found in the Lower Gault, but attain to some abundance on reaching zone xi. The remarkable form *R. cervicornis* Chapman sp. is found attached to shell-fragments, and appears to be frequent wherever there are shelly bands in the Gault clay. *Vitriwebbina* is represented by 3 species and 1 variety, two of which, *V. Sollasi* and its variety *gonoidea* nov., have been newly described from the Gault.

The Family of the *Globigerinidæ* is an important one on account of the great abundance of one of its species, *G. cretacea* d'Orb., which is found in all zones and at all the levels with two exceptions. From zone i. this species progressively increases in abundance to zone xi., and then slightly diminishes to the top of the Gault. At no level is *G. bulloides* d'Orb. so abundant as the preceding species, although it is common at the top of zone xi., and the top of zone xiii. *Sphæroidina* is represented by *S. bulloides* d'Orb., of which only one specimen was found, in zone v.

Of the Family of the *Rotaliidæ*, *Spirillina* has only one species, *S. tuberculata* Brady, which was found only in zone viii. The *Discorbinæ*, as might be expected from deposits of a more or less shallow-water character, have several representatives, but the genus is by no means a strong one in the Gault. The species do not appear until zone iii. is reached, and after that are not confined to any particular part of the series. *Truncatulina* is sparingly represented by three species, first appearing in zone vii. The next genus, *Anomalina*, is somewhat difficult to separate into species. There appear to be three forms, of which *A. ammonoides* Reuss sp. is by far the commonest as well as the best distributed, being found in every sample examined. *A. ammonoides* is the only species of the Gault Foraminifera which occurs in every level from zones i. to xiii. The genus *Pulvinulina* comprises six species, the rarest of which, *P. Hauerii* d'Orb. sp., appears to be restricted to the Lower Gault. Concerning the remaining five species of *Pulvinulinæ*—which by the way all possess the curious Epistomine aperture—the commonest is *P. spinulifera* Reuss, of which that author says that it is "die häufigste Species unter allen Foraminiferen des Gaults von Folkestone." As far as these present studies go to prove, *Globigerina cretacea* is, however, the most abundant species, speaking for the Gault generally, *Anomalina ammonoides* following somewhat closely upon it.* The occurrence of *Pulvinulina spinulifera* is somewhat restricted, and exhibits a peculiarity of rise and fall in its development which has already been noted on p. 9. *Rotalia* possesses only one form, *R. Soldanii* d'Orb. sp. var. *nitida* Reuss, which increases in abundance towards the top of the Gault.

The Distribution of the Foraminifera in the Folkestone-Gault, compared with that of the larger fossils enumerated by Messrs. De Rance and Price.

The Gault has been divided at Folkestone by Messrs. De Rance and Price into two great divisions, the Upper Gault and the Lower Gault, with a passage bed containing a limit fauna, and also one which is peculiar to the stratum. The zones of the Lower Gault are from i.–vii. (according to Mr. Price's divisions), the passage bed viii. (zone of *Ammonites cristatus* or of *Am. Beudanti*, and the Upper Gault consisting of zones ix. (with the latest subdivisions mentioned on p. 17) –xiii.

Mr. Price records 240 species of the larger fossils from the entire series of Gault strata. Out of these "124 forms [52 per cent.] become extinct in zone viii., and 39 forms [16 per cent.] are continued into the Upper Gault. Bed viii., besides containing the limit fauna, possesses as many as 18 species which are peculiar to it. 59 new forms [25 per cent.] occur in the Upper Gault, making their first appearance either in No. viii. or in a higher zone."

With regard to the Foraminifera here recorded, of the 265 spp. and vars., 23 (9 per cent.) are restricted to the Lower Gault; 148 forms (56 per cent.) are common to the Lower and Upper Gault; whilst 94 forms (35 per cent.) are peculiar to the Upper Gault.

* This latter species is the only one which I have found common to all the zones and levels of the Gault at Copt Point.

THE CONTENTS OF THE ZONES OF THE GAULT AT FOLKESTONE.

Zone.	No. of Species found.	Species peculiar to the Zone.
i	62	*Hormosina globulifera* Brady, *Textularia turris* d'Orbigny, *Nodosaria sceptrum* Reuss, *Frondicularia Archiaciana* d'Orbigny, *Cristellaria exilis* Reuss, var. *crispata* nov.
ii	61	*Lagena quinquelatera* Brady var. *inflata* n.
iii	83	*Discorbina Vilardeboana* d'Orbigny sp.
iv	56	None.
v	92	*Lagena acuticosta* Reuss, *Nodosaria (D.) xiphioides* Reuss, *Lingulina nodosaria* Reuss, *Marginulina Parkeri* Reuss, *Vaginulina sparsicostata* Reuss, *Cristellaria gladius* Philippi sp., *Sphæroidina bulloides* d'Orbigny.
vi	40	None.
vii	63	*Placopsilina vesicularis* Brady, *Vitriwebbina tuberculata* Sollas sp., *Truncatulina refulgens* Montfort sp.
viii	44	*Nodosaria (D.) soluta* var. *discrepans* Reuss, *Discorbina turbo* d'Orbigny sp.
ix	60	*Rhabdogonium Maertensi* Reuss.
x	98	*Spiroloculina nitida* d'Orbigny, *Reophax scorpiurus* Montfort sp., *R. Helvetica* Haeusler, *R. cylindracea* n., *Haplophragmium latidorsatum* Born. sp. var. *papillosa* n., *Frondicularia quadrata* n., *Vaginulina striolatus* Reuss, *Cristellaria latifrons* Brady.
xi	184	*Nubecularia depressa* n., *Rhizammina indivisa* Brady, *Spiroplecta prælonga* Reuss sp., *S. anceps* Reuss sp., *Lagena apiculata* var. *emaciata* Reuss, *L. gracillima* Seguenza sp., *Nodosaria (D.) hamulifera* Reuss, *N. (D.) costellata* Reuss, *Marginulina glabra* d'Orbigny, *Vaginulina Priceana* n., *Cristellaria linearis* Reuss, *Polymorphina gutta* d'Orbigny, *P. compressa* d'Orbigny, *Ramulina lævis* Jones, *Discorbina globularis* d'Orbigny sp., *D. orbicularis* Terquem sp., *Truncatulina lobatula* Walker sp., *T. Wuellerstorfi* Schwager sp.
xii	60	*Haplostiche Sherborni* n., *Frondicularia lanceola* Reuss, *Vitriwebbina* Sollasi var. *gonoidea* n.
xiii	125	*Reophax ampullacea* Brady, *Gaudryina oxycona* Reuss, *Lagena marginata* Walker and Boys, *Marginulina asperula* n., *Cristellaria scitula* Berthelin, *C. complanata* Reuss, *C. secans* Reuss var. *angulosa* n., *Polymorphina lactea* Walker and Jacob sp. var. *acuplacenta* Jones and Chapman, *P. gutta* d'Orbigny var. *diffusa* Jones and Chapman, *P. sororia* Reuss var. *acuplacenta* J. and C., *Discorbina pileolus* d'Orbigny sp.

In bringing to a close this concluding portion of my work on the Folkestone-Gault Foraminifera, it now only remains for me to express my obligations to the Council of this Society in permitting me to monopolise so much of the space allotted to original papers in the Journal.

The artist, Mr. Eustace Knight, has interpreted my drawings in an eminently satisfactory manner, and I take this opportunity of thanking

him for the care which he has shown in the preparation of the lithographs.

In addition to those friends to whom, at the commencement of this series of papers I have acknowledged my obligations, must be added the name of my friend Mr. Fortescue W. Millett of Marazion, who has, by his intimate knowledge of the literature of this subject, greatly helped to render the foregoing descriptions and lists as free, perhaps, from errors of nomenclature as is possible in dealing with such a variable group of organisms; also to my wife my thanks are due for much assistance in the selection of the fossils, and in other details in connection with this work.

CORRIGENDA AND ADDENDA.

Part 1. *Journ. R. Micr. Soc.*, 1891.

P. 567, line 13 from top, *et seq.*, for "*Bolivina textularioides*" read *Bolivina textilarioides.*

P. 568, line 21 from top, *et seq.*, for "*Textularia pygmæa* Reuss" read *Textularia minuta* Berthelin (see pt. 2, p. 327).

P. 568, line 2 from foot, for "*Rotalia spinulifera*" read *Pulvinulina spinulifera.*

P. 569, line 14 from top, for "*Nodosaria simplex* Silvestri" read *Nodosaria oligostegia* Reuss.

P. 569, line 15 from foot, for "*Nodosaria Jonesi* Rss." read *Nodosaria radicula* (L.) var. *Jonesi* Rss.

P. 570, line 10 from foot, for "*Spirillina vivipara* Ehrenb." read *Spirillina tuberculata* Brady.

P. 572, line 9 from top, for "*Pleurostomella eocæna* Gümbel" read *Pleurostomella alternans* Schwager.

Pp. 574 and 575. *Ophthalmidium tumidulum* Brady, *Cornuspira cretacea* Reuss, *C. involvens* Reuss, and *C. foliacea* Philippi sp. are transferred to *Ammodiscus incertus* d'Orbigny sp. (see p. 21).

Part 2. *Journ. R. Micr. Soc.*, 1892.

P. 324, line 2 from top, *delete* "and Wealden beds."

Part 3. *Journ. R. Micr. Soc.*, 1892.

P. 750, line 12 from foot, for "*Spiroplecta annectens*" read *Spiroplecta complanata.*

P. 756, line 21 from top, for "Upper Triassic ?" read Lias.

P. 756, *Bulimina polystropha* Reuss is now determined as *Verneuilina pygmæa* Egger sp.

Part 4. *Journ. R. Micr. Soc.*, 1893.

On Plate IX. *transpose* the numbers 15 and 16.

P. 580, in explanation to plate VIII. and p. 587, line 1, for "*Nodosaria farcimen* Soldani sp." read *Nodosaria farcimen* Reuss after Soldani.

P. 583, line 5 from foot, for "Pitzpuhl" read Pietzpuhl.

Part 5. *Journ. R. Micr. Soc.*, 1894.

P. 156, for "*Frondicularia pinnæformis* sp. nov." read *Frondicularia Fritschi* Perner (see p. 21).
P. 162, alter "*Marginulina aspera*" to *Marginulina asperula* (see p. 22).

Part 6. *Journ. R. Micr. Soc.*, 1894.

P. 427, line 10 from foot, for "parelled" read parallel.

Part 7. *Journ. R. Micr. Soc.*, 1894.

P. 648, line 12 from top, for "1803" read 1798.
P. 652, line 23 from top, after "*Cristellaria latifrons*" add Brady.

Part 8. *Journ. R. Micr. Soc.*, 1896.

P. 4, line 9 from top, for "*Cristellaria nodosa* Reuss sp." read *Cristellaria lobata* Costa sp. Also between this and the next line insert, *Robulina lobata* Costa, 1856, Atti Accad. Pontaniana, vol. vii. fas. 2 (not described), pl. xx. fig. 14.
P. 10, line 4 from foot, for "Schlich" read Schlicht.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, Etc.

*Including Original Communications from Fellows and Others.**

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Mechanics of Development.‡—Dr. Albrecht gives an account of the present state of the controversy between Hertwig § and Roux || as to the value of the "mechanical" method in the study of development. Hertwig's criticism of Roux is directed, firstly against the philosophical implications of the theory, and secondly, against its practical utility. In the first part of his attack Hertwig accuses Roux of falling into the old error of converting a statement of observed facts into the effective cause of the phenomena, i.e. of making laws into fetishes, and on this assumption reduces Roux's statements to absurdity. Albrecht maintains that this is due to a total misapprehension of Roux's position; and, while admitting that Weismann's hypotheses attempt to explain phenomena merely by converting the facts to be explained into causes, denies that this reproach is applicable to Roux. His object, Albrecht believes, is primarily to find methods of analysing phenomena and their causal relations.

The second part of Hertwig's attack consists of an eloquent justification of the observational method in biology, and a protest against what he calls the over-valuation of the new experimental method, which gives, he says, pathological and not physiological results. This protest Albrecht considers to be also in part the result of misunderstanding; he

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

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

‡ Biol. Centralbl., xvii. (1897) pp. 769-85.

§ 'Zeit- und Streitfragen der Biologie, Heft 2, Mechanik u. Biologie,' Jena, 1897, 211 pp.

|| 'Programm u. Forschungsmethoden der Entwicklungs-mechanik der Organismen,' Leipzig, 1897, 203 pp.

thinks also that Hertwig should allow something for the natural enthusiasm of the discoverers of a new and fruitful method in biology.

The paper also includes a brief account of the reply which Roux himself makes to Hertwig. The aim of the new school, according to him, is to refer the phenomena of the organic world to the fewest possible causes (*Wirkungsweisen*), and to explain each particular phenomenon as the result of a special combination of these general causes. In reply to Hertwig's attack upon the experimental method in embryology, he admits that the method can only yield fruitful results when combined with other methods, but protests against Hertwig's dismissal of the results as "pathological." The changes produced are quantitative, and not qualitative; they have their homologues in the so-called "normal" organism, and must therefore be of value in the comprehension of these normal processes.

Albrecht's summing up is in favour of Roux; but he so far agrees with Hertwig that he believes that the terms used by Roux are liable to misconception, even if Roux himself has not been guilty of a misuse of them. He strongly pleads, therefore, for a revisal of nomenclature, and deprecates the rash use of terms like "formative forces" (*gestaltende Kräfte*) by a school which has already made good its claim to rank with the existing schools of morphologists and physiologists.

Gastrulation in Amphioxus.*—Dr. J. Sobotta has worked through the early stages of the development in *Amphioxus*, in order to decide the question at issue between Hatschek and Lwoff. Lwoff dissents from Hatschek's well-known description in that he believes that the micromeres of the blastosphere form part of the endoderm as well as the whole of the ectoderm. He believes that certain of the small cells are the active agents in the process of invagination, and that they form the roof of the mid-gut. Sobotta's results confirm those of Hatschek in almost all particulars, but in two points they support Lwoff. The two points relate to the method of closure of the blastopore, and the so-called pole-cells of the mesoderm. Sobotta denies that the blastopore becomes slit-like and closes from before backwards. He believes that it gradually diminishes on all sides. He was further quite unable to find the pole-cells, and believes that they do not exist, certainly not, at least, in those early stages in which they were described by Hatschek.

Gastrulation in Vertebrates.†—Dr. J. Sobotta discusses briefly the discogastrula of Selachii and Teleostei, the amphigastrula of Amphibia, the epigastrula of Amniota, and the primitive archigastrula of the lancelet.

Development of Rodent Dentition.‡—Herr P. Adloff has studied the embryos of a number of Rodents, and has got some interesting results, of which the most important seems to be that the minute rudiments of front teeth, repeatedly described, are not the deciduous representatives of the large gnawing teeth, but correspond to a more anterior pair of incisors—the first incisors in other forms. The large gnawing teeth are really the second incisors.

* Verhandl. Phys.-Med. Ges. Würzburg, xxxi. (1897) pp. 1–21 (1 pl. and 20 figs.).
† SB. Phys.-Med. Ges. Würzburg, 1897, p. 9.
‡ Zool. Anzeig., xx. (1897) pp. 324–9.

Phylogeny of Claws of Vertebrates.*—Dr. E. Göppert has studied, by means of sections, the extremities of the digits in Amphibia, in order to contrast the appearances found there with the simple claws of crocodiles, turtles, and birds. The results show that in the Amphibia the fingers and toes are either rounded or pointed at the tip. If rounded, no structures resembling claws are present; but in the Urodela, at least, the rounded condition is derived from the pointed. In the Urodela the pointed form is frequently retained throughout life, and claws, or rudiments of claws, are of common occurrence. The most primitive condition is a cap of horn more or less strongly developed round the finger-tip; the next stage is the development of a slight curvature of the tip of the digit, which still retains its primitively circular contour. Such structures are of obvious use to aquatic animals in enabling them to retain foothold in the water; and they attain their maximum development in *Onychodactylus*, where they have all the parts of the claws of the Amniota. In the Anura, with the exception of *Dactylethra* (*Xenopus*), claws are not represented. His observations lead Göppert to deny Boas' homology of claws and epidermic scales; he regards them, on the contrary, as structures *sui generis*, homologous in Amniota and Amphibia, but having evolved independently in those cases in the latter group in which they are well developed.

Development of Cranial Region in Necturus.†—Miss Julia B. Platt concludes from her investigations that the branchial cartilages and the anterior part of the trabeculæ arise in tissue of ectodermic origin. The basal plate of the skull, the auditory capsule, and the occipital arch, are of mesodermic origin.

The plate of prochondral tissue which primarily underlies the brain is not coextensive with the basal plate of the skull, but includes in its antero-median part prochondral tissue surrounding the point of the chorda, which is not converted into cartilage.

Distinctly separate cartilaginous elements, the homologues of the independent trabecular and occipital plates found in *Triton*, do not appear in *Necturus* in the development of the basal plate, although a middle region of the prochondral plate chondrifies slightly later than the anterior and posterior regions of the plate.

The operculum auris arises near the antero-ventral margin of the fenestra ovalis in cells of the mesenchyma external to the auditory capsule. The dorsal part of the crista trabeculæ arises independently, and is possibly the rudiment of the large alisphenoid cartilage found in the Selachii. A rudimentary arch, shown by its relation to the myotomes to be serially homologous with the occipital arch and the neural arches of the trunk, is taken into the otic capsule. The cartilage roofing the posterior part of the brain (*tectum interoccipitale*) arises independently from paired *Anlagen*, and becomes connected with the dorsal extremities of the occipital and præoccipital arches, as the cartilage roofing the spinal cord, which also arises from paired *Anlagen*, is connected with the neural arches.

Each of the proper branchial muscles may be traced to mesothelial tissue primarily continuous with the wall of the pericardium, and is

* Morph. Jahrb., xxv. (1896) pp. 1–30 (1 pl. and 19 figs.).
† Tom. cit., pp. 377–464 (3 pls.).

consequently formed morphologically in the wall of the cœlom. No branchial muscle in *Necturus* arises in tissue similar to that composing the *periaxiale Stränge* described by Goronowitsch as taking part in the formation of the branchial musculature in the bird. The history of the various somites is given in detail.

Accessory Optic Vesicles in Chick Embryo.*— Prof. W. A. Locy finds that there exist in the brain walls of the chick and *Acanthias* (six) serial differentiations of epithelium that take the form of accessory vesicles, closely connected with the optic vesicles. They are very transitory—lasting for three hours in the chick—and disappear before the true brain vesicles arise, with which they might otherwise become confused. Their existence supports the hypothesis that the Vertebrate eyes are segmental, and that the ancestors of Vertebrates were primitively multiple-eyed. Since the optic vesicles in many cases arise before the brain vesicles, it seems likely that their primitive relation is not that of diverticula.

Significance of Hypophysis and Infundibular Organ. † — Herr B. Haller has conducted a very extensive series of investigations on the hypophysis and related organs, the animals chosen including representatives of all the Vertebrate classes. He concludes that the idea that the hypophysis is a rudimentary structure is entirely erroneous; it is a glandular structure, at first simple but afterwards greatly increasing in complexity, primarily opening into the cavity of the skull, and probably secreting a substance which serves to keep the brain-membranes moist. Primitively, the hypophysis is sac-like at the time of its origin, and this condition persists in Selachians and Amniota; in Teleosteans, Amphibians, and Cyclostomes, on the other hand, it arises as a solid outgrowth. The investigation does not support von Kupffer's theory that the external opening of the hypophysis represents the primitive mouth of Vertebrates; and so far from accepting the correlated theory that the nasal opening of cyclostomes represents this primitive mouth, the author believes that the cyclostomes are descended from forms with paired nostrils.

The infundibular gland is entirely distinct in origin and structure from the hypophysis, and primitively opens into the cavity of the brain. It occurs in relatively few Vertebrates, and although occasionally attaining a high development in terrestrial Vertebrates (e.g. Batrachians), has in the general case already disappeared in Amphibians. The *processus infundibuli*, on the other hand, though absent in Selachians and Teleosteans, is well developed in most Vertebrates. It has nothing to do with a gland.

Thyroid, Thymus, and Parathyroid Glands.‡— MM. F. Tourneux and P. Verdun have studied the development of these structures in the human embryo.

The median thyroid arises from a median bud of the bucco-pharyngeal epithelium, which grows out so that its anterior end comes into relation with the aortic bulb.

The lateral thyroids arise from the anterior or ventral walls of the

* Anat. Anzeig., xiv. (1897) pp. 113-24 (9 figs.).
† Morph. Jahrb., xxv. (1896) pp. 31-114 (6 pls. and 4 figs.).
‡ Journ. Anat. Physiol., xxxiii. (1897) pp. 305-25 (3 pls.).

fourth endodermic pouches, whose dorsal walls form the thyroidean glandules. These lateral thyroids separate from the pharynx and from the thyroidean glandules, and fuse with the median thyroid to form the final thyroid gland.

The lobes of the thymus are primitively represented by two tubes formed at the expense of the third endodermic pockets. They have a somewhat complex history.

The thymic glandules arise on the wall of the third endodermic pouches, and have a structural development like that of the thyroidean glandules.

Pleural Cavities and Pleuro-Pericardial Membranes.* —Dr. A. Brachet has tackled this difficult subject from the embryological side. We have only space to notice two general conclusions, which may suggest to those interested the importance of the paper. The diaphragm is formed by the *septum transversum*, and two of its extensions—the pleuro-peritoneal and the peritoneo-pericardial membranes. The pleuro-pericardial membrane properly so-called is formed, in small part, by the quite anterior portion of the *septum transversum*, and, in great part, by the pleuro-pericardial extension of this septum.

Development of Pronephros and Mesonephros in Myxine.†—Herr O. Maas furnishes an important contribution to the comparative study of the excretory systems of the lower Vertebrates. He was fortunate in obtaining unusually small specimens of *Myxine* (one of only 8·5 cm.), and employed them for the investigation of the development and relations of the pronephros and mesonephros, recently the subject of keen discussion between Spengel and Semon. His interpretation of his observations is as follows:—The pronephros consists primitively of a series of tubules, segmentally arranged, which in the anterior region open into the pericardium by one or several funnels, and which have a superficial network of capillaries formed by the dividing up of vessels from the dorsal aorta. The general similarity to Boveri's tubules in *Amphioxus* hardly requires emphasis, but a marked difference is discernible in the absence of external openings, and in the tendency of the blind ends of the tubules to fuse together. These pronephric tubules, hypothetically extending throughout the body, undergo different modifications in (1) the region of the true (adult) kidney, in (2) the intermediate zone, and in (3) the head-kidney of the adult. (1) In the posterior region of the body the internal openings are lost, the outer ends fuse together to form the pronephric duct, which however retains some excretory significance, and the segmental capillary networks persist on the surface of the duct. The pronephric tubules of this region, though in a modified form, are thus functional throughout life. (2) In the intermediate zone the tubules undergo degeneration, but in young forms traces of tubules or of the pronephric duct are readily perceived. (3) In the region of the head-kidney the outer ends of the tubules fuse together and with part of the capillary network to form a mass of lymphoid tissue—the adrenal. Certain portions of the capillary network persist and become specialised to form the

* Journ. Anat. Physiol, xxxiii. (1897) pp. 421–60 (2 pls.).
† Zool. Jahrb., x. (1897) pp. 473–510 (4 pls.).

glomi, probably functional during the interval of the development of the true glomeruli of the mesonephros. Maas thus maintains that the glomi of the pronephros are wholly secondary structures, not entering into the definition of the organs. The mesonephros consists of very simple tubules furnished with Malpighian capsules, and acquiring a secondary connection with the pronephric duct.

The important general result is that, as regards its excretory system, *Myxine* is intermediate between *Amphioxus* and Fishes, its mesonephros is simple, and the excretory function is in part discharged by the modified pronephros. There is no indication of a transition between pronephric and mesonephric tubules, the two showing marked histological differences. The observations on the mesonephros lend no support to Semon's theory of the cœlomic origin of the cavity of the Malpighian capsule.

Excretory System of Bdellostoma.*—Herr W. Felix has subjected Price's work on this subject to a detailed criticism, dealing especially with three of Price's conclusions :—(1) that the whole excretory system of *Bdellostoma* is pronephric; (2) that the cœlom pouches of the embryo in stage A 2 arise by a secondary segmentation of the unsegmented body-cavity; and (3) that the urinary system develops in a caudo-cranial direction. Felix does not think that the facts substantiate (1). He does not believe in the existence of the cœlom pouch, which is nothing more than the gradually diminishing communication between urinary tubule and cœlom. The development is cranio-caudal, not the reverse.

Development of Californian Hag.†—Dr. Bashford Dean gives some account of the development of *Bdellostoma Stouti* Lockington. It spawns in the Bay of Monteret, about a mile from shore, in twelve fathoms of water, but the eggs can very rarely be dredged, probably because they have been deposited among rock fragments or deep in the mud. In some cases, however, a hag is caught with an egg-string entrapped in its encasing slime. From observations made upon embryos reared for a time in aquaria, the author concludes that the eggs do not hatch within two months.

Some of the more striking features in the development are the following :—

The neural tract is laid down, nearly in its entire length, before the appearance of somites, and without any indication of neuromeres. The tract, as in the lamprey, acquires a lumen by dissociation of cells, proceeding antero-posteriorly.

The brain is distinctly tubular, and differs little in calibre from the spinal cord up to the time of the appearance of the paired sense-organs, of gill-slits, and of nearly the adult number of somites. The brain portion is about one-fifth of the entire length of the neural tube at a stage when nearly the adult number of somites are present.

The numerous (asymmetrical) foldings of the brain-wall, by which the regions come to appear, indicate a primitive condition of the craniote brain, i.e. that the latter was originally a tube of many vesicles (eight at

* Anat. Anzeig., xiii. (1897) pp. 570–99 (11 figs.).
† Quart. Journ. Micr. Sci., xl. (1897) pp. 269–79 (1 pl.).

least between cerebellum and thalamus) which have become merged in the ontogeny of higher forms. There is scarcely any cranial flexure.

Although the developmental type of *Bdellostoma* is distinctly meroblastic, it is noteworthy that there appears no trace of a germ-ring; except in the immediate region of the tail, the somites arise *in situ* at the sides of the neural axis.

The early appearance in each segment of pronephric tubules, similar to each other in essential characters, demonstrates, as Price has shown, that the entire excretory system of Myxinoids must, from the standpoint of ontogeny, be regarded as univalent. If we accept, therefore, Spengel's criticisms of the results of Semon on the morphology of the excretory system in *Myxine*, we must nevertheless admit Semon's *a priori* view as to its homology as a pronephros.

Supra-Renal Capsules.*—Dr. Swale Vincent finds in a recent paper by E. Huot a reason for restating the case in regard to supra-renal and inter-renal bodies. The cortex and medulla of the supra-renal in Mammals correspond respectively to the inter-renal and paired supra-renal bodies of Elasmobranchs. In Teleosteans the known supra-renal bodies (corpuscles of Stannius) appear to consist solely of cortex, the medullary substance being absent. In the higher Vertebrates the two parts occur in combination.

Eggs and Larvæ of Marine Fishes.†—Fabre-Domergue and E. Biétrix have made an extensive series of observations on various points connected with marine pisciculture. They begin with methods of keeping adult mature fish in captivity, the turbot being chosen as the subject for experimentation. The main difficulty is that there supervenes upon capture a longer or shorter period during which the fish take no food whatever, while the rate of mortality is exceedingly heavy. Dissection showed that the refusal of food is not merely due to lack of appetite, but that the physiology of nutrition is profoundly modified, the process of digestion being temporarily suspended. Thus food taken immediately before capture remains undigested in the gut until death occurs. This period of acclimatisation is much shorter and less fatal in young fish, which should therefore only be chosen. The observations upon eggs and larvæ were conducted on a large series of forms. It was found that larvæ respectively with and without eye-pigment behaved very differently under the action of light. The former were markedly actinotropic, collecting in the area of greatest illumination, and following a moving light, while the latter showed themselves indifferent to light. The authors lay most stress, however, upon their observations on larvæ in the critical stage, namely that which intervenes between the absorption of the yolk and the assumption of the adult form. Such larvæ cannot be induced to take food in captivity, and, save in rare and isolated instances, invariably die if not set free. In consequence the habit at marine stations has been to liberate the larvæ before the disappearance of the yolk-sac, and to assume that it is the lack of suitable food which is the cause of death. The authors made numerous examinations of the intestinal contents in larvæ caught in the open sea, and supplied their

* Anat. Anzeig., xiv. (1897) pp. 151–2.
† Ann. Sci. Nat. (Zool.), iv. (1897) pp. 151–220 (18 figs.).

artificially reared forms with similar food, but without succeeding in diminishing the mortality. Further, they find that in highly differentiated larvæ like those of *Cottus bubalis*, a condition of marked anæmia can be shown to begin *before* the food-yolk is used up. They believe, therefore, that it is not wholly want of food which causes death, but some radical defect in method which acts injuriously upon both eggs and larvæ. They are in consequence unable to assure themselves that the larvæ liberated from the stations do survive even with the environmental change, and express themselves as sceptical not of the utility of marine pisciculture but of present methods.

Breeding Habit of a Japanese Tree-Frog.* — S. Ikeda has an interesting note on the breeding habit of *Racophorus Schlegelii* Günth. They pair in April and May immediately after awakening from hibernation. The females are always larger than the males. With the male on her back the female makes a round hole in the muddy banks of paddy-fields, ponds, and lakes, and spawning may be finished by the next morning. There is some evidence that the spawning may also take place on trees.

The eggs, when laid as stated above, are enveloped in a white jelly-mass full of air-bubbles, and of spheroidal form. This frothy envelope, like well-beaten white of hen's egg, protects the egg from external agencies, perhaps prevents overcrowding, but especially facilitates the respiration of the eggs and embryos. The outer surface dries into a crust, the air-bubbles within secure aeration. Ikeda gives a detailed description of the treading and kneading movements of the female which work the jelly into froth.

Segmentation is unequal and total, but shows a closer approach to the meroblastic mode than other amphibian eggs. The early development has some striking resemblances with that of Ganoids:—(1) the embryo is greatly flattened over the large yolk-mass, so that the ventrally observable organs, such as the heart and the hyo-mandibular arches, appear in front and at the side of the head; (2) the body of the embryo in later stages is wedged into the yolk-mass, which is deeply grooved along the dorso-median line.

Interstitial Cells of Testis.† — Prof. K. von Bardeleben concludes that the interstitial cells (*Zwischenzellen*) of the Mammalian testis are originally epithelial elements which, like mesenchyme elements, leave their original association and become migratory. He regards them as contributing to the nutrition and liberation of the spermatozoa.

Axial Filament of Human Spermatozoa ‡—Dr. Fr. Meves finds that in man, as in the rat and salamander, the axial filament of the spermatozoon has an extra-nuclear origin, from one of the two central corpuscles, namely from the one which is nearest the periphery of the spermatid.

Dimorphism of Spermatozoa in Mammals.§—Prof. K. von Bardeleben thinks that the facts of spermatogenesis in Monotremes, Marsupials,

* Annot. Zool. Japon., i. (1897) pp. 113–22 (2 figs.).
† Anat. Anzeig., xiii. (1897) pp. 529–36.
‡ Op. cit., xiv. (1897) pp. 168–70 (2 figs.).
§ Op. cit., xiii. (1897) pp. 564–9 (6 figs.).

hedgehog, and man, point clearly to dimorphism. From Sertoli's cells there arise by amitosis long, sometimes coiled, chromatin-containing axial filaments, with a terminal swelling and a plasmic mantle. These may be (*a*) parts of spermatozoa, i.e. tails, or (*b*) rudimentary (abortive, reduced) spermatozoa. The author adopts the latter alternative. He has also some suggestions to offer in regard to the embryonic hermaphroditism of the epithelial content of the testes, and compares the penetration of the spermatozoa into the protoplasmic mass of Sertoli's cells with fertilisation. He emphasises his conclusion that the axial filament is formed, not from the chromatin of the nucleus, but essentially from the centrosomes.

In a subsequent paper * the author recognises that the tail-rudiments which he confesses to have confused with dimorphic *Nebenformen*, do not arise from cells different from those which form the heads. They arise from the centrosomes, accessory body, and cytoplasm of the spermatids; the axial filament in particular is formed mainly from the central corpuscle.

Path of the Spermatozoa in the Frog.† — Herr O. Frankl has studied this subject by means of injections from "Leydig's duct," and by fixation of the organs in frogs killed during copulation. Both methods showed that the *vasa efferentia* are continued through the kidney as transverse canals opening into the urospermatic duct, and that these transverse canals are connected by sagittal ducts with the Malpighian capsules. Although therefore the Malpighian capsules are not in the direct path of the spermatozoa, yet a rise of pressure, produced e.g. by an extremely active flow of semen temporarily blocking the ducts, forces spermatozoa into the cavities of the capsules. The paper concludes with a brief discussion as to the relations of sexual and excretory organs in Fishes and Amphibia.

Prof. M. Nussbaum ‡ points out the morphological interest of the fact that in adult males of *Rana esculenta* var. *berolinensis* and *hungarica* the efferent canals from the testes are connected with renal canals whose glomeruli persist, while in *R. fusca* the glomeruli in the same region have disappeared.

Problems of Hybridisation.§ — M. André Suchetet, who has devoted so much attention to hybridism, asks three questions :—(1) What is the nature of those species which can be successfully crossed? (2) Are their progeny fertile or sterile? (3) What are the causes of the sterility of many?

(1) Authentic cases of hybridism in Mammals number about 93, of which 82 (*a*) are crosses of species of the same genus; there are 11 doubtful cases (*b*) of hybridism between members of different genera; there is no instance of crossing (*c*) between members of distinct families or widely separated genera. Among birds, 262 cases are recorded, 178 of the first category (*a*), 68 of the second (*b*), and 16 (some doubtful) of the third (*c*).

(2) Of the 82 crosses between Mammals of distinct species but of

* Anat. Anzeig., xiv. (1897) pp. 145–7.
† Zeitschr. wiss. Zool., lxiii. (1897) pp. 23–38 (1 pl.).
‡ Zool. Anzeig., xx. (1897) pp. 425–7.
§ Journ. Anat. Physiol., xxxiii. (1897) pp. 326–55.

the same genus, the great majority (62) have resulted in sterile offspring. In about 12 cases, the offspring have been fertile with one of the parent species or with a third species; in seven or eight cases they have proved fertile *inter se*, sometimes for three or four generations.

Among birds, in 78 crosses between distinct species, but of the same genus, only 22 have resulted in fertile offspring, 8 *inter se*, the others with the parent species, or with a third species, or with other hybrids.

Of the 68 crosses between species of different genera, but belonging to the same family, only one had offspring fertile with one of the parent species—the male hybrid of *Columba livia* × *Turtur risorius* was fertile with the female of the latter species. The female hybrid seems sterile. In two other cases a hybrid of this category fertilised a third species; in another case it was fertilised by this third species.

(3) As to the causes of sterility, the gonads may be atrophied, the ducts may be abnormal, and so on; there is no doubt that the defect is constitutional; but little more can be said.

Regeneration in Vertebrates.*—Herr Tornier has two preliminary notes on the production of supernumerary tails, limbs, and digits in Vertebrates after certain kinds of injury, whether artificial or natural. In lizards it is easy to obtain double or even triple regeneration of the tail by injuring two or three vertebræ at once. When three tails are present, the whole three are not usually visible externally, but can be demonstrated by means of the Röntgen rays. By amputating a limb and tying a thread in the middle of the wound, it is possible to obtain a duplex regeneration. Similarly, by successive injuries it is possible to produce supernumerary limbs or digits. In the case of extra digits in Mammals, the additional ones are always images of the normal (cf. Bateson), so that the limb appears to consist of a combination of a right and left limb. Such supernumerary limbs or digits the author regards as the result of pressure on the amnion, causing this to grow out into folds, often symmetrical, which press against the growing limbs, and stimulate these to regenerate the part injured.

Von Baer's Philosophy.†—Herr E. Wasmann briefly reviews Dr. R. Stölzle's ‡ new book on Von Baer. He praises its impartiality, and describes it as containing a full exposition of Von Baer's views on biological and other problems.

Variation of Fin-Rays of Fishes.§—Dr. Georg Duncker has made an extended series of observations on the correlation in the number of fin-rays in the different fins of *Acerina cernua* L. The observations were made in 1900 cases between the vertical fins and their respective segments; in 1650 cases between the pectoral fins; in the same number between the pectoral fins on the one hand and the dermal rays and the total number of rays of dorsal and anal fins on the other. The results show that, in the case of vertical fins, there is negative correlation between the dissimilar segments, positive between the similar segments and the total number. Between the pectoral fins there is marked posi-

* Zool. Anzeig., xx. (1897) pp. 356–61 (6 figs.), and pp. 362–65 (3 figs.).
† Biol. Centralbl., xvii. (1897) pp. 799–800.
‡ 'Karl Ernst v. Baer und seine Weltanschauung,' by Dr. Rem. Stölzle, Regensburg, 1897, 687 pp. § Biol. Centralbl., xvii. (1897) pp. 785–94, and 815–31.

tive correlation, yet the symmetry of the two fins is not rigid. The pectoral fins are in negative correlation to the dorsal fins, in positive to the anal fins, but the correlation could not always be demonstrated.

Problem of Utility.*—Captain F. W. Hutton replies to Mr. A. R. Wallace's conclusion that, "whether we can discover their use or no, there is an overwhelming probability in favour of the statement that every truly *specific* character is or has been useful; or, if not useful, is strictly correlated with such a character." He takes two tests of utility—adaptation and recognition-marks. Recognition-marks must be restricted to animals with eyes. What then of the colours of the shells of blind Lamellibranchs, the obscured venation of the wings in Lepidoptera and Trichoptera, the crabs covered with sea-weeds? Their marks cannot be recognition-marks; are they adaptations? Adaptations are of two kinds: those useful to their possessors, and those which have been useful to former ancestors. We can eliminate the last group by restricting our attention to the specific characters of a species the habits of which agree with those of other species of the genus; for in these cases the habits must have remained the same during the whole of its specific life, and the specific characters must have been developed by their present possessors. What, then, of the colours of the arenicolous species of *Tellina*, a spine more or less on a crab's carapace, the branching of a wing-vein once or twice, the number and shape of teeth in snails, the ribbing of the shells, the shapes of the spicules in Holothurians and Sponges, the skeletons of Radiolarians, the ornamentation of Diatoms, and so on? As a particular case, Hutton selects the species of *Ptilopus* (fruit-pigeon), thirteen of which are found isolated on islands or small groups of islands. The colours are not recognition-marks; they are not due to correlation; they cannot have been useful to ancestors, since they have only lately developed; and there is no evidence of adaptation to locality, since all the islands have practically the same climate, fauna, and flora. The author concludes that we are forced to look for an origin apart from utility for many a specific character. "Just as gravitation does not express the whole of the relations between inorganic bodies, so, probably, selection does not express the whole of the relations between organic bodies."

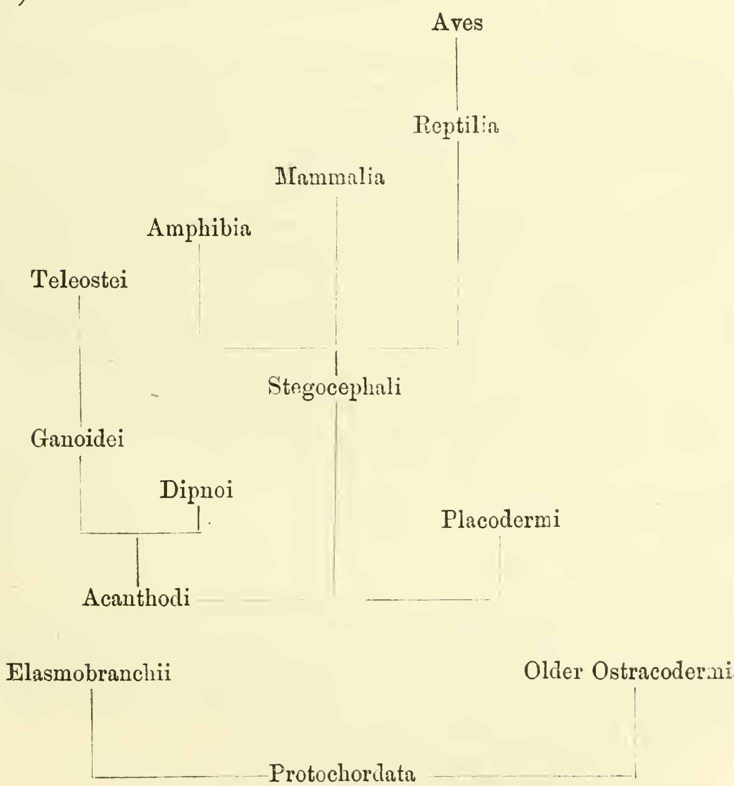
Variations in the Brachial and Lumbo-Sacral Plexi of Necturus maculosus.†—Mr. F. C. Waite has studied thirty specimens of this large perennibranch salamander, which were, in the main, procured from one locality in Lake Erie. The brachial plexus showed a tendency towards variation in the location of "strength-centre" (central with regard to the combined strengths of the component nerves); but this is not correlated with the variations in the position of the pelvic girdle, or with displacements of the strength-centre in the lumbo-sacral plexus. The variations in the lumbo-sacral plexus are grouped under three heads:—those in which the girdle is attached to the nineteenth vertebra; those with the girdle carried by the twentieth vertebra; and those in which the constituents of the girdle have an asymmetrical position.

Two theoretical questions are asked:—(1) Does the abnormal posi-

* Journ. Linn. Soc. (Zool.), xxvi. 1897, pp. 330-4.
† Bull. Mus. Comp. Zool. Harvard, xxxi. (1897) pp. 71-92 (2 pls.).

tion of the girdle arise by intercalation or excalation of pre-sacral segments, by slipping of the girdle upon the column towards the head or towards the tail, or by some other means? (2) Is there any correlation between the variations of the plexus and those of the girdle, and if so, of what sort is it? To the first question the author answers, after discussion, that neither intercalation, nor excalation, nor slipping is involved; the abnormal position of the girdle represents development of a *new* girdle at a *new* point, usually to the tail end of the normal. To the second question the author answers that the nerve relations show that variations of girdle and plexus are nearly parallel, but that they are in some degree independent, as exhibited by the fact that the strength-centre of the plexus does not have just the same relation to the girdle in the variant that it had in the normal condition.

Pedigree of Vertebrata.*—Herr O. Jækel discusses the origin of paired limbs, the possible characters of the vertebrate *Stammform*, and the relationships of the various classes. He expresses his conception of the phyletic relations in the following scheme (slightly modified):—



* SB. Ges. Nat. Freunde Berlin, 1896, pp. 107–29.

Spiral Fold of Selachian Intestine.*—Dr. Paul Mayer has an interesting note on this subject. Jeffery Parker spoke of that of *Raja* as "the most remarkable case on record of spontaneous variation," and distinguished four types. But Mayer shows that these are in part artefacts and in part functional changes due to the amount of food and the state of digestion.

Classification of Monstrosities.†—M. Louis Blanc distinguishes:—(*a*) those abnormalities which arise from an ovum with one nucleus; (*b*) those which arise from an ovum with two nuclei; (*c*) those which arise from an ovum with multiple nuclei. He also distinguishes the abnormalities (*a*) of formation (defect, excess, or malformation); (*b*) of development (defect, excess, or some other perturbation); and (*c*) of growth (defect or excess). The detailed classification follows the different systems of the body.

b. Histology.

Précis of Histology.‡—Prof. M. Duval has published a *précis* of his course of lectures on histology, an up-to-date and carefully thought out introduction to the subject, which is sure to be valued throughout the wide circle of histologists.

Sickle-shaped Nuclei and Giant-Spheres in Resting Epithelial Cells.§—Prof. E. Ballowitz describes these in the pharyngeal and cloacal cavities of *Salpa*; each nucleus has an exquisite sickle-shape, and sometimes the ends meet; each concavity contains a very large sphere with radiate structure and two or three centrosomes.

Energids of Plants and Animals.‖—Prof. A. von Kölliker sums up the general result of a detailed comparison, as follows. In the organisation of plants naked energids play no part, being replaced by those which are surrounded by a cellulose membrane and have become true cells. Yet the conditions of growth and organisation of the energids determine the forms of the cells and organs. Cuticular structures and intercellular substances take little part in the construction of the plant, and functional alloplasmatic products of energids are almost wanting.

In animals, on the other hand, naked energids play a very essential part in the formation of many organs, prominent among which are epidermic structures and glands. Moreover the energids produce abundant intercellular substances, connective tissue, elastic tissue, dentine, cartilage, and bone. Especially characteristic of animals is the fact that functional alloplasmatic energid-products, especially muscle-cells and nerve-cells, attain dominance, rule the whole life, and form the typical animal organs.

Number of Chromosomes in Somatic Cells of Man.¶—Prof. W. Flemming points out that this has never been estimated with certainty. Hansemann gives numbers from 18 to 40; Bardeleben in dealing with spermatogenesis mentions 8 and 16. From preparations of the corneal

* MT. Zool. Stat. Neapel, xii. (1897) pp. 749–54 (1 pl.).
† Journ. Anat. Physiol., xxxiii. (1897) pp. 100–4.
‡ 'Précis d'Histologie,' 8vo, Paris, 1897, xxxii. and 956 pp., 408 figs.
§ Anat. Anzeig., xiii. (1897) pp. 602–4.
‖ Verh. Phys.-Med. Ges. Würzburg, xxxi. (1897) pp. 202–21.
¶ Anat. Anzeig., xiv. (1897) pp. 171–4 (1 fig.).

epithelium, Flemming has been led to believe, in the meantime, that 24 is the normal number.

Epithelium and Reticular Tissue.*—M. Ed. Retterer has for many years made a special study of these tissues. Among his general conclusions we note the following:—(1) the existence of a basilar layer of elements with homogeneous protoplasm, opaque and coalescent, characterising epithelia in the stage of growth. (2) The homogeneous protoplasm of this basilar layer elaborates a reticulum from which there arises the polyhedric epithelium *du sabot* or closed amygdaloid follicles. (3) The closed amygdaloid follicles and the interfollicular bridges arise entirely from epithelial buds of the pharyngeal mucosa. (4) Each closed follicle has three stages, epithelial, reticular, and fibrous. (5) The epithelium of the primitive invaginations, which persists in part in the adult in the lining of the amygdaloid crypts, is transformed in part into reticular tissue by a process analogous to that which occurs in the transformation of the closed epithelial follicle into reticular tissue.

Heart Muscle-Cells.†—Mr. J. B. MacCallum describes the structure of the heart muscle-cells in man, dog, cat, pig, rabbit, and mouse, and their development in the pig. "It is to be emphasised that in the protoplasm of the adult heart muscle-cell there are columns of fibrils which run longitudinally, surrounded by sarcoplasm, in such a way that each bundle is surrounded by a varying number of small sarcoplasmic discs, the horizontal separating partitions of which are continuous with Krause's line on the fibril bundles." In pig embryos there is a definite developmental sequence formed by the following five stages: (1) cells with a simple irregular network; (2) cells with a regular network consisting of large sarcoplasmic discs; (3) cells in which the large sarcoplasmic discs have been broken up with the formation of the small sarcoplasmic discs; (4) cells in which fibril bundles have formed at the junction of the small sarcoplasmic discs with one another; (5) adult cells as described above.

Appearance of Intercellular Bridges between Smooth Muscle-Cells.‡—M. Charles Garnier has studied in particular the muscular sheath of the œsophagus in the Greek tortoise, and the retractors of the long horns in the edible snail. He has convinced himself that an appearance of intercellular bridging is often due to the network of connective tissue which enters into very intimate relations with the muscle.

Hypophysis in Health and Disease.§—Dr. G. Wolff has made some observations on the minute structure of the human hypophysis, in the main confirming those of Lothringer and Rogowitsch. What we know may be briefly stated:—The hypophysis is a blood-gland, without duct, penetrated by a very thick network of blood-vessels with very thin walls. There are two kinds of cells, more and less susceptible to stains. The gland secretes a substance, colloid, which in its chemical

* Journ. Anat. Physiol., xxxiii. (1897) pp. 461–522 (2 pls.).
† Anat. Anzeig., xiii. (1897) pp. 609–20 (10 figs.).
‡ Journ. Anat. Physiol., xxxiii. (1897) pp. 405–20 (1 pl.)
§ Verh. Phys.-Med. Ges. Würzburg, xxxi. (1897) pp. 223–35.

reactions agrees essentially with the chromophilous cells. Some of the gland-cells contain red blood-corpuscles, and disruptive products of these which are taken up and dissolved in the vacuoles discovered by Rogowitsch. There thus seem to be two functions, secreting colloid and destroying red blood-corpuscles, but we know nothing of the relations (if any) between these. The author had intended to compare with the healthy hypophysis that of cretins and paralytics, and has done something in this direction,—too little, however, to warrant the emphasis of a summary.

Conducting Element in Nervous Tissue.*—Prof. St. Apáthy contributes the first part of an elaborate memoir on this subject to which he has for many years given much attention. The detailed part is mainly concerned with Hirudinea and Lumbricidæ. The general conception may be briefly stated. The nerve-cell is analogous to the muscle-cell, producing conducting substance (primitive fibrils, neurofibrils), as the muscle-cell produces contractile substance (myofibrils). The primitive fibrils grow inwards into ganglion-cells, outwards into sensory cells. They form a meshwork in the ganglion-cells, and pass out, variously grouped, to other ganglion-cells, to muscles, and to gland-cells. The ganglion-cells must be distinguished from the nerve-cells; they have been intercalated into the conducting system, producing what has to be conducted. The structural units of the conducting system are the neurofibrils, which can be isolated optically and mechanically. The present memoir is especially devoted to a consideration of these neurofibrils and their topographical relations.

Spinal Ganglion-Cells of Reptiles.†—Charles-Amédée Pugnat has studied these in *Testudo græca*, *Uromastix spinipes*, *Agama colonorum*, and *Emys europæus*. The cytoplasm has a fibrillar structure, the fibrils being very distinct peripherally, but disappearing in the clear central zone. The chromatin substance is generally in the form of very fine granulations, sometimes pulverulent. The nucleus, itself large, contains a very large nucleolus and a close network of linin-filaments, with numerous acidophilous granulations in the meshes. As to the very small cells found in most, if not all, types of Vertebrates in the spinal ganglia, the author thinks it most probable that they give rise to sensory fibres which pass by the *rami communicantes* to the sympathetic ganglia.

Molecular Layer of Cerebellum.‡—Prof. A. E. Smirnow finds in the molecular layer of the cerebellum in various Mammals the following types of nerve-cells:—(A) nerve-cells with a long neurite (Purkinje's cells), and (B) nerve-cells with a short neurite,—including (1) the cells of Ramón y Cajal, and (2) the cells described in the present paper. These are of two sorts, some with horizontally disposed neurite, and others with a neurite which immediately divides into terminal branches.

Minute Structure of the Lamprey's Skin.§—Herr W. Kapelkin gives an elaborate account of the lamprey's skin, in regard to which

* MT. Zool. Stat. Neapel, xii. (1897) pp. 495–748 (10 pls.).
† Anat. Anzeig., xiv. (1897) pp. 89–96 (4 figs.).
‡ Op. cit., xiii. (1897) pp. 636–42 (7 figs.).
§ Bull. Soc. Imp. Moscou, 1896 (1897), pp. 481–514 (2 pls.).

much diversity of statement prevails. The epidermis is characterised by two sets of elements, adapted to different ends:—(*a*) the cuticle and the granular cells serving to protect the animal from the injurious influences of the medium; (*b*) the club-shaped elements and free nerve-endings with orientating and sensory functions. Between the epidermis and the cutis there is a very thin basal membrane, perforated by minute apertures (for nerves?) and roughened by indentations where the epidermic cells are fixed. The cutis consists of several layers of parallel connective tissue fibres, running chiefly in two directions. The pigment-layer of much branched cells lies between the cutis and the subcutaneous tissue. The latter consists of a loose network of connective tissue fibres, with fat, lymph-spaces, and nerves. The fibres pass directly into the connective sheaths of the deeper muscles. It stores fats and gives the skin a useful mobility.

Ciliated Epithelium in Amphibian Larvæ.*—Prof. O. Mayer describes the distribution of cilia on the surface and in the interior of Amphibian larvæ. His results, like those of many others, show that ciliated cells may occur in the endoderm and ectoderm alike. As they occur also in different parts of the urogenital apparatus, which cannot be referred to either ectoderm or endoderm, it may be said that any of the three layers may be ciliated.

Ostioles.†—J. J. Andeer discusses the ostioles found in the lung, the intestines, the synovial membranes, the peritoneum, &c., and points out the pathological consequences of their obstruction on the one hand and of their hyper-secretion on the other.

Electric Organs.‡—Dr. E. Ballowitz obtained recently two specimens of *Gymnotus electricus*, one specimen being in the living condition. He was able to make very extended observations, both on the general anatomy and the histology of the electric organ.

The general structure of the organs in *Gymnotus* essentially resembles that in *Torpedo* and *Raja*. The electric tissue is formed by an extremely thick finely fibrous framework, which furnishes the substance of the papillæ and villi. The whole plate is surrounded by an electrolemma which is especially thick on the papillæ. Close beneath the electrolemma there lies on the surface of the villous layer an extremely dense layer of delicate minute parallel rods which must number several millions on each plate. In contrast to *Torpedo*, the rods are here quite free from nerve-endings.

The *Gymnotus* plate has three layers, an anterior papillary layer, a posterior villous layer, and an ill-defined middle layer between them. There is great variety of form and length among the villi, the longest being the *prolungamenti spiniformi* of Pacini, or the *Dornpapillen* of Du Bois-Reymond. The whole villous structure recalls that in some species of *Raja*, with this important difference that in the latter the nerves never extend to this surface, but keep to the smooth anterior surface of the plate. The nerves do not enter the substance of the villi,

* Anat. Anzeig., xiv. (1897) pp. 69–81.
† Comptes Rendus, cxxv. (1897) pp. 669–71.
‡ Anat. Anzeig., xiii. (1897) pp. 643–8 (2 figs). Arch. Mikr. Anat., i. (1897) pp. 686–750 (3 pls.).

but lie between them, and form terminal expansions on their surfaces. It may be said that the long villi are mainly, though not exclusively, the bearers of the terminal nervous expansions. They serve to increase the superficial extent of the essential electromotor tissue.

Hard Tissues of Vertebrates.* — Dr. C. Rose has a very learned article on the different forms of hard tissues, which he classifies as follows :—

A. True hard tissues (arising from odontoblasts and osteoblasts).

(1) True ivory, dentine or orthodentine (including normal dentine, vitrodentine, and vasodentine).
(2) Trabecular dentine.
(3) Osteoid tissue.
(4) Bone.
(5) Osteodentine.

B. Calcified connective tissue.

Unlike any of the above, whose origin is from connective tissue, enamel is formed from epithelial cells. It is of much wider occurrence than used to be supposed. In the much discussed case of the dogfish, the epithelial sheath forms an enamel cuticle—a superficial protective mantle—which may be regarded as the first stage in the formation of a true enamel.

c. General.

The Living Substance.†—Mrs. G. F. Andrews has made a study of protoplasm, and gives an account of its visible structure, its inclusions, its areal differentiations, its activities, &c., working gradually up to reproduction, heredity, habit, and instincts. She sums up her own observations, several of which have been previously referred to in this Journal, and insists on the idea of "an infinitely graded series of vesiculations of the protoplasmic foam." "Protoplasm is a very complex emulsion, having the physical arrangement of a very finely subdivided variably viscid foam, which characters are coextensive with the continuous element of all visible optical reticula." Unless we misunderstand, the book is not so much a treatise on protoplasmic phenomena as an expression of a certain interpretation which is summed up thus: "The facts seem to warrant present belief that the living substance of all organisms is one physiologically continuous living plasma, homogeneous throughout in its intrinsic powers and properties, but having varied local and temporary habits of self-expression, which are largely and inextricably correlated with physical and chemical conditionings of its form and composition as complex emulsive foam—yet not to be wholly identified with, nor wholly explained by these."

Theory of the Functions in Living Matter.‡ — Miss F. A. Welby has done good service in translating Prof. E. Hering's article (1888) on the theory of the functions in living matter, in which he expounded his conception of metabolism as consisting of two closely interwoven processes of assimilation and dissimilation.

* Anat. Anzeig., xiv. (1897) pp. 21–31, 33–69 (28 figs.).
† 'The Living Substance as such and as Organism,' Boston, 1897, 8vo, 176 pp.
‡ 'Brain,' 1897, pp. 232–58.

Functions of White Blood-Corpuscles.* — Herr Hs. Friedenthal gives a useful summary of recent work on this subject, and sums up as follows. It seems certain that the leucocytes play an important part in connection with coagulation (both preventing it and causing it), in phagocytosis, and in the secretion of the protective substance known as alexine. Their phagocytic activity includes the removal of dust-particles from the lungs, of pigment from the epidermis, of necrotic portions, and of intrusions. They play an important part in transporting material during metamorphosis; in regeneration they furnish the first material; the blood-plates are in part due to their disruption. Requiring confirmation, however, are the suggestions which have been made as to the share of the leucocytes in forming blood-ferments, in absorbing food, and in forming red blood-corpuscles. In short, they represent a reserve-power in the organism, helping various tissues in various ways to resist injurious influences and to respond to special functional demands.

Melanism in Reptiles and Amphibians.†—Herr Fr. Werner has a stringent criticism of Tornier's ‡ conclusion in regard to melanism in reptiles and amphibians. Tornier committed himself to the statement that melanism is to be regarded as a reversion to the original colour of the species. Werner gives many reasons why this cannot be accepted, and discusses in particular the import of the black colour in free-living amphibian larvæ. If every species with melanism was originally black, then the coloration of all these forms must have evolved independently, and all homologies in the coloration of related forms are mere analogies.

Freshwater Fauna.§—Prof. S. J. Hickson gives an interesting statement of the problems connected with the distribution of the freshwater fauna. He recognises three groups:—(1) the Cosmopolitan group, illustrated by *Hydra*, *Spongilla*, *Astacus*, *Anodon*, *Lymnæa*; (2) the Archaic group, illustrated by *Apus*, Dipnoi, *Limnocodium*; (3) the Recent group, illustrated by *Cordylophora*, *Palæmonetes*, and the prawn in the Tropics.

INVERTEBRATA.

Mollusca.

γ. Gastropoda.

Apex of Gastropod Shell.‖—Mr. F. C. Baker has studied the apex of the shell in 132 species, which, as he notes, is a small fraction of the total of 15,000 or so. There seem to be three main types, with numerous variations:—(1) whorls numerous, carinated, nucleus prominent; (2) whorls numerous, rounded, smooth, nucleus prominent; (3) whorls few, rounded, nucleus buried in the coil of the second whorl. Great changes take place after birth, many of them apparently modifications due to environment. It would be interesting if the author could in this case bring out the difference between variation and modification.

* Biol. Centralbl., xvii. (1897) pp. 705–19. † Tom. cit., pp. 376–81.

‡ 'Die Kriechthiere Deutsch-Ostafrikas. Beiträge zur Systematik und Descendenzlehre,' Berlin, 1897.

§ Trans. Manchester Micr. Soc., 1896 (1897), pp. 88–99.

‖ Ann. New York Acad. Sci., ix. (1897) pp. 685–704 (3 pls.).

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Young of Cryptochiton.‡ — Mr. H. Heath describes the external features of *Cryptochiton stelleri*, one of the most modified types of Polyplacophora. In the adult, no trace of the tegmentum is visible, the articulamentum alone remains. In the young, there is a series of eight openings along the median dorsal line, corresponding to the posterior portion of each valve. They are about 0·5 mm. in diameter, and through them the shell is plainly visible. On carefully dissecting out the valves, a well-defined tegmentum is visible. The type is not primitive, but represents the last of a series which has undergone successive modification, by which the tegmentum, originally the same size as the articulamentum, has gradually disappeared. Palæontological evidence also supports this conclusion.

δ. Lamellibranchiata.

Experiments on Bivalves.§—Dr. J. B. Pieri has experimented with species of *Tapes*, *Venus*, *Artemis*, and other bivalves. They do not become habituated to a diminution of salinity by 1/2 or 1/3, nor to an increase of 2 per cent., nor to an increase of iodide or bromide of potassium; in short, they have little power of adaptive reaction to changes in the medium. Vapours of creosote make the heart-beats slower, and end in their stoppage; laudanum applied to the heart, or injected, stops the beats at once, but they may re-commence in 15–25 minutes; vapours of laudanum are but slightly injurious; pure nicotine in contact with the heart stops it at once; a weak solution makes the beats slower; cocaine acts as a very powerful muscular poison, having an effect even when diluted to 1/000; cyanide of mercury is still more injurious; even when diluted to 1/30,000 it has an effect.

Head-kidney of Lamellibranchs.‖—Dr. H. Stauffacher has investigated the structure, function, and development of the head-kidney in the trochosphere of *Cyclas cornea*. In opposition to Ziegler, he finds that it is an unpaired organ, and actively functional. It consists of an internal ciliated portion opening into the primary schizocœle, of a middle portion formed of two complex cells, and of an external portion consisting of a vesicle opening to the exterior by a fine canal and pore. The lumen is wholly intracellular. In development, the inner and middle regions

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‡ Proc. Acad. Nat. Sci. Philadelphia, 1897, pp. 299–302 (1 pl.).
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Arthropoda.

Relation of Arthropod Head to Annelid Prostomium.†—Mr. E. S. Goodrich discusses this morphological problem. The prostomium (Huxley, = *Kopflappen*, *lobe céphalique*) is a median anterior process, lying above and in front of the mouth, and varying greatly in size and form. It is attached to the peristomial segment, which is usually modified in connection with the mouth. It may be (1) a modified or reduced segment; (2) an incipient segment; (3) not a segment at all, but a structure of different and special nature. It is the last interpretation which the author seeks to prove.

A typical segment is a region more or less distinctly marked off from the rest of the body by transverse grooves, surrounding the alimentary canal, containing a special cœlomic cavity (more or less completely separated off from the cœlom of adjoining segments by means of transverse septa), a pair of nephridia and of peritoneal funnels communicating with the exterior, a pair of ganglionic enlargements of the ventral longitudinal nerve-cords, and (in Polychætes and Arthropods) a pair of appendages. But such fully equipped segments are rarely found in nature; the embryological test is the decisive one. The peristomium fulfils the test; but the prostomium presents none of the characters essential to a segment. Goodrich's views in regard to the homologies of the head-region in Arthropods are summed up—not dogmatically, of course—in the following table.

Annelida.	Peripatoidea.	Insecta.	Arachnida.	Crustacea.
Prostomium with or without tentacles, archicerebrum.	Frontal processes ?	?	?	? Frontal processes.
Segment 1. Peristomium	Procephalic lobes, antennæ, protocerebrum.	Procephalic lobes, protocerebrum.	Procephalic lobes, protocerebrum.	Procephalic lobes, protocerebrum.
,, 2.	Mandibles, deutocerebrum.	Antennæ, deutocerebrum.	Cheliceræ, deutocerebrum.	First antennæ, deutocerebrum.
,, 3.	Oral papillæ.	Rudimentary appendage, tritocerebrum.	Trunk segment.	Second antennæ, tritocerebrum.
,, 4.	Trunk segment.	Mandibles.	,,	Mandibles.
,, 5.	Do.	First maxillæ.		First maxillæ.
,, 6.	Do.	Second maxillæ.	,,	Second maxillæ.

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a. Insecta.

Coloration of Insects.*—Dr. Brunner von Wattenwyl has published a gorgeously illustrated essay on the coloration of insects, which has been translated by Mr. E. J. Bles. He discusses uniform and rainbow coloration, stripes, bands, and spots; the line of orientation which "indicates the position assumed by the insect on receiving its coloration;" strokes and dots; eye-spots; spirals; splash marks; clouded markings; stencil patterns; erosion; changes in patterns; enlargement and diminution of spots and bands; dislocation; diminution of patterns; changes due to adaptation; staining of contiguous parts; fading in covered parts; colouring in relation to position; and arbitrariness in coloration.

The particular point of this essay is the evidence (*a*) that the coloration is frequently "independent of the biology of the insect coloured, and in nowise connected with its structure;" (*b*) that a utilitarian interpretation cannot be verified throughout. "The careless splashings, the defective stencil patterns, or the impairment of vision by a band laid over the eyes, and many other facts met with in the study of coloration, cannot be brought into relation with any purposeful tendency."

The translator points out the difficulty of weighing the possibilities of advantage and disadvantage, and notes that the Darwinian is quite prepared to find the occurrence of indifferent characters, or even of disadvantageous characters in process of disappearance. He calls attention to the novelty of some of the facts which the author has brought together, and to the magnificence of the illustrations.

Compound Eyes of Ephemerids.†—Herr Carl Zimmer prefaces his paper on this subject with an account of the division of the compound eyes into two parts which occurs in many different Arthropods. The phenomenon is seen in many Crustacea, especially Schizopods, and has been described by Chun. In Schizopods the eyes are divided into lateral and frontal eyes; of these the lateral eyes retain their normal structure, while the frontal eyes show a great elongation of their elements, and a diminution in amount of pigment. These modified eyes are adapted for the perception of movement, and for seeing in obscurity. The division of the eyes has also been noted in insects, but has not previously been studied there in detail. The Ephemerids were chosen for the purpose, and especially the genus *Cloë*, of which several species were investigated. In this genus the eyes are normal in the female, but in the male are subdivided into small lateral eyes of the same type as the eyes of the female, and large prominent frontal eyes of peculiar structure. Among their chief peculiarities are the reduction of pigment, and the presence of a thick layer of a homogeneous fluid or jelly, lying between the outer (nuclear layer) and inner (rhabdome layer) of the retinulæ. Such eyes, according to the views of Exner, are adapted for seeing in obscurity — they form *Superpositionsbilder*. Further, the arrangement of the scanty pigment especially fits them for the perception of movement. Their use is probably to enable the male to meet with the female, both sexes being of active flight, and mating taking

* 'Observations on the Coloration of Insects,' by Brunner von Wattenwyl, translated by E. J. Bles, Leipzig, folio, 16 pp., 9 pls.

† Zeitschr. wiss. Zool., lxiii. (1897) pp. 236-62 (2 pls.).

place after sundown. A comparative study of the eyes of Ephemerids shows that it is possible to construct a series illustrating the evolution of these complex frontal eyes.

The point of interest is the similarity in structure to the eyes of deep-sea Crustacea, where the modified eyes enable the possessor to seize active prey.

Male Genital Organs of Hydrophilus.*—P. Blatter gives a detailed description of the male genital organs of this beetle,—the testes, the efferent ducts with seminal vesicles, and the glandular accessory organs. The system is highly differentiated; but like that of other Coleoptera, it conforms in essentials to the general plan which Escherich worked out in the Carabicidæ. A useful comparative table may be reprinted.

	Carabus.	*Blaps.*	*Hydrophilus.*
Organs arising from the mesoderm	1. Efferent canals, acting as seminal vesicles at the base.	1. Efferent canals. 2. Accessory glands (mesadeniæ) opening into the base of (1).	1. Efferent canals. 2. Seminal vesicles. 3. Accessory glands (mesadeniæ) forming a 3-branched tube.
Organs arising from the ectoderm	1. Penis. 2. Genital armature. 3. Ejaculatory duct. 4. Tubular accessory glands (ectadeniæ).	1. Penis. 2. Genital armature. 3. Ejaculatory duct. 4. Scorpioid glands (ectadeniæ).	1. Penis. 2. Genital armature. 3. Ejaculatory duct. 4. Chalk-white accessory glands (ectadeniæ).

Genital Ducts of Calliphora.†—Dr. L. Brüel has made an exhaustive study of the anatomy and development of the genital ducts and the associated organs in *Calliphora erythrocephala.* His results show that these are of ectodermal origin, and render it at least probable that this is also true of some, if not all, of the Diptera, Hymenoptera, and Hemiptera. In an additional note, the author criticises the work of B. Thompson Lowne on the Blow-fly.

Formation of Sex-Cells in the Silk-Moth.‡—Herr v. la Valette St. George discusses this subject, giving an account of some observations of his own. In 1889 Verson described the four spermatic tubes in *Bombyx mori.* He found at the apex of each tube a very large cell, with an eccentric nucleus containing little chromatin, and stated that this cell is produced by amitotic division daughter-cells, which ultimately become the spermatozoa. These remarkable results were discussed by Verson himself and others in numerous later papers. Toyama, who especially investigated the subject, found Verson's cells in the ovary as well as in the testes, and believed that they were supporting cells which had

* Arch. d'Anat. Micr., i. (1897) pp. 384–416 (1 pl. and 3 figs.).
† Zool. Jahrb., x. (1897) pp. 511–618 (3 pls.).
‡ Arch. Mikr. Anat., l. (1897) pp. 751–66 (3 pls.).

nothing to do with the formation of the sexual products. The present author entirely agrees with Toyama. The spermatic tubes at an early stage consist of a mass of spermatogonia. One of these in each tube becomes specialised to form Verson's cell; the others form spermatocytes and ultimately spermatosomes. Quite similar appearances can be seen in the ovarian tubes. Verson's cells are probably both supporting and nutritive.

Defensive Adaptations of Lepidopterous Larvæ.*—Mr. H. G. Willis gives a vivid account of many of the more or less familiar instances of these adaptations.

Abdominal Appendages of Insects.†—Dr. R. Heymons criticises Verhoeff's conclusions as to the appendicular nature of the genital parts in insects. Verhoeff ‡ rested his argument mainly on the indubitable appendage nature of the copulatory parts in Myriopods, on the occasional jointing of the genital structures, and on the musculature. To these arguments Heymons entirely objects:—(1) One cannot argue from the copulatory legs of *Julus* or *Lithobius* to the analogous structures in insects. (2) Their jointing is not a proof of genuine appendicular nature. (3) The argument from musculature is also illegitimate.

Arctic Lepidoptera.§—Dr. A. Pagenstecher gives an account of what is known in regard to Arctic Lepidoptera. They are characterised by their thick covering of hair, pale transparent colouring, great variability, long larval period, and great power of resistance to cold. There is a general, but by no means complete, resemblance between the northern and the Alpine fauna; thus the characteristic Alpine genus *Parnassius* is almost absent in the north.

Internal Metamorphosis of Ants.‖ — Herr W. Karawaiew has studied this in the female larvæ of *Lasius flavus*, particularly as regards the gut and the musculature. There is no metamorphosis as regards nervous system, tracheæ, or heart. The most remarkable feature is the entire absence of phagocytosis. Disintegration and chromatolysis occur, but phagocytes play no part—a fact which may be associated with the long duration of the metamorphosis in ants.

Development of Gut in the Silk-Moth.¶—Sig. E. Verson notes the following results. The mid-gut of *Bombyx mori* is never a *closed* sac; the epithelial cells of fore-gut and hind-gut do not multiply after the beginning of the larval period, they merely grow; the fully formed epithelial cells of the mid-gut remain of the same size in all the larval periods, and lose their power of dividing; they are all able to secrete, but are not all alike chemically; they and the goblet-cells to which they give rise have a strictly limited length of life. There are, however, nests or centres of epithelial regeneration where abundant proliferation occurs before each moult; at the base of the cardiac and of the pyloric valve there is a germinal ring which proliferates at each moult, and enlarges the valves; the firm membranous sheath which forms a sort

* Trans. Manchester Micr. Soc., 1896, issued 1897, pp. 61–72.
† Zool. Anzeig., xx. (1897) pp. 401–4. ‡ Tom. cit., pp. 293–300.
§ JB. Nassau Ver. Naturk., l. (1897) pp. 179–240. Zool. Centralbl., iv. (1897) pp. 795–6. ‖ Zool. Anzeig., xx. (1897) pp. 415–22. ¶ Tom. cit., pp. 301–2.

of sausage-skin-like envelope around the food in the mid-gut of the larva is cuticular in its origin.

Alimentary Canal of Anthrenus Larva.*—Dr. A. Möbusz has an interesting paper on this subject, which deserves a longer summary than we can give it. He describes the general and the minute structure, with some interesting physiological notes by the way. Thus he advances strong reasons for regarding the Malpighian tubes as more than excretory; they absorb fluid food from the cæcum, pass it to various parts of the body, and receive waste material in exchange. There is complete epithelial regeneration of the mid-gut during the larval moultings. The gut is emptied, the intima of the stomodæum is separated off and passes into the mid-gut, the muscularis contracts energetically several times, the basal membrane of the mid-gut is hoisted off, the crypts beneath spread out and form a new epithelium. The metamorphosis in the pupa is to be regarded as an intense moulting, or the moulting as a weakened metamorphosis, the differences being quantitative, not qualitative.

Development of Platygaster.†—Prof. N. Kulagin has made an extended series of observations on the development of this important parasite of *Cecidomyia*. He finds that it occurs in the larvæ of a large number of Diptera, Hemiptera, and Hymenoptera. The larva inhabits the fatty body of the host, and pupates at the same time as the host. If the host has been infected by more than one egg, it does not survive pupation, but if by only one, the attack is apparently not fatal. The author gives an account of the formation of the germ-layers, of the development of the external form, and of the derivatives of the ectoderm, mesoderm, and endoderm in *Platygaster*, adding in each case comparative notes to show the relation of his own observations to those of others on the development of the parasitic Hymenoptera. The result is to show that *Platygaster* is most nearly related to the genus *Teleas*, studied by Metschnikoff and Ayers. This is shown by the absence of yolk in the egg, and the consequent formation of a typical blastula, and by the simple organisation of the larva, which is parasitic throughout life. In one species of *Platygaster* it was found that the sex-cells were distinct at the time of the formation of the mesoblastic somites, that is, before mesoderm and endoderm were differentiated from one another.

Chromatin Reduction in Spermatogenesis of Pentatoma.‡—Dr. T. H. Montgomery, jun., finds 14 chromosomes in the spermatogenetic mitoses; they appear in the reduced number (7) in the first spermatocyte; in the succeeding divisions they undergo two transverse divisions (reducing divisions); and at no stage is there any evidence of a longitudinal division (equation division). The author compares his results with those reached in regard to the allied *Pyrrhocoris* by Henking.

Symbiosis between a Butterfly and a Flower.§—Herr E. Ule describes a singular relationship between a butterfly, *Danais Euripus*, and the flower of an asclepiad, *Asclepias curassavica*, in Brazil. The

* Arch. Naturges., lxiii. (1897) pp. 89–128 (3 pls.).
† Zeitschr. wiss. Zool., lxiii. (1897) pp. 195–235 (2 pls.).
‡ Zool. Anzeig., xx. (1897) pp. 457–60 (9 figs.).
§ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 385–7.

eggs are laid on the flower, and the asclepiad gives board and lodging to the caterpillar. The butterfly appears to live entirely on the nectar of this flower, and when settled upon it, protects it from enemies; for the wings of the butterfly, when spread out, resemble in colour the umbel in bloom, and, when folded, the umbel in bud. The butterfly also assists in pollination by dragging out the pollinia.

The author further alludes to a similar relationship between ants and a species of *Cecropia*.

Entomology of the Oak.*—Mr. A. T. Gillanders notes that Kaltenbach catalogues 537 species of insects breeding on the oak, and S. L. Mosley mentions 272; these differ widely in the degree of damage which they cause. The author furnishes notes on some of these forms, and briefly discusses galls and alternation of generations.

β. Myriopoda.

Studies on Myriopods.—Dr. C. Verhoeff continues indefatigable in his study of Myriopods. He takes a survey † of the more precisely known European genera of Chordeumidæ. Then follows ‡ an account of the Polydesmidæ of Bosnia, Herzegovina, and Dalmatia. A third paper § deals with the Chordeumidæ and Lysiopetalidæ of the same region. The list of new forms mounts up steadily.

δ. Arachnida.

Acari from Franz-Josef Archipelago.‖—Mr. A. D. Michael reports on five Acari collected by Mr. Fisher at Cape Flora, Northbrook Island, Franz-Josef Archipelago, the most northern Acari yet obtained. There is no hint of a specialised local fauna. The five are:—the common *Glyciphagus domesticus* (found far away from the camp); *Oribata setosa* (common even in S. Europe); *O. Fisheri* sp. n. (closely allied to *O. antarctica*); *Erythræus Harmsworthi* sp. n.; and *Rhagidia gelosa*.

Parasites of Ants.¶—Herr E. Wasmann adds some additional notes to his former communication on the mites found in the nests of ants. He asserts that the *Hypopus* found on *Formica sanguinea*, and formerly ascribed to *Tyroglyphus Krameri*, really belongs to *T. Wasmanni*. This last species is not only a common parasite of the ant named, but occurs also on other ants, such as *Camponotus ligniperdus* and *Lasius fuliginosus*. The parasites do not seem to feed upon the host, but form surface crusts, which injure especially the delicate sense-organs, e.g. of the antennæ, and ultimately cause death. The occurrence of other mites in other ants' nests is also described.

Sheep-Ticks and Louping-Ill.**—Messrs. A. Meek and R. Greig Smith report on some experiments, which corroborate those made by Williams, as regards the propagation of louping-ill by means of the sheep-tick. The disease itself is doubtless bacterial, but practically the tick is responsible.

* Trans. Manchester Micr. Soc., 1896 (1897), pp. 78–88.
† Arch. Naturges., lxiii. (1897) pp. 129–38.
‡ Tom. cit., pp. 139–46 (1 pl. and 1 fig.). § Tom. cit., pp. 147–56 (1 pl.).
‖ Journ. Linn. Soc. (Zool.), xxvi. (1897) pp. 355–7 (1 pl.).
¶ Zool. Anzeig., xx. (1897) pp. 346–50.
** Veterinarian, lxx. (1897) pp. 698–709.

New German Hydrachnidæ.*—Herr R. Piersig has a preliminary note on some new species. These include two new species of *Libertia*, *L. polita* and *L. rugosa*, an *Acercus*, *A. ligulifer*, and two new species of *Hydrachna*, *H. crassipalpis* and *H. maculifera*. Some of the species are figured.

Swiss Arachnids and Myriopods.†—MM. Simon and Brœlemann publish respectively faunal lists of the above, collected at Bex. Among the Arachnids were specimens of the male of the rare *Ceto unicolor*. The characters of the male have hitherto been known only from the brief notes of Bertkau, and are here described more fully.

Pigment of Tardigrades.‡—Dr. T. Rywosch discusses the reddish pigment in the epithelial cells of *Macrobiotus Oberhäuseri* Doy. and of species of *Milnesium*. In the mature individuals of the former species it is arranged in cross bands, which seem to arise from the confluence of longitudinal bands. The pigment does not seem to be a lipochrome; but what it is remains undetermined. It is brought by the body-fluids to the cells—which are for some time quite colourless—and gradually accumulates there.

Crustacea.

Respiratory Mechanism in Decapods.§—Mr. W. Garstang describes some adaptations of structure subservient to respiration in Decapod Crustaceans which burrow in sand, and discusses the utility of specific characters in these forms. Thus, the characters which distinguish the different species of *Calappa* are principally the following:—(1) Proportion of length to breadth of carapace; (2) extent of postero-lateral clypeiform expansions of carapace; (3) serrations of carapace on the antero-lateral margins and on the edges of the clypeiform expansions; and (4) the hairiness of the pterygostomial regions. In regard to these Garstang points out:—(1) that the more elongated species are restricted to deeper water than the broader species; (2) that the clypeiform expansions are largest in the shallow-water species, and smallest in those which inhabit deep water; (3) that the denticulations of the antero-lateral margins have a sieve-like function in British crabs, and may have had the same in the ancestors of *Calappa*, while the clypeiform expansions perhaps present protective resemblance to bivalves; and (4) that the pterygostomial hairs serve as a sieve for the finer particles of mud. In *Matuta*, water seems to enter the orbits and travel backwards through the orbital gutter into the carpet of hairs (which, when the chelipeds are flexed, must furnish a most efficient sieve for the finer particles of mud and sand), through which it no doubt eventually makes its way to the afferent aperture at the base of the chelipeds. Many of the characters which distinguish the species of *Albunea*, both from one another and from their allies, are very probably correlated with the function of respiration under arenicolous conditions of life.

Carcinological Studies.‖—Dr. A. E. Ortmann continues his studies on Decapods, and deals in this systematic paper especially with those in

* Zool. Anzeig., xx. (1897) pp. 350–4 (8 figs.).
† Rev. Suisse Zool., v. (1897) pp. 101–5.
‡ Biol. Centralbl., xvii. (1897) pp. 753–5.
§ Quart. Journ. Micr. Sci., xl. (1897) pp. 211–32 (3 pls.).
‖ Zool. Jahrb. (Abth. Syst.), x. (1897) pp. 258–372 (1 pl.).

the collection of the Philadelphia Academy. Several new genera and species are established, and not a few changes in the nomenclature have been introduced.

Nervous System of Shore-Crab.*—Herr A. Bethe has conducted an elaborate series of investigations on the anatomy and physiology of the central nervous system in *Carcinus mænas.* The paper does not readily lend itself to the purpose of a summary, but the following may serve to indicate its scope. The anatomy of the brain and thoracic mass is described in detail, a complete analysis of their elements being given. A full description is given of the habits and movements of the living normal animal, including some interesting observations on food-taking, relation to light, and so on. The animals habitually avoid light, and seek corners where the body is partially concealed; a strong light will cause them to leave these lurking-places; but even blind animals seek places of concealment—a phenomenon described by the author as "positive kalyptrotropism." The paper also includes an account of numerous physiological experiments on the crab. The otocysts or statocysts are regarded as organs having to do with the maintenance of equilibrium, the relation of the body to the horizontal plane. They are thus contrasted with the semicircular canals of Vertebrates which have to do with the perception of the degree and direction of a movement, especially of a rotatory movement.

Development of Nervous System and Sex-Cells in Lernæa branchialis.†—Herr D. Pedaschenko finds the apical plate to be at first unpaired; it becomes divided into two lateral portions, which probably pass into the frontal sense-organs. A continuation of the apical plate on the ventral surface forms the "procerebrum"; the "secondary brain" (rudiment of eyes and optic ganglia) arises from paired dorsal thickenings. The two halves of the ventral cord arise independently.

During the epibole four micromeres sink below the ectoderm and form the primary genital cells.

There are two median dorsal organs, formed of high prismatic ectoderm cells. In later stages these are insinuated beneath the ectoderm and absorbed by the yolk-cells.

Vertical Distribution of Limnetic Crustacea.‡—Mr. E. A. Birge has studied this in Lake Mendota, Wisconsin, since July 1894. The factors are numerous and their action is complex. "The quantity and kind of food in any stratum of the water constitute a prime factor in determining its crustacean population. The distribution is also modified by light, temperature, gravity, wind, and the chemical condition of the water. These forces act in different ways on different species, and also act differently on the individuals of the same species at different ages; and in many cases have more effect than food on the vertical distribution of the Crustacea."

Annulata.

Physiology of Oligochætes.§—L. Cuénot has made investigations on the following points:—(1) Reserve substances. The typical reserve is

* Arch. Micr. Anat., l. (1897) pp. 460–546, and 589–639 (7 pls.).

† Trav. Soc. Nat. St. Pétersbourg, xxvii. (1897) pp. 187–94. See Zool. Centralbl., iv. (1897) p. 844.

‡ Biol. Centralbl., xvii. (1897) pp. 371–4.

§ Arch. Biol., xv. (1897) pp. 79–124 (2 pls.).

found to be glycogen stored in certain cells of the peritoneal epithelium; in *Phreoryctes* it is replaced by fat. (2) The elements of the cœlomic fluid. These consist of varying stages in the development of amœbocytes, and in rare cases, e.g. *Allolobophora rosea*, also of motionless elæocytes. This worm exhibits in addition the remarkable mucocytes of Rosa, which are ejected by the dorsal pores. The red blood also contains amœbocytes. (3) As to the function of the dorsal pores, Cuénot is inclined to regard the occasional ejection of the cœlomic fluid through them as a protection against desiccation; they may also be excretory. (4) Phagocytosis is important and well marked. By means of it waste substances and degenerating cells are eliminated, and the organism is protected against the action of parasites. The following cells act as phagocytes: the young amœbocytes of the cœlomic fluid, the special phagocyte cells of *Perichæta*, and certain cells of the nephridia. (5) The process of excretion in the Lumbricidæ is carried on by five different sets of cells:—(*a*) The cells of the nephridia, (*b*) the chloragogenous cells of the intestine, (*c*) the peculiar "bacteroidal" cells of the connective tissue, (*d*) the yellow cells, (*e*) the amœbocytes of the red blood. In addition the amœbocytes of the cœlomic fluid are important in transporting to the nephridia, skin, &c., the products of the chloragogenous cells.

Regeneration in the Naidæ.*—Herr Paul Hepke has studied histologically the origin of new organs in species of *Nais* which have had portions of the body amputated. The results serve to emphasise the great importance of the ectoderm in the regenerative processes. The epidermis speedily closes over the wound, and forms a many-layered cap of ectoderm cells from which all the organs ultimately take origin. Thus the gut originates as a bud of ectoderm growing in towards the old gut. This acquires a lumen, and becomes stomodæum or proctodæum as the case may be. The mesoderm originates from ectoderm cells which arise at either side of the *Anlage* of the gut, and go free into the body-cavity. In general there seems to be a return to the period of the origin of the germ-layers, the cells exhibiting their primitive marvellous power of differentiation.

Budding of Chætogaster.†—Herr Max von Boch's paper on this subject affords an interesting comparison with that of Hepke. He found specimens of *Chætogaster diaphanus* Truith., which, as already described by Semper, formed long chains of zooids. The budding occurs at some distance from the posterior end of the last worm. Here a proliferating zone forms a new tail in front, a new head behind, so that two complete zooids arise from the originally single one. After a period of growth the process is again repeated. Sections show that at each side of the body there are gaps in the muscular coat, occurring between dorsal and lateral muscles and ventral and lateral muscles respectively. At these gaps the ectoderm grows into the body-cavity, and the four patches unite with one another and with certain cells budded off from the ventral nerve-cord, to form a half-moon-shaped band of cells. This band grows upwards round the gut, and forms the new œsophageal commissure and

* Zeitschr. wiss. Zool., lxiii. (1897) pp. 263–91 (3 pls.).
† Jenaisch. Zeitschr. Naturwiss., xxxi. (1897) pp. 105–52 (3 pls.).

the "brain." The original ventral nerve-cord remains functional and complete until the separation of the zooids occurs; it increases partly by the proliferation of its own cells, partly by the intervention of the ectodermic cells. The fore-gut originates as an *endodermal* outgrowth of the gut, at first unpaired and later paired; the two branches fuse with two very small ectodermic invaginations, and form ultimately the unpaired mouth and gullet. The mid-gut increases by the proliferation of its own cells, the hind-gut by the fusion of the torn edge of the mid-gut with the body-wall. The origin of the other organs was not certainly ascertained.

The author compares these results with those of others, and points out the following peculiarities:—The endodermal origin of proctodæum and stomodæum, the originally paired condition of the mouth (already described in some other cases), the fact that the supra-œsophageal ganglia are formed from ventral and not from dorsal cells. These peculiarities he explains on mechanical grounds, and, in an interesting discussion of the germ-layer theory, maintains that they show that in regenerative processes the organism "enjoys great freedom, and accomplishes these in the way which the physiological, or even the mechanical, conditions, render most suitable." He does not believe that nature can be confined in a scheme in the fashion suggested by the germ-layer theory.

In the course of some observatíons on asexual reproduction, the author emphasises his belief in the essential similarity of division and budding.

Branching Annelid.*—M. Caullery and F. Mesnil describe an interesting abnormality in *Dodecaceria concharum* Oerst., in which it seems as if a fragment of four segments had bifurcated anteriorly and had also given off a posterior branch—a case of regeneration with heteromorphosis.

New Species of Clymene.†—Miss M. Lewis describes *Clymene producta* sp. n., one of the Maldanidæ, but with a much larger number of segments than any known form. It constructs a tube of coarse sand, similar to that of *Axiothea torquata*, with which it was found associated on the sand flats of Vineyard Sound, Mass. There seem to be about seventy segments,—four to the thorax, five to the abdomen, and about sixty to the tail. The external characters are fully described.

Acanthobdella peledina.‡—Prof. A. Kowalevsky amplifies his previous description of this interesting animal, which occurs in Lake Onega as an ecto-parasite on *Salmo salvelinus*, and probably also on *Salmo trutta* and *Coregonus albula*.

He describes small reserve setæ at the base of the large setæ, three pairs of eyes resembling those of *Piscicola*, the pigment-cells, the partitions separating the somites, the lateral lines, the ventral and dorsal blood-vessels, the food-canal, which in many ways recalls that of Oligochæta, the ventral chain of (20) ganglia, of which the sub-œsophageal and the most posterior show distinct traces of being composed of several

* Zool. Anzeig., xx. (1897) pp. 438–40 (3 figs.).
† Proc. Boston Soc. Nat. Hist., xxviii. (1897) pp. 111–5 (2 pls.).
‡ Bull. Acad. Sci. St. Pétersbourg, v. (1896) pp. 263–74 (7 figs.).

fused centres, and the genital organs, which, on the whole, resemble those of leeches. A full memoir is promised.

New Capitellid.*—M. Félix Mesnil describes *Capitellides Giardi* g. et sp. n. from the coast of France. The animal is of small size (about 10 mm.); the thorax has 9 segments: the first six with biramose capillary setæ; the seventh, eighth, and ninth with hooded hooks. The two last have, in the adults of both sexes, modified dorsal setæ, which form a copulatory apparatus. This character distinguishes it from *Capitella*, between which and *Capitomastus* the new genus must be placed.

Physiological Experiments with Clepsine.†—Prof. A. Kowalevsky injected blue litmus into the gut; it turned red in the crop, but remained blue in the intestine, except at the terminal part, where it was red. The character of the gut-contents is therefore first acid, then alkaline, and finally acid again. Lymph-cells in the cœlomic lacunæ and canals take up injections of Indian ink, carmine, and bacteria, and digest the latter phagocytically. But such substances are not taken up by certain large "acid" cells on the walls of the cœlomic canals (except the subdermals and laterals), which absorb litmus and retain it in the form of red granules. Powdered substances are also taken up by the cells of the nephridial capsules, which also act as phagocytes. The nephridial cells themselves do not act thus. After injection of ammoniacal carmine, red drops are after a time found in the nephridial capsules, probably through the mediation of the "acid cells," which yield up the pigment to the leucocytes, or are devoured by them.

Nematohelminthes.

Life-History of Trichina.‡—Mr. J. W. Graham has studied especially the vexed question of the passage of the Trichinæ from the gut to the muscles. The chief arguments in support of active migration are:—(1) the occurrence of young Trichinæ in the body-cavity; (2) the occurrence of the same free in the connective tissue; and (3) the unequal distribution in the different groups of muscles. Graham seeks to show that these arguments do not prove that active migration is the normal mode of distribution. The arguments in support of the view that the parasites are carried by the blood stream are:—(1) the occurrence of embryos in the blood; (2) the occurrence of an embryo in an artery of the diaphragm; (3) the occurrence of embryos in the muscle-capillaries: (4) the lesions and bleeding of muscle-capillaries; (5) the occurrence of embryos beside blood extravasations in the heart-muscle; (6) the presence of embryos in hæmorrhagic clots in the lungs; and (7) the rapidity of the distribution.

Not only the sarcolemma, but the destroyed contractile substance must be recognised as having a share in the encapsuling, though neither forms the permanent capsule, which is due to the connective tissue. The connective tissue-cells or leucocytes probably have a fatal action on many of the Trichinæ.

* Zool. Anzeig., xx. (1897) pp. 441–3.

† Mém. Acad. Imp. St. Pétersbourg, v. (1897) pp. 1–15 (1 pl.). See Zool. Centralbl., iv. (1897) pp. 838–9.

‡ Arch. Mikr. Anat., l. (1897) pp. 219–75 (3 pls.).

Excretory Cells of Ascarids.*—Prof. J. W. Spengel answers the criticisms of Shipley and Nassonow on a previous note dealing with this subject.

Platyhelminthes.

Nemertea.†—L. Joubin has written the section on Nemerteans in Blanchard's 'Traité de Zoologie', discussing external characters, distribution, structure, development, classification, and affinities. Like Bürger, who reviews the book,‡ he places the Nemertea among the Platyhelminthes, in closest relationship to the Turbellarians.

New Tapeworm.§—O. Fuhrmann has found in a species of *Anas*, a tapeworm of the genus *Cittotænia*, which he describes as *C. avicola*. The interest of this discovery is that not only has this genus not been hitherto found in birds, but it has been supposed to be confined to Rodents. This may be compared with the fact that the genus *Davainea*, formerly supposed to be confined to birds, has been recently found in man, in different species of *Lepus*, and in other Mammals. The structure of the new species is described in detail.

Tænia confusa.‖—Prof. H. B. Ward has a note on the head of this new tapeworm, which presents a remarkable resemblance to that of *Dipylidium*, so remarkable indeed that some confusion is suspected.

Bothriocephalus Zschokkei.¶—Dr. M. Lühe makes a detailed comparison of this Cestode (described by Fuhrmann from *Ardea stellaris*) and *Schistocephalus dimorphus* Creplin (from *Ardea cinerea*, with stickleback as intermediate host). The result shows that the distinctiveness of Fuhrmann's species has not been substantiated.

Epithelium of Cestodes.**—Dr. F. Blochmann replies to a note by Bott on the absence of a true epithelium on the bladder-wall of a Cysticercus. He points out that it is not inconsistent with epithelial nature for the cells to form a branched network, as in the case mentioned. The same modification of epithelium may be seen in the embryonic fin-spines of *Spinax niger* or on the horny teeth of the hag. Moreover, staining reactions clearly differentiate the epithelial from the subjacent parenchyma-cells.

Russian Turbellaria.††—Herr W. Zykoff completes his previous list of the Rhabdocœla of Moscow by the addition of six species. The paper includes some notes on their external characters.

Swiss Turbellaria.‡‡—Dr. G. du Plessis has an interesting faunistic study on the Turbellaria of the Cantons of Vaud and Geneva. After each species he gives a careful account of the localities in which it occurs, and the best methods of capture.

* Zool. Anzeig., xx. (1897) pp. 427–30.
† 'Traité de Zoologie' (Raphael Blanchard), fasc. xi., Paris, 1897, 8vo, 59 pp., 53 figs.
‡ Zool. Centralbl., iv. (1897) pp. 829–30.
§ Rev. Suisse Zool., v. (1897) pp. 107–17 (1 pl.).
‖ Zool. Anzeig., xx. (1897) pp. 321–2.
¶ Tom. cit., pp. 430–4.
** Tom. cit., pp. 460–3 (1 pl.).
†† Tom. cit., pp. 450–2. Cf. this Journal, 1895, p. 190.
‡‡ Rev. Suisse Zool., v. (1897) pp. 119–40.

New Turbellaria.*—Mr. W. McM. Woodworth, in the second part of his 'Contributions to the Morphology of the Turbellaria,' describes and figures two new species of *Planaria*, *P. unionicola* and *P. dorotocephala*, found at Havana, Illinois, and gives some notes upon the morphology of some other fresh-water forms from the same region. The notes are illustrated by figures, some of living forms.

Incertæ Sedis.

Notochord of Cephalodiscus.†—Mr. S. F. Harmer has a note upon Mr. Masterman's researches on the above subject. Mr. Harmer appears to accept generally Masterman's results, but strongly opposes his homology of the "notochord," which he formerly described, with the proboscis-gland of *Balanoglossus*, and with the structure called by Masterman the sub-neural gland in *Actinotrocha*. Harmer is not prepared apparently to offer suggestions as to the meaning of Masterman's "paired notochords," so that his criticism is in large part a reassertion of his own previous position. This he does chiefly on account of the relation of his notochord to surrounding structures. He believes that the structure called by Masterman the sub-neural sinus is homologous with the proboscis-vesicle of *Balanoglossus*, and opens neither into the blood-system nor into the anterior body-cavity. The position of this structure in regard to the "notochord" confirms, in his opinion, the view that the latter is homologous with the *Eicheldarm* of *Balanoglossus*.

Mr. Masterman's reply ‡ is, like his opponent's paper, confused by the use of terms which involve in themselves the assumptions to be proved. He believes that his "sub-neural gland" is throughout of glandular structure; it certainly has not the structure of a notochord. His sections show clearly that the sub-neural sinus is merely the swollen end of the dorsal blood-vessel, and is continuous with it. Further, the *Eicheldarm* of *Balanoglossus* lies between the *ventral* body-wall and the anterior body-cavity, while the "sub-neural gland" of *Cephalodiscus* lies between the *dorsal* body-wall and the anterior body-cavity; and finally, the similarity of the "sub-neural gland" of *Cephalodiscus* to an epiblastic structure in *Actinotrocha* is against the view that it has notochordal significance. Masterman therefore denies that Harmer's "notochord" can legitimately be described as such, especially on histological grounds, and reiterates his homology of the pharyngeal dorso-lateral grooves of *Cephalodiscus* with "double notochords." Apart from the question of chordate affinities, the paper is interesting as affording additional evidence of the relations between *Phoronis*, *Cephalodiscus*, and *Balanoglossus*.

Development of Mesoderm in Phoronis.§—Herr E. Schultz finds that in the blastula-stage some mesoderm (mesenchyme?) cells migrate into the blastocœl. In the first stages of gastrulation many others originate from the endoderm. They become massed together in the region of the future head-lobe and towards the anus. Those lying freely in the blastocœl become disposed on the ectoderm and the endoderm, forming a

* Bull. Mus. Comp. Zool. Harvard, xxxi. (1897) pp. 1–16 (1 pl.).
† Zool. Anzeig., xx. (1897) pp. 342–6. ‡ Tom. cit., pp. 443–50 (5 figs.).
§ Zool. Centralbl., iv. (1897) pp. 781–2.

cœlomic epithelium or peritoneum. In several respects the author's results differ radically from Caldwell's.

Plankton Brachiopods.*—Prof. H. Simroth reports on the sparse collection of Brachiopod larvæ made by the Plankton Expedition. There were only four—all Ecardinate—possibly belonging to *Discina*, *Lingula*, and *Crania*.

Development of Myzostoma glabrum.†—Dr. W. M. Wheeler has studied in detail the maturation, fecundation, and early cleavage of the eggs of this form in their bearing upon the problems of modern cytology. He confirms and amplifies the descriptions of Lovén and others with regard to the structure of the spermatozoon. This has an elongated *contractile* head, containing a series of chromatin beads, and a slender, motionless, and apparently inconstant tail, now described for the first time. The middle piece with its centrosome is apparently absent, and the movements are produced by the striated head. Associated with these peculiarities of the sperm, the author finds that the egg, at the time of fertilisation, is "characterised by a certain immaturity and conservatism," an apparent lack of well-marked sexual differentiation. This is shown, *inter alia*, by the delay which occurs between the entrance of the spermatozoon and the response of the egg, by the long persistence of the nucleolus, and especially by the method of formation of the polar bodies. With regard to the last, the points of importance are the large size of the asters and centrosomes of the polar body spindles, the fact that the first spindle appears near the middle of the egg and not at its periphery, and that, in the case of the second polar body, the centrosomes divide early, so that two are found at each pole of the spindle. Further, the centrosomes at the inner pole seem to become the centrosomes of the first cleavage spindle.

The general part of the paper is concerned with the following points:—(1) the polarity of the ovum; (2) the function of the nucleolus; (3) the significance of the polar bodies; (4) the reduction of the chromatin; (5) the origin of the centrosomes of the first cleavage spindle.

(1) In *Myzostoma* the polarity of the ovum is established at a very early stage, and, in spite of the pressure to which the ripening eggs are subjected, is never lost; the author is of opinion that this is also true of the eggs of the majority of animals. (2) The nucleolus of *Myzostoma*, although unusually persistent, takes no part in the formation of the polar body spindles; and, similarly, the numerous nucleoli of the pronuclei take no part in the formation of the first cleavage spindle. These facts, therefore, support Häcker's views as to the secretory nature of the nucleolus and its unimportance in cell-division. (3) The size and development of the polar bodies seem to support the view that these are rudimentary or abortive ova. (4) There is no evidence of a reducing division in the formation of the polar bodies, but the author is inclined to believe that chromatin reduction occurs during the prophases of the first cleavage spindle. (5) The author argues strongly against the existence of Fol's "quadrille," but believes that *Myzostoma* shows that the centrosomes of the first cleavage spindle may originate either from the sperm or from the egg.

* Ergebn. Plankton Exp., ii. (1897) 17 pp. and 1 pl. Zool. Centralbl., iv. (1897) pp. 784-5.

† Arch. Biol., xv. (1897) pp. 1–70 (3 pls.).

This important paper is illustrated by beautiful plates, and includes a copious bibliography.

Rotatoria.

Rotifera of Sandusky Bay.*—In this second paper, Dr. D. S. Kellicott continues his record of the Rotifera found by him near his station on Lake Erie, extending his list to 106 species. Of particular interest are a few rare Rotifers only known from one or two localities in other parts of the world, as *Polychætus serica* Gunson-Thorpe, known only from China, *Distyla spinifera* Western, from Putney, *Notogonia ehrenbergi*. from Switzerland and Calcutta. The following four species are described as new :—*Proales algicola, Ploesoma mollis, Sacculus orbicularis*, and *Mastigocerca multicrinis*. The first two are unfortunately not figured, which is always a great drawback, and almost prevents future identification. Of *Sacculus orbicularis* there is a slight sketch which very much resembles that of a contracted *Notops pygmæus* Calman, and the imperfect description, as far as it goes, also agrees with this species. *Mastigocerca multicrinis* is figured, and with its six slender frontal appendages and spine, reminds one of *M. capucina* Wierz., if it be not identical with it.

Rotifera from Spitzbergen.†—Mr. David Bryce has examined a quantity of moss brought in tins from Advent Bay, Ice Fiord, Spitzbergen, by Dr. J. W. Gregory, and collected by him during Sir W. Martin Conway's expedition in the summer of 1896. Twenty-six species of Rotifers were found in the moss, distributed as follows :—2 *Philodina*, 1 *Rotifer*, 13 *Callidina*, 3 *Adineta*, 1 *Proales*, 1 *Furcularia*, 1 *Diglena*, 2 *Stephanops*, 1 *Colurus*, and 4 *Metopidia*, some of these being moderately abundant. One species only,' *Stephanops tenellus*, is described as new, but not figured, and even this one has been seen before by the author in England. *Callidina venusta* is a new name given to Milne's *Macrotrachela elegans*, which it was necessary to rename. The author points out the evidence that is afforded of the vitality and endurance of these minute yet highly organised animals under such exceedingly trying conditions of life as those obtaining in Spitzbergen. For under the most favourable conditions, during only three months in the year is the temperature sufficiently high for active life ; during the remaining nine months the animals and their eggs, as everything else, are frozen hard as rock.

Male of Proales Wernecki.‡—Mr. C. F. Rousselet gives a short account and some good figures of this recently discovered male Rotifer, the female of which has long been known to inhabit the galls found on various species of *Vaucheria*. It is of particular interest as being the second male Rotifer known to possess a fully developed mastax and jaws, the first having been the male of *Rhinops vitrea*.

New Male Rotifers.§—Dr. E. F. Weber gives a description and figures of the following six male Rotifers found in the neighbourhood of

* Trans. Amer. Micr. Soc., 1897, pp. 43–54 (3 figs.). Cf. this Journal, 1897, p. 207.
† Proc. Zool. Soc. London, 1897, pp. 793–9.
‡ Journ. Quekett Micr. Club, vi. (1897) pp. 415–8 (1 pl.). Cf. this Journal, 1897, p. 7.
§ Rev. Suisse de Zool., v. (1897) pp. 91–9 (1 pl.).

Geneva and hitherto undescribed:—*Copeus labiatus*, *Dinocharis pocillum*, *Scaridium longicaudum*, *Diglena forcipata*, *Salpina mucronata*, and *Salpina brevispina*. All these males have the usual characters of their tribe, being small in size and devoid of manducatory and digestive organs, excepting however as regards the size of the male of *Diglena forcipata*, which is as large as the female.

Lacinularia elliptica, a new Rotifer.* — Mr. J. Shephard figures and describes this new species from a lagoon near the Yarra river in Victoria, Australia, where it was found in company with *L. natans*. *L. elliptica* forms large elliptical free-swimming clusters with a substantial axis, and resembles most nearly *L. racemovata* of Gunson-Thorpe. It differs from the latter species in the form of the corona, in the trophi, and by possessing a constricted trunk, and large foot-glands at the junction with the foot.

Early Development of Rotifers.†—Herr R. v. Erlanger and Dr. R. Lauterborn give a preliminary note on their researches on this subject in the case both of the fertilised and parthenogenetic eggs of *Asplanchna priodonta*. The object of the research was to investigate the difference between the centrosome of the fertilised and of the parthenogenetic eggs. The parthenogenetic eggs are of two kinds, those which develope into males and those which develop into females. The latter form two polar bodies, the former only one. This single polar body shows many peculiarities in its origin; the term polar spindle can hardly be employed, as the "spindle" has only one pole and only one centrosome, and half of the germinal vesicle is extruded without the previous disappearance of the nuclear membrane. The single centrosome, which is apparently present in the immature egg, divides after the extrusion of the polar body, the two parts forming the poles of the first segmentation spindle. The first segmentation nucleus only assumes very gradually its typical shape, as it remains for a long time in connection with the polar body.

The parthenogenetic eggs with two polar bodies were not fully studied, but apparently the first polar body divides after its formation.

The formation of the polar bodies in the fertilised eggs was also not fully ascertained, but it was found that the spermatozoon furnishes the centrosome of the fertilised egg, and this originates as usual from the middle piece of the spermatozoon. As in *Ascaris*, there is no single first segmentation nucleus, but both male and female pronuclei take part in the formation of the first segmentation spindle. The poles of the spindle are occupied by the divided centrosomes of the spermatozoon.

Sporozoic Parasites in a Rotifer.‡—Dr. Lenssen notes that the presence of sporozoic parasites in Rotifers has not been hitherto established with certainty. He has, however, found indubitable proofs of their presence in the intestinal cells of *Hydatina senta*. Certain appearances lead him to suspect that the *Euglenæ* present in the intestine may have some share in the development of the Sporozoa found in the intestinal cells.

* Victorian Naturalist, 1897, pp. 3–4 (1 pl.).
† Zool. Anzeig, xx. (1897) pp. 452–6. ‡ Tom. cit., pp. 330–33 (5 figs.).

Echinoderma.

Upper Silurian Palæchinus.*—Mr. J. Mitchell notes that the occurrence of Echinoids in Palæozoic rocks is extremely rare, and that some palæontologists doubt whether their occurrence in Silurian rocks has been satisfactorily established. He therefore describes, from the Upper Silurian of New South Wales, a fragment of a middle part of an inter-ambulacral area of *Palæchinus* sp.

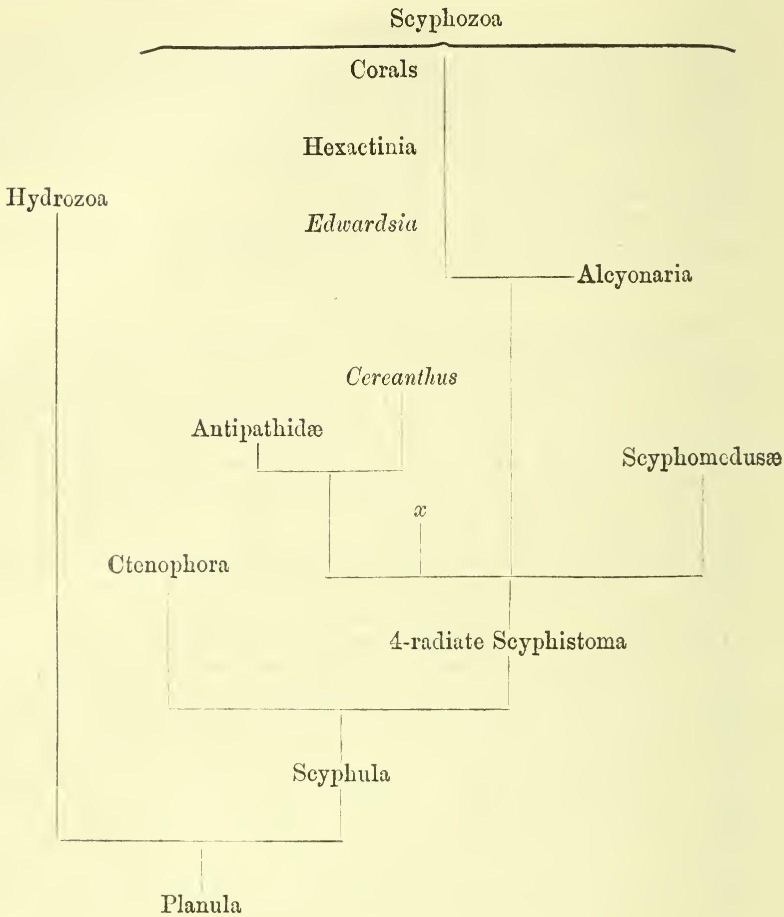
Fossil Echinoids.†—M. P. de Loriol describes a collection of sea-urchins from Lebanon. The collection includes ten new species.

Cœlentera.

Development of Scyphopolypes.‡—Herr A. Goette, under this heading, publishes an important paper, whose contents may be conveniently considered under three heads:—(1) Observations on the development of certain Scyphopolypes (Anthozoa); (2) discussion of the principles of classification; (3) genealogy of the Cœlentera. Under the first heading we have an account, based both upon the author's own researches and on those of others, of the development of the Cereanthidæ, of *Cereactis aurantiaca*, and of other Actiniæ. The result is to show that in the Actiniæ certain peristomial pockets occur which are apparently homologous with the *Septaltrichter* of the Scyphistoma and the lower Scyphomedusæ. Further, in several not nearly related Scyphopolypes it is found that the region of gastric pockets and septa is the same as in the Scyphistoma. In general, therefore, the research confirms the author's views as to the relation of Scyphomedusæ and Anthozoa, and makes it probable that the ancestor of both was a polypoid Scyphistome. Under the second heading the author has some interesting observations on what he calls the antithesis between genealogy and classification. He points out that, as a "natural" classification is merely an expression of ignorance, the effect of advancing knowledge must always be to shake rather than to strengthen it. It is obvious that if any group were completely worked out, and all its members past and present described, a classification would be no longer possible. Starting, therefore, from this conception of classification as dependent rather upon practical convenience than upon the known facts of phylogeny, the author proceeds to explain his views of the inter-relations of the Cœlentera, while refraining from expressing any opinion as to the desirability of making marked changes in the present classification in accordance with these views. His views are best explained by the genealogical tree which he constructs (see overleaf).

The points of importance are the removal of the Hydrozoa from the primitive position usually assigned to them, the position of the Ctenophora, and the separation of the Antipathidæ and *Cereanthus* from the other Hexacorallia. The letter x marks the position of other probable derivatives of the tetraradiate form; *Tetractis* should perhaps be placed here.

* Proc. Linn. Soc. N.S.W., xxii. (1897) pp. 258–9 (1 fig.).
† Rev. Suisse Zool., v. (1897) pp. 141–78 (3 pls.).
‡ Zeitschr. wiss. Zool., lxiii. (1897) pp. 292–378 (4 pls. and 25 figs.).



Development of Mesenteries in Actiniæ.* — Herr Oscar Carlgren describes this process in a peculiar anemone found in the Chinese and Japanese seas, which he regards as the type of a new genus and a new family. This peculiar form, to which he assigns the generic name of *Endocœlactis*, has both tentacles and mesenteries arranged in circles of irregular numbers, tentacles 18 + 10 + 16 + 8 + 16 = 68, mesenteries 10 (with two directive mesenteries) + 8 + 16 = 34. In the development of the mesenteries it was found that for a long time these arise after a bilateral method. According to the author, in the Actiniæ in general the radial type of development appears sooner in the higher forms than in the lower. For this and other reasons *Endocœlactis* must therefore be placed low among the Actiniæ.

* Öfversigt Vetensk.-Akad. Förhandl., liv. (1897) pp. 159–72 (5 figs.).

Development of Caryophyllia cyathus.*—Dr. G. von Koch describes the newly liberated free-swimming larvæ, the newly fixed young polyps, the stages with 4, 6, 8, and 12 parietes, and the gradual growth of the skeleton.

Porifera.

Lacework Sponge.†—Mr. W. Blackburn gives a description of the external characters, skeletal system, and canals of *Semperella Schulzei.*

New Calcareous Sponge.‡—Herr L. L. Breitfuss describes under the name of *Axandra hermesi* a new sponge from the Adriatic. This form resembles *A. reticulum* O. S. very closely, but differs from it in the size and shape of its rhabdi.

Protozoa.

Coloration of Living Protozoa.§—Herr S. Prowazek has made a series of experiments on the staining of living *Paramœcia* with neutral red. The first result of the staining is the appearance of a ring of coloured granules round the margins of the food-vacuoles. Observation shows that these granules are apparently connected with the process of digestion, and are perhaps the precursors of ferments. The staining was also very useful in the study of the rotation of the protoplasm and similar processes. The results are of some importance in reference to the question of the permeability of the outer layer of protoplasm. It has been stated that this permeability is characteristic of the parasitic Infusoria as contrasted with the free-living forms, where the mouth region only is credited with osmotic properties; but some of the author's experiments suggest the possibility of a surface osmosis even in free-living forms.

Notes on the Protozoa.‖—Dr. Fr. Doflein publishes some interesting notes on *Kentrochona nebaliæ* Rompel, and describes a new apparently closely related form as *Kentrochonopsis multipara.* The first-named occurs in spring as a commensal on *Nebalia geoffroyi.* It is found on the gills in connection with the thoracic limbs, and feeds upon the organic particles contained in the respiratory currents. In the summer and autumn only females of *Nebalia* are obtainable; at these seasons the respiratory movements are greatly modified owing to the presence of the eggs, and, in consequence apparently of this, *Kentrochona* is no longer present. A similar modification of the respiratory movements takes place in the mature male, but it is not known by what means *Kentrochona* is enabled to survive this periodic inability to maintain its commensalism.

The structure and method of budding of *Kentrochona* are described in some detail. The new genus *Kentrochonopsis* is remarkable for its curious multiple budding, as many as seven buds being given off at once.

New Freshwater Protist.¶—Prof. J. Frenzel describes, under the name *Modderula hartwigi,* a remarkable organism found in the Müggel

* MT. Zool. Stat. Neapel, xii. (1897) pp. 755–72 (1 pl. and 21 figs.).
† Trans. Manchester Micr. Soc., 1896, issued 1897, pp. 57–61 (1 pl.).
‡ Zeitschr. wiss. Zool., lxiii. (1897) pp. 39–42 (2 figs.).
§ Tom. cit., pp. 187–94 (1 pl.).
‖ Zool. Jahrb., x. (1897) pp. 619–46 (3 pls. and 11 figs.)
¶ Biol. Centralbl., xvii. (1897) pp. 801–8.

Lake. The bottom of the lake is covered with a slimy substance called by the fishermen *Modder*; and when this was allowed to stand in beakers in the laboratory, the new organism appeared. It is elliptical in shape, without pseudopodia, cilia, flagella, or nucleus, and contains small colourless particles apparently of sulphur, and usually also large refracting bodies. Protoplasm is not apparent, but the author believes that the organic nature is proved by the power of movement, and by the apparent occurrence of transverse division.

Ramulina.*—Messrs. T. Rupert Jones and F. Chapman discuss the fistulose Polymorphinæ and the genus *Ramulina* in particular. The genus is represented from Jurassic to recent times, and can be specifically divided into five well-marked types. The generic characters are summed up thus:—Test free or attached, branching, consisting of a calcareous tube, swollen at intervals, so as to form more or less definite, often irregular segments, from which lateral stolons or branches are sometimes given off. The swollen segments have complete or incomplete internal septa. The one or more apertures in the free forms are circular, being formed by the open end of the stolon-tube; in the attached forms the apertures are usually formed by the protracted terminations of the stolon-tubes, and are semicircular in outline where the entire test is adherent to the foreign body. The surface may be smooth, hirsute, prickly, or tuberculate. An instance is known where *Ramulina* has been found within the chambers of another Foraminifer, also on and in fossil Echinoderm-tests; but this cannot be true parasitism.

Parasites of Sticholonche and the Acanthometridæ.†—Dr. A. Borgert has an interesting paper on the curious and little-known structures found in the above Radiolarians, and constituting the "spiral bodies" of Fol, the *Amœbophyra* of Köffen. The author accepts Köffen's name, and considers that the forms inhabiting respectively *Sticholonche* and the Acanthometridæ are specifically distinct. By means of sections the author is enabled to describe in more detail than was previously possible the structure of *Amœbophyra* as it appears on leaving the host. The form is elongated and somewhat wormlike, and is marked externally by a ciliated spiral furrow, with numerous small nuclei following the line of the spiral. Internally there is a distinct tubular cavity with a posterior opening. Between the wall of this space and the external protoplasm there is apparently another cavity whose lumen is traversed by numerous strands of protoplasm. As to the position of these parasites, the author rejects Korotneff's suggestion as to Orthonectid affinities, and accepts that of Köffen, who regards them as Acinetarian Protozoa. The life-history is probably complex, and is constructed by the author as follows:—The parasite becomes adult within its host, and then, escaping from it, becomes sessile, suctorial, and tentacle-bearing. This form gives rise to ciliated embryos, presumably with a single nucleus, which again become parasitic. In an additional note the author describes three mononucleated forms. As these were obviously not very young, they do not shed any light on the life-history, but rather render this more puzzling.

* Journ. Linn. Soc. (Zool.), xxvi. (1897) pp. 334–54 (51 figs.).
† Zeit. wiss. Zool., lxiii. (1897) pp. 141–86 (1 pl.).

Protozoan Parasites of Termites.*—Mr. James F. Porter has found, in the intestine of *Termes flavipes* in Cambridge, U.S.A., the curious Infusorian parasites already described by Leidy in New Jersey Termites, i.e. *Trichonympha agilis*, *Pyrosonympha vertens*, and *Dinenympha gracilis*. The last form the author is inclined to regard as merely the young of *Pyrosonympha*; while he believes that the forms described by Leidy as the young of *Trichonympha agilis* are probably specifically distinct both from this species and from each other. The paper includes numerous notes on the anatomy and habits of the parasites. They were found in the gut in large numbers, and were accompanied by Gregarines.

Hæmatozoan Infections of Birds and Man.†—Dr. W. G. Maclallum states that the observation of Opie, who pointed out that there are two adult forms of *Halteridium* in crows, may be readily confirmed. The one is hyaline and non-staining, the other granular and darkly staining with methylen-blue. The hyaline form becomes flagellated, and the flagella, on becoming free, act after the manner of spermatozoa. One, and only one, gains entrance into a non-motile granular sphere, and by the coalescence of the two, the fusiform body, having a pigmented appendage and refractive nucleus-like corpuscle, is produced. This is the vermiculus described by Danilewsky. The author has recently observed a very similar process in human blood. But in this instance, after the flagellum had entered the non-motile form, the organism merely swelled up, and no appearance analogous to the vermiculus was observed.

* Bull. Mus. Comp. Zool. Harvard, xxxi. (1897) pp. 47–68 (6 pls.).
† Johns Hopkins Hosp. Bull., viii. (1897) pp. 235–6.

BOTANY.

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

a. Anatomy.

(1) Cell-structure and Protoplasm.

Structure of Cytoplasm.*—From his investigation of the phenomena of nuclear division in *Fucus*,† Prof. E. Strasburger came to the conclusion that there is a difference in structure between the kinoplasm and trophoplasm when in an active condition. He now gives it as a general law that active kinoplasm has a filamentous, active trophoplasm a honeycomb structure. This difference does not, however, extend to the two kinds of plasm when in an inactive condition; the whole of the cytoplasm having then a honeycomb structure. It is difficult to determine how the kinoplasm is then distributed within the walls of the network. In animals, on the other hand, kinoplasm or archiplasm can often be detected in resting nuclei.

The centrosomes which are a constituent part of the cell in Thallophytes and Bryophytes, have not at present been detected in Pteridophytes or Phanerogams. The author concludes that in these higher branches of the vegetable kingdom the filamentous framework of the kinoplasm reaches a degree of development which renders possible some other mode of origin of the spindle; and this is connected with the special use of the combining-threads in the completion of cell-division.

Continuity of Protoplasm in Guard-cells and Moss-leaves.‡—Herr F. G. Kohl calls attention to the fact that in the great majority of plants the starch disappears in the autumn from the guard-cells of the stomates, while the remaining cell-contents have also either disappeared or become disorganised. This takes place to a large extent even in those leaves which remain green in the autumn. This has been supposed hitherto to be associated with a complete absence of protoplasmic communications in the guard-cells. The author shows, however, that this anomaly does not exist. By using the iodine-sulphuric-acid-methyl-violet method, he has established the presence, in very large numbers, of connecting-threads between the guard-cells and adjoining cells, in the mistletoe. In the cortical parenchyme-cells of the same plant he reckons the number of connecting protoplasm-threads from each cell to amount to from 7350 to 9600; in the guard-cells of the stomates they are probably somewhat fewer. In the leaves of *Catharinea undulata* and other mosses, Herr Kohl has demonstrated the existence of similar connecting-threads, though in somewhat smaller numbers. He concludes that all the living cells of a plant are in this way united into a connected whole; the most important functions of this connected system being the transport of food-materials and the conduction of irritations.

Nuclear Division in Pollen-mother-cells.—Herr D. M. Mottier§ has studied the mode of division of the nucleus in the pollen-mother-

* Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) pp. 375–405 (2 figs.).
† Cf. *infra*, p. 107. ‡ Bot. Centralbl., lxxii. (1897) pp. 257–65 (1 pl.).
§ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) pp. 169–204 (3 pls.).

cells of a number of Dicotyledons and Monocotyledons, and agrees in the main facts with the results obtained by other observers. He maintains that there exists a very close connection between the chromosomes or the chromatin-ball and the cytoplasm; in *Podophyllum* very delicate threads of cytoplasm appear to pass through the wall of the nucleus, and to attach themselves to the chromatin-ball. The loose state of the ball described by Moore as synapsis he believes to be the result of the processes employed. The pollen-mother-cells are described by the author as being connected with one another by fine strands of protoplasm. He believes the reduction in the number of chromosomes before the heterotype division to be an apparent reduction only.

Herr H. O. Juel * has studied the cases (in *Hemerocallis fulva*) in which, instead of the normal tetrads of pollen-grains, more than four are formed. He agrees with Strasburger in tracing this irregularity to the first division-process, a chromatin-body remaining attached to the equator in the diaster-stage, and forming later a small nucleus. These act as normal nuclei, form spindles, and divide. The author was unable to detect centrospheres in the pollen-mother-cells of *Hemerocallis*. Similar irregularities also occur in the second division, resulting in the formation of supernumerary nuclei.

In another paper,† Prof. E. Strasburger and Herr D. Mottier, further discussing the second process of division in pollen-mother-cells, abandon the view that a reduction-division of the chromosomes takes place in them similar to that which has been observed in nuclear division in animals. No such reduction takes place in the embryo-sac, or in the pollen-mother-cells (of Liliaceæ); but an ordinary nuclear division of the heterotype pattern. This description includes the second division in the embryo-sac, by which the egg-apparatus and the upper polar nucleus are formed.

Biology and Physiology of the Cell-wall.‡—Dr. Z. Kamerling discusses several points connected with the structure of cell-membrane. He states that in various circumstances bubbles may arise within the uninjured cell-wall, which may contain either air or aqueous vapour; as, for instance, in the cells of the annulus of the sporange of ferns. In almost all cases cell-walls are, when dry, impermeable to air. There are three classes of structures in which this impermeability is especially manifested: viz. in structures connected with motility, such as the annulus of sporanges, the capsule of Jungermanniaceæ, the elaters of Hepaticæ; in structures which absorb water very rapidly after desiccation, such as the xerophytous Marchantiaceæ, the testa of many seeds, &c.; and in structures which live for a long time in the dry state, such as *Selaginella lepidophylla*, the leaves of mosses, &c. Where air does pass through dry membranes, it is generally through small fissures.

A striking character of cell-membrane is the resistance to moistening of its outer surface, often the result of a layer of wax or of granules of resin. The chief purpose of the formation of cork is not that it is impermeable to water, but that it allows the passage of air. One important object in the lignification of tissues is that it permits a very great

* Tom. cit., pp. 205–26 (3 pls.).
† Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 327–32 (1 pl.).
‡ Bot. Centralbl., lxxii. (1897) pp. 49–54, 85–91.

difference in the degree of tension in elements separated from one another by a lignified membrane.

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

Composition of the Sap.*—M. A. Hébert has investigated the chemical composition of the sap in a species of *Ampelocissus* and in *Musa paradisiaca*. In the former he finds a comparatively large amount of iron, the sap becoming blue on long exposure, probably in consequence of the formation of iron-salts of gallic acid. In the sap of *Musa* potassium oleate was found, the source of its use for saponification. In the sap of the wood of black grapes, he found œnotannins, hitherto known only in the fruit.

Localisation of Amygdalin and Emulsin in Eriobotrya.†—In *Eriobotrya japonica* M. L. Lutz finds the distribution of these two substances to correspond with that in other genera of Pomeæ. Amygdalin is present in the very minute embryo (i.e. in the hypocotyl, plumule, and radicle), and in the cotyledons; emulsin in the cotyledons only. Amygdalin was found in cells dispersed through the parenchyme of the cotyledons, and in the parenchymatous cells of the phloem of the vascular bundles.

Production of Gum in the Sterculiaceæ.‡—According to M. L. Mangin, the normal production of gum in this order of plants is limited to canals or lacunæ buried in the parenchyme of the pith or of the cortex. Usually the gum does not escape outside the stem or branch, but there are some cases in which it does. The formation of this gum is effected by a special mechanism. The walls of the cells which border tho canals become gradually thickened and transformed into gum, while the outermost cell-wall retains its cellulose character without alteration.

(3) Structure of Tissues.

Central Cylinder of the Root.§—Herr A. Kattein describes the special structure of the central cylinder of the root in a large number of Dicotyledons and Monocotyledons, and discusses the question whether it has the same value in the two classes of plants. This question he answers in the affirmative, and maintains that in these two classes, as well as in Conifers, it consists of separate xylem- and phloem-bundles, and of fundamental tissue. As in the embryo the two plerome-cones of the stem and of the root which face one another by their bases are altogether homologous, so also the whole inner portion of the stem (vascular bundle and fundamental tissue), and the central cylinder of the root, which both originate in the plerome-cones, have the same morphological value. In the stem each phloem-portion, with its xylem-portion, develops into a closed vascular bundle, both portions lying on one radius. In the root this union does not take place; the xylem and phloem-portions lie alternately side by side, each on its own radius. The fundamental tissue of the root is homologous to that of the stem.

* Bull. Soc. Chim. Paris, xiii. pp. 927–32; xvii.–xviii. pp. 88–91. See Bot. Centralbl., 1897, Beih., p. 280.

† Bull. Soc. Bot. France, xliv. (1897) pp. 263–5. Cf. this Journal, 1897, p. 303.

‡ Comptes Rendus, cxxv. (1897) pp. 725–8.

§ Bot. Centralbl., lxxii. (1897) pp. 55–61, 91–7, 129–39 (2 pls.).

Development of Primary Sieve-Tubes.*—M. G. Chauveaud defines what he terms "the phase of maximum differentiation" in the development of sieve-tubes. When the tube begins to lengthen, the lateral walls become thicker inwardly, but the thickening is not uniform; elongated punctations appearing in them, and at the same time rounded punctations on the transverse walls, these becoming ultimately the pores of the sieve. This is the period of maximum differentiation; subsequently, as the tube elongates, the sieve-structures become thicker, but the pores less and less distinct.

Development of the Phloem-Elements in Vascular Bundles.†—M. L. J. Léger describes the occurrence in young procambial bundles of "pearly" cells, distinguished by their thick white refringent longitudinal walls, which are shown, by their chemical reactions, to be composed of cellulose. They are first formed, at the expense of the cambial or procambial cells, in the outermost layers of the bundle, the formation gradually advancing inwardly. Subsequently these "pearly" cells either disappear altogether, or revert to the condition of ordinary parenchymatous cells.

Vascular Bundles in the Pith of Alnus.‡—In the pith of an example of the black alder, *Alnus glutinosa*, Herr T. Künkele finds bundles within the pith and entirely proper to it, without any union with the normal vascular bundles. The vessels (or tracheids) have thickened lignified strongly refractive walls, often with bordered pits. The author regards them as probably survivals of normal bundles which have originated in the pith.

Rudimentary Silicified Cystoliths in the Loranthaceæ.§—Herr F. Kólpin-Ravn finds that the so-called "mucilage-cell-spheres" found in various Loranthaceæ (*Viscum album* and *articulatum*, *Loranthus europæus*, *Phorodendron rubrum* and *emarginatum*) have been inaccurately described, the cell-walls not responding to the reactions for mucilage. He asserts, on the other hand, that they show the reactions for silica, and compares them to the rudimentary cystoliths in the Borragineæ, Compositæ, and Cucurbitaceæ. They differ, however, from the structures in these orders in containing no calcium carbonate.

Anatomy of Solanaceæ.‖—According to Herr F. Fedde, the Solanaceæ present a number of characters which differentiate them sharply from all allied orders, while it is very difficult to separate the families from one another by anatomical characters. The epiderm always consists of only a single layer, it is not lignified, and the cuticle is always thin. There is always a layer of collenchyme in the herbaceous parts of the stem. The vascular bundles are always collateral; they have never a protecting sheath. The vessels of the secondary xylem and the tracheids have bordered pits. In most of the genera there are very minute crystals (*Krystallsand*) in the cortical and medullary parenchyme and in the leptome. When these are wanting, there are larger crystals

* Comptes Rendus, cxxv. (1897) pp. 546–7. † Tom. cit., pp. 619–20.
‡ Bot. Centralbl., lxxii. (1897) pp. 1–6 (1 pl.).
§ Bot. Tidskr., xxi. (1897) pp. 53–8 (with figs.). See Bot. Centralbl., lxxii. (1897) p. 273.
‖ Beitr. z. vergleich. Anat. d. Solanaceen, Breslau, 1896, 48 pp. See Bot. Centralbl., lxxii. (1897) p. 144.

or a formation of thorns. The pith is usually composed of thin-walled cells, which, when lignified, have large round pits.

(4) Structure of Organs.

Microsporange of Stangeria.*—From a study of the development of the male organs in *Stangeria paradoxa*, Mr. W. H. Lang concludes that the arrangement of the sporanges in sori, and the mode of development of the latter, agree closely with *Angiopteris* (Marattiaceæ); while, on the other hand, the origin of the sporogenous cells from the hypodermal layer, a distinct epiderm being present, is quite different from what takes place in any Vascular Cryptogam hitherto investigated; and, except from the small number of sporogenous cells, is similar to their origin in the pollen-sac of an Angiosperm.

The microsporanges are arranged in sori, the development of which is similar to that in *Ceratozamia*; sometimes the sporanges remain for a time united in pairs. The sporogenous cells, usually four in number, are derived by periclinal division from cells of the hypodermal layer; the superficial cells take no part in their formation. The tapete arises, when the sporange has attained a considerable size, from the outer cells of the sporogenous mass. Isolated cells throughout the sporogenous mass undergo sterilisation. The structure of the epidermal layer of the wall and the mechanism of dehiscence present close resemblances to *Angiopteris*; stomates are found on the sporange. In the pollen-grain two cells are cut off from the large vegetative cell before germination. In the later stages of development the ovule resembles that of other Cycads.

Pollen of Asclepias.†—Miss F. E. Langdon states that in the pollen of *Asclepias Cornuti* the archespore is composed, as in most Dicotyledons, of a layer of cells, and not, as has been stated, of a single column. The tapete is composed, from an early stage, of two or of several layers, never of a single layer. The outer wall of the pollinium is derived partly from a secretion from the tapete, partly from the outer walls of the pollen-cells. The cells of the tapete undergo remarkable changes during the development of the pollen, forming a secretion which serves as a protection to the pollen.

Structure of Seeds.—Herr A. Tschirch ‡ states that the ovule of mustard (*Brassica nigra*) has two integuments, of which, when ripe, the outer consists of 3, the inner of 6–8 rows of cells. These latter constitute the nutrient layer, giving up their starch, and then more or less disappearing. In cacao-seeds the layer which has generally been regarded as endosperm is really perisperm. In *Melampyrum pratense* the appendage at the base of the seed is not a caruncle or a strophiole, but belongs to the endosperm. The ovule has only one integument, and even this is partially obliterated in the ripe seed.

Herren A. Nestler and J. Stoklasa § describe in detail the anatomy

* Ann. of Bot., xi. (1897) pp. 421–38 (1 pl.).
† Bot. Gazette, xxiv. (1897) p. 189.
‡ Schweiz. Wochenschr. f. Chem. u. Pharm., xxxv. (1897) No. 17. See Bot. Centralbl., lxxii. (1897) p. 107.
§ Zeitschr. f. Zucker-Industrie in Böhmen, xxi. (1897) p. 883. See Bot. Centralbl, lxxii. (1897) p. 120.

of the seed of the beet. The testa consists of two distinct coats, both containing numerous crystals of calcium oxalate. It contains also a very large amount of pentosanes. The albuminoids are contained chiefly in the embryo.

Stomates on Petals and Stamens.*—Miss Grace D. Chester notes the occurrence of stomates on the petals of about one-half of the species examined. They occur especially on thick petals or perianth-leaves (*Convallaria*, *Fritillaria*, *Lilium*, *Nuphar*, *Tulipa*, &c.), where they are frequently not rudimentary, but have open fissures, the guard-cells being full of chlorophyll and capable of carrying on assimilation. In *Lilium bulbiferum* the guard-cells on the perianth-leaves have the normal irritability of those of foliar stomates. In *Nuphar* the pore is wanting, as in those of the foliage-leaves. On anthers stomates are also frequent. Rudimentary stomates are occasionally found on the filament.

Stomates on the Bud-Scales of Abies.†—The rare occurrence of stomates on the bud-scales in Conifers is noted by Mr. A. P. Anderson in the case of *Abies pectinata*. They are found on all the scales, but only on the lower surface, and only near the base.

Pitcher-Plants.‡—Prof. S. H. Vines gives a *resumé* of what is known respecting the structure and function of pitchers in plants belonging to the natural orders Sarraceniaceæ, Nepenthaceæ, Asclepiadaceæ, Saxifragaceæ, and Lentibulariaceæ, including also the subterranean scales of *Lathræa*. The great majority of these structures are insect-traps, while others have apparently no relation to the capture of insects. Of the insect-traps the majority (Sarraceniaceæ, *Utricularia*, *Genlisea*), appear to be incapable of digesting the animals which they capture, absorbing only the products of decomposition effected by micro-organisms, and are, therefore, not correctly described as carnivorous. The pitcher of *Nepenthes*, and possibly that of *Cephalotus*, undoubtedly secretes a digestive enzyme. Those pitchers which are not insect-traps are related to the water supply of the plant, either relieving it of an excess of water which it may have absorbed, or storing it up for future use.

Hydathodes.§—Herr G. Haberlandt has studied the structure of the water-secreting organs in *Lathræa squamaria* and *Phaseolus multiflorus*. In the former case he considers—in opposition to the view of Goebel ||—that it is the capitate and not the peltate glands which act as hydathodes, founding this view on the result of pressure-experiments. The great efflux of water from these glands helps in the absorption by the parasite of large quantities of food-material from the host-plant, especially into the scales of the rhizome. In the case of the scarlet runner, the author contests the statement of Nestler,¶ that the excretion of water takes place chiefly through the stomates. As in other plants, the club-shaped hairs here act as hydathodes.

* Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 420–31 (1 pl.).
† Bot. Gazette, xxiv. (1897) pp. 294–5 (2 figs.).
‡ Journ. R. Hortic. Soc., 1897, 22 pp.
§ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) pp. 511–28 (1 pl.).
|| Cf. this Journal, 1897, p. 406. ¶ Cf. this Journal, 1897, p. 557.

Leaves and Scales of Lathræa.*—From experiments on the leaves of *Lathræa* and allied saprophytic genera (*Pedicularis*, *Rhinanthus*, *Odontites*), Mr. P. Groom finds a very large excretion of water through the dome-shaped glands, the cuticle of which is perforated by a pore; thus agreeing with the view of Goebel rather than with that of Haberlandt. There is a close connection between these glands and the tracheids in the fine vascular bundles. The leaves of *Lathræa squamaria* excrete a certain amount of chalk; their fleshy mesophyll contains a great quantity of large starch-grains. The pocket-like leaves of *Lathræa* are therefore both excretory organs and reservoirs for carbohydrates.

Phenomena of Torsion.†—From a series of experiments made chiefly on the bamboo, Herr W. Dingler draws the following conclusions. The process of twisting falls under the general problem of a cylindrical system which ultimately becomes conical, constructed of material points arranged in a spiral. The general mechanical processes of such a system, and their geometrical conditions, are discussed at length. The vigour of growth of the various sections of the internodal zone of the lower portion of a twisted stem corresponds to the vigour of growth of corresponding successive internodes of normal vigorous stems, if it is assumed that the inappreciable resistances in the twisted stem decrease in arithmetical progression from below upwards.

Causes of Anisophylly.‡—The cause of anisophylly in leaves must, according to Herr W. Figdor, be sought in the influence of light. In the course of the later development of a shoot, the unequal growth of the leaves becomes gradually obliterated, and may finally, under the influence of light, become reversed, so that the originally small leaves on the morphologically upper side of the axis become large leaves, and *vice versâ*.

Peduncle of Cycadeæ.§—According to Dr. D. H. Scott, the peduncle of certain Cycads belonging to the genera *Stangeria*, *Bowenia*, *Zamia*, and *Ceratozamia*, have mesarch vascular bundles comparable to those of the leaves, to which they have hitherto been supposed to be confined. He regards this as confirming the theory of the descent of the Cycadeæ from the Filicineæ rather than from the Lycopodineæ. The Cycadean type of vascular bundles, one of the most ancient of anatomical characters, was not originally a mere peculiarity of the leaf, but rather represents the vestige of a primitive organisation which was once common to the stem also. In recent Cycads the stem has all but lost this character; it appears to have survived only in certain peduncles.

Structure of American Conifers.‖—Mr. H. Trimble and the late Prof. E. S. Bastin give a description of a number of the more important American Conifers, and of the characters by which they may be dis-

* Ann. of Bot., xi. (1897) pp. 385–98 (1 fig.). Cf. this Journal, 1897, p. 406.
† Flora, lxxxiv. (1897) Ergänzbd., pp. 249–342 (3 pls.).
‡ Ber. Deutsch. Bot. Gesell., xv. (1897) Gen.-vers.-Heft, pp. 70–9.
§ Ann. of Bot., xi. (1897) pp. 399–419 (2 pls.).
‖ 'Some North American Coniferæ,' Philadelphia, 1897, 124 pp., 2 pls. and 58 figs.

tinguished from one another, special attention being given to the microscopic structure of the stem and leaves, which are profusely illustrated, and to the chemical composition.

Morphology of Aquatic Plants.*—Pursuing his investigations on this subject, Herr W. Wächter finds that, in the Nymphæaceæ, the relationship of the submerged to the floating leaves is the same as that of the narrow primary leaves to those which have a broad lamina in the monocotyledonous aquatic plants already examined. Both kinds undoubtedly originate from leaf-rudiments which are morphologically alike. Whether the rudiment develops into a submerged or into a floating leaf depends on external conditions such as the supply of food-material; the submerged leaves represent an arrested stage of growth.

Anatomy of Phrymaceæ, Stilboïdeæ, Chloanthoïdeæ, and Myoporaceæ.†—Dr. J. Briquet gives further details of his researches into the anatomy of these orders and families. The Phrymaceæ agree, in the general structure of their vegetative organs, with the Labiatæ, and with some families of Verbenaceæ with opposite leaves. They differ widely from the Myoporaceæ in the course of the vascular bundles, and in the presence, in the latter order, of secreting pockets. The Stilboïdeæ do not differ, in any essential point, from the other tribes of Verbenaceæ. The Chloanthoïdeæ, another tribe of Verbenaceæ, display far less uniformity of structure than the Stilboïdeæ. The hairs, when present, are invariably branched. As regards the classification of the genera of Myoporaceæ, *Oftia* must be placed by itself in a separate tribe, distinguished by the absence of secretory pockets.‡

Dimorphism of Ranunculus Ficaria.§—Prof. F. Delpino calls attention to the fact that this common plant is dimorphic (gynodiœcious), one form being hermaphrodite, the other female; and the two are readily distinguished from one another by the size of the flowers. Besides having larger flowers (in the proportion of about 3 : 2), the hermaphrodite flowers are distinguished by having a larger number of petals (8–11 instead of always 8 in the female), a larger number of stamens (those of the female flowers being functionless), and a larger number of carpels. There do not appear to be intermediate stages between the two forms.

Morphology and Anatomy of the Nymphæaceæ.‖—Mr. D. T. Gwynne-Vaughan has investigated several points in the morphology of the leaf, the anatomy of the mature rhizome and of the seedling, the apical meristem, the insertion of the adventitious roots, and the occurrence of polystely, in various genera of Nymphæaceæ. The leaf of the mature plant passes, in its youth, through stages which are quite parallel to those permanently retained by the embryonic leaves. The number of bundles in a stele varies between a large number in *Victoria* and only two in *Cabomba* and *Brasenia*. The simplicity of the anatomical structure in these two genera corresponds to the structure of the flower;

* Flora, lxxxiv. (1897) Ergänzbd., pp. 343–8. Cf. this Journal, 1897, p. 405.

† Mém. Soc. Phys. Hist. Nat. Genève, xxxii. (pt. 2), 163 pp. (29 figs.). Cf. this Journal, 1896, p. 537.

‡ Cf. this Journal, 1897, p. 48.

§ Atti r. Accad. Sci. Ist. Bologna, 1897, pp. 685–710.

‖ Trans. Linn. Soc., v. (1897) pp. 287–99 (2 pls.).

its parts being arranged in whorls of three only, and the gynæceum being superior and apocarpous.

Morphology and Anatomy of Obolaria.*—Mr. T. Holm gives an account of the structure of this anomalous genus, which he places in the *Gentianaceæ*. It appears to occupy an intermediate position between autophytes and saprophytes. It has no primary root nor root-hairs, and is deficient in stereome; but, on the other hand, it has lignified tissue, as well as chlorophyll and stomates. It resembles *Pleurogyne* in having the inner surface of the carpels entirely covered by ovules.

Morphology of Ilex and Cakile.†—Dr. M. Dalmer points out that in the holly, as in other spiny plants, the spines on the margins of the leaves are much more strongly developed on old than on young plants, and more so on lower than on higher branches; indicating that their main function is probably protection against destructive animals.

In *Cakile maritima* the peculiar umbrella-like arrangement of the branches appears to act as a protection against violent winds.

β. Physiology.

(1) Reproduction and Embryology.

Fertilisation.—Prof. E. Strasburger ‡ discusses and compares the results obtained in connection with the reduction in the number of chromosomes which accompanies an act of conjugation or impregnation. In Bryophytes, Pteridophytes, and Phanerogams, the reduction-process coincides with the alternation of generations, and appears to present a typical form. In all Archegoniatæ, Bryophytes, and Pteridophytes, the true generative division is that which takes place immediately before impregnation in the central cell of the archegone, producing the so-called ventral-canal-cell and the oosphere.

Commenting on Strasburger's various papers on karyokinesis, Herr W. Belajeff § charges him with confusing between fission and separation of the segments. The true fission of the segments takes place in the knot-stage; that which is termed fission in the metakinesis stage is not in reality true fission, but is a separation of previously split segments.

Fertilisation of Zamia and Salisburia.‖—Mr. H. J. Webber gives further details of the structure and action of the antherozoids of *Zamia*. For a considerable time during the development of the pollen-tube apparatus, the archegone remains in nearly the same stage of development, gradually increasing in size. During this period the very large nucleus remains at the apex of the archegone. Shortly before fecundation this nucleus divides, and a small cell is cut off at the apex, corresponding to the canal-cell of Conifers. The lower nucleus, which forms the oosphere, then travels downwards to below the middle of the archegone. Only one of the antherozoids takes part in the fecundation. It would appear that shortly after the antherozoid enters the protoplasm of the archegone, the nucleus escapes from the body of the antherozoid and

* Ann. of Bot., xi. (1897) pp. 369-84 (1 pl. and 1 fig.).
† Bot. Centralbl., lxxii. (1897) pp. 6-13.
‡ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) pp. 405-22.
§ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 345-9.
‖ Bot. Gazette, xxiv. (1897) pp. 225-35 (1 pl.). Cf. this Journal, 1897, p. 554.

wanders alone to the oosphere. It is never found in connection with the spiral ciliiferous band. After fecundation the male nucleus appears as a small nearly spherical body in the upper portion of the oosphere. No organ corresponding to the centrosomes of the lower Cryptogams has been detected.

The "attractive spheres" in the male generative cell of *Salisburia* (*Gingko*) undoubtedly correspond to the "centrosome-like" bodies already described in *Zamia*, and to the "subsidiary nuclei" found in the Equisetaceæ and Filicineæ by Belajeff,* and in the Characeæ. But they are not true centrosomes, and the author proposes for them the term *blepharoplast.* This must be regarded as a distinct organ of the protoplasm of spermatic (male) cells, having for its primary function the formation of the motile cilia of the antherozoids. From it is formed the spiral band on which the cilia are developed.

Pollen-Grains and Antipodal Cells.†—Prof. J. M. Coulter objects to the view that the pollen-tube is the homologue of the male prothallium. The not unfrequent occurrence of a small lenticular cell cut off before the usual divisions of the microspore nucleus, and the occasional direct division of the vegetative nucleus, support the older view that this lenticular cell represents the prothallial cell which constantly appears in the heterosporous Pteridophytes, and that the pollen-grain without this cell represents the single antherid. Four types of antipodal development may be distinguished in Dicotyledons:—(1) A group of evanescent cells, usually three in number (Amentiferæ); (2) Three large antipodal cells, increasing in size with the embryo-sac, and usually becoming multinucleate; (3) A small number (usually three) of comparatively permanent cells, not notable for size or activity; (4) An indefinite number of cells forming a permanent tissue, which often breaks through the bottom of the sac (Compositæ).

Endosperm and Suspensor of Lupinus.‡—Dr. L. Buscalioni confirms the observations of Hofmeister regarding the dissociation of the cells composing the suspensor of *Lupinus.* He states that (in *L. albus*, *pilosus*, and *hirsutus*) the embryo becomes detached from the suspensor, and moves to the dilated part of the embryo-sac. At a later period the cells of the suspensor become dissociated, increase in size, and branch. The protoplasm of the isolated cells, at first resembling that of the endosperm, soon becomes coarsely granular, with one or two large vacuoles, the nucleus at the same time increasing in size, and showing itself to be composed of a dense network of coarse filaments. The neighbouring portion of the endosperm itself becomes massed into bodies resembling the isolated cells of the suspensor, and corresponding to the "pseudo-cells" of the endosperm of *Vicia Faba.* The cells derived from the endosperm are, however, distinguished from those derived from the suspensor by being destitute of a membrane. In the nuclear division of the endosperm of *Lupinus* it is not uncommon to find tripolar karyokinesis, and irregularly placed chromatic and achromatic spindles.

Cross-Pollination and Self-Pollination.—Mr. T. Meehan§ records the remarkable fertility of *Heliophytum* (*Heliotropium*) *indicum*; the off-

* Cf. *infra*, p. 104. † Bot. Gazette, xxiv. (1897) pp. 181–2.
‡ Atti r. Accad. Lincei, vi. (1897) pp. 269–76.
§ Proc. Acad. Nat. Sci. Philadelphia, 1897, pp. 169–72.

spring of a single seed producing, in three months, as many as 48,960 seeds, every seed-vessel being fertile. Although freely visited by insects, the author states that the structure of the flower is such as to render cross-pollination almost impossible.

The same author * states that, in the form of *Lamium purpureum* which has been introduced into N. America, self-pollination takes place before the opening of the corolla, and the flowers are almost invariably fertile.

Herr W. O. Focke † gives the results of a long series of experiments on the self-fertility or self-sterility of a great variety of species, and on the production of hybrids.

Prof. P. Knuth ‡ describes the adaptation of the flowers of *Antirrhinum Orontium*, *Molucella lævis* (Labiatæ), and *Melissa officinalis* to cross-pollination by bees.

Mr. T. D. A. Cockerell § states that in New Mexico it is very common to find species of bees practically confined to particular species of flowers. This is specially the case with the genus *Perdita*, of which 80 species are known, all limited, with a few exceptions, to the arid region. The honey-bee, however, does not conform to this general rule.

Mr. A. G. Hamilton ‖ describes the remarkable mode of pollination in the Australian *Eupomatia laurina* (Anonaceæ). A row of staminodes intervenes between the fertile stamens and the stigmas, rendering self-pollination almost impossible. Pollination is effected by a beetle, *Elleschodes* sp. indes., belonging to the Curculionidæ, which visits the flowers in great numbers. They eat their way through the staminodes, and in so doing carry the pollen from the outer fertile stamens of the same or of some other flower to the stigmas. Although very strongly scented, the flowers appear to be entirely unvisited by all other kinds of insects.

Pollination of Erythronium ¶—Dr. J. Briquet has investigated the mode of pollination of species of *Erythronium*, especially *E. dens-canis*. He finds the flower to be entomophilous and somewhat proterogynous; the visiting insects are chiefly bees, especially *Bombus terrestris*. The attracting organs are the brightly coloured perianth and the *nectaroseme*, by which term the author indicates the spotted portion of the perianth-leaves which indicates the road to the nectary. The nectar-apparatus consists of three nectaries placed in pits at the base of the sepals, a nectariferous corridor, composed of the bases of the petals, and communicating with the pits by three orifices, and a *nectarostege*, which forms the roof of the corridor. The pollination by bees is autogamous, or more often allogamous.

Determination of Sex in the Hemp.**—According to M. Molliard, the proportion of male and female plants in the hemp is, under natural

* Proc. Acad. Nat. Sci. Philadelphia, 1897, pp. 175–7.

† Abhandl. naturw. Ver. Bremen, xiv. (1897) pp. 297–304. See Bot. Centralbl., lxxi. (1897) p. 235.

‡ Bot. Centralbl., lxxi. (1897) pp. 433–5 (4 figs.); lxxii. (1897) pp. 81–4 (6 figs.).

§ Bot. Gazette, xxiv. (1897) pp. 104–7.

‖ Proc. Linn. Soc. N.S. Wales, xxii. (1897) pp. 48–54 (1 pl.).

¶ Mém. Soc. Sci. Nat. Cherbourg, xxx. (1897) pp. 71–90 (1 pl.).

** Comptes Rendus, cxxv. (1897) pp. 792–4.

conditions, nearly constant, and apparently independent of soil, climate, and other external conditions; but under exceptional conditions this proportion can be varied, and in a direction contrary to that which has usually been the case in other experiments. A transformation of male into female flowers takes place in conditions which are unfavourable to the development of the vegetative organs.

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

Dependence of the Chlorophyll-Function on the Chromatophores and the Cytoplasm.*—According to Dr. L. Kny, the chlorophyll-pigment has no power of decomposing carbon dioxide when removed from the living plant, or when its organic matrix—the chromatophore—is killed. The elimination of oxygen in the light may, however, proceed when the cytoplasm has lost its motility and withdrawn from the cell-wall, or when the nucleus has become disorganised. Constant electric currents and induction currents appear to promote the assimilation of carbon dioxide in the light.

Mixed Grafts.†—M. L. Daniel uses this term for grafts in which some of the buds of the stock are still allowed to remain, instead of all being destroyed. This brings about a certain degree of symbiosis between the graft and the stock; the former acquiring some of the properties of the latter. The process is, therefore, to be used when it is desired to produce new varieties, rather than when it is the object to perpetuate existing forms.

Absorption of Organic Matters by Roots.‡—From experiments made on maize grown in a mineral solution containing glucose or invertin, M. J. Laurent states that the quantity of sugar absorbed is in proportion to the dry weight of the plant; and that the saccharine matters thus absorbed are utilised by the plant, a large portion being oxidised into carbon dioxide.

Influence of the Röntgen Rays on Vegetation.§—Professor G. F. Atkinson finds the effect on the higher plants of exposure to the Röntgen rays to vary according to the time of exposure. In periods varying from 1–10 hours, no perceptible injury resulted; while an exposure of 45 hours produced the same effect as total darkness. Species of *Mucor*, *Oscillatoria*, and Bacteria were exposed to the action of the rays, but no influence was observed on their growth or movement.

Assimilating Energy of Blue Light.‖—Herr F. G. Kohl gives further evidence in support of his view of the powerful effect of the blue rays of the spectrum in promoting assimilation, which is merely an exemplification of Engelmann's general law of the coincidence of the maxima and minima of absorption and of assimilation. The absorption of the blue rays is effected by the carotin of the chlorophyll, which has for its function the utilisation of these rays in assimilation.

* Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 388–403.
† Comptes Rendus, cxxv. (1897) pp. 661–4. ‡ Tom. cit., pp. 887–9.
§ Rep. Brit. Ass., 1897 (Toronto). See Nature, lvi. (1897) p. 600.
‖ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 361–6 (1 pl.). Cf. this Journal, 1897, p. 310.

Action of Mineral Salts on the Structure of the Lupin.*—M. Dassonville finds that, by growing lupin seeds in a solution of mineral salts (Knop's solution), the following changes take place:—The number and size of the vessels is increased in all the organs, and their lignification retarded. The formation is promoted of a closed ring of wood both in the stem and in the root. The number of pericyclic fibres is increased, but their sclerification retarded. The degree of lignification of the endoderm of the root is reduced, while its cells show increased development. The cells of the pith and of the cortex are increased in size.

Influence of Atmospheric Precipitation on the Growth of Plants.†—According to Herr E. Wollny, plants have no power of absorbing water through the leaves when these are already charged with moisture; and even when they are withered, the power of absorption is very small. The moistening of the leaves has, however, the effect of reducing transpiration. The reason why plants gathered when moist wither more quickly than those gathered when dry, is that the cell-walls in contact with water swell, and are stretched by the pressure of the cell-contents; hence the micellæ of the cell-wall are pressed apart, and the movement of water facilitated. Even heavy rain has no injurious effect on leaves. Injury from hail is often compensated, if the plant is in a young condition, by the luxuriant growth of lateral shoots induced by the destruction of the primary shoots.

Germination of Seeds.‡—Mr. F. Escombe sums up the present state of our knowledge respecting the power of seeds to resist unfavourable conditions for germination. In the latent condition he regards seeds as being, strictly speaking, neither alive nor dead, but as "hypnotes" in a state of "hypnosis," the cell-contents being in the condition of "hypnoplasm." The length of time during which seeds may remain in this condition, but still be capable of awakened life, is at present entirely undetermined, as also is the degree of cold to which they may be subjected without being killed, certainly as low as $-62°$ C. in a state of nature, and artificially probably much lower.

(3) Irritability.

Geocarpism of Morisia hypogæa.§—Sig. L. Pampaloni describes the mechanism by which the fruit of this plant, belonging to the Cruciferæ, buries itself in the soil. It consists of two distinct successive movements, one belonging to the lower, the other to the upper half of the pedicel; they can be shown to be the result of positive geotropism rather than of negative heliotropism. The seed-vessels do not all mature below the surface of the soil; the plant is amphicarpous, producing two kinds of fruit, one above, the other below the surface.

Curvature of Roots.||—Mr. J. B. Pollock claims to have determined, as the result of experiment, that the stimulus in response to which cur-

* Comptes Rendus, cxxv. (1897) pp. 794–7.
† Forsch. a. d. Geb. d. Agricultur-Physik, xx. See Bot. Centralbl., 1897, Beih., p. 306. Cf. this Journal, 1897, p. 560.
‡ Science Progress, i. (1897) pp. 585–608.
§ Nuov. Giorn. Bot. Ital., iv. (1897) pp. 424–30 (4 figs.).
|| Bot. Gazette, xxiv. (1897) pp. 189–90.

vature takes place in roots is transmitted in the cortex either of the convex or of the concave side, and that the root, in curving, takes advantage of tensions already existing. In an unstimulated root the tensions of the tissues are such that the tension on each side tends to curve the root away from that side; when these tendencies balance each other, the root grows straight. The elasticity of the cell-walls forces water out of the cells into the intercellular spaces, and this shortens the cells on that side; while, at the same time, the stimulus causes an extension of the cells on the side which becomes convex.

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

Formation of Chlorophyll.*—From a series of experiments, made chiefly on *Vicia Faba* and *Phaseolus vulgaris*, M. W. Palladine concludes that certain substances—saccharose, raffinose, glucose, fructose, maltose, glycerin, galactose, lactose, dextrin—promote the formation of chlorophyll in the green parts of plants; that others—inulin, tyrosin—appear to have no sensible effect; while others, again—mannite, dulcite, asparagin, urea, alcohol, ammonium chlorhydrate, quinic acid—retard or completely inhibit the process. A larger amount of oxygen is necessary for the production of chlorophyll in vegetable tissues than for the process of respiration.

Transformation of Saccharine Substances into Oil.†—From the fact that the proportion $\frac{CO_2}{O}$ is less than unity during the earlier, greater than unity during the later period of the ripening of the olive, M. C. Gerber argues that oil has been formed at the expense of mannite or some other carbohydrate.

A further series of observations leads M. Gerber to extend this conclusion to fruits and oily seeds generally. The value of the proportion $\frac{CO_2}{O}$, dependent on this process, differs materially from that due to fermentation or to the production of acids.

Formation of Proteids by Leaves. — According to observations made on a number of different plants by M. U. Suzuri,‡ the decrease at night of the amount of sugar and other carbohydrates in the leaves is associated with a decrease also in the amount of proteids. He concludes that leaves possess the function of facilitating the formation of proteids in all parts of the plant by assimilating nitrates, yielding thereby amido-compounds.

M. E. Godlewski § states that proteids are formed from nitrates only in the light. The process is not, however, a direct one; non-proteid compounds are first produced, even without the assistance of light; these are then converted into proteids only in the light.

* Comptes Rendus, cxxv. (1897) pp. 827-9; Rev. Gén. de Bot. (Bonnier), ix. (1897) pp. 385-94 (1 fig.).
† Tom. cit., pp. 658-61, 732-5.
‡ Bull. Coll. Agric. Imp. Tokyo, 1897, pp. 241-52. See Journ. Chem. Soc., 1857, Abstr., p. 580.
§ Ann. Agron., 1897, pp. 310-24. See Journ. Chem. Soc., 1897, Abstr., p. 583.

Production of Alcohol in Respiration.*—Herren E. Godlewski and F. Polzeniusz have established the production of alcohol in the intramolecular respiration of peas. The process is precisely the same as the alcoholic fermentation caused by yeast, the difference being quantitative only, and not qualitative. In both cases it consists of a simple splitting of a carbohydrate into alcohol and carbon dioxide. Up to the period when the production of carbon dioxide entirely ceases, about 40 per cent. of the dried substance of the peas was converted into alcohol and carbon dioxide.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Development of Marsilia.†—Mr. D. Johnson finds that *Marsilia* (*M. quadrifolia*) agrees with most other Leptosporangiates in the origin of the leaf, in its growth by a two-sided apical cell, and in the formation of the pinnæ by the continual activity of the marginal cells in certain regions. The sporocarp is developed from the marginal cell of one of the lower segments of the apical cell of the leaf. The sporocarp is thus a fertile portion or branch of the leaf, but it does not develop any structure homologous to the lamina of the sterile portion. The tissue surrounding the sori is a true indusium arising by the outgrowth of the cells of the ventral surface of the branch; the microsporanges are derived from sister-cells of the megasporange mother-cells, and not from segments of the apical cells of the latter.

Spermatogenesis and Secondary Nucleus in Filicineæ and Equisetineæ.‡—Herr W. Belajeff publishes a contribution to our knowledge of the development of the antherozoids in Filices and Equisetaceæ. He reasserts his previous statement that the antherozoid is formed partly from the nucleus, partly from the cytoplasm. No centrosomes could be detected in the poles of the nuclear spindle. The division of the internal spermatogenous cells in the antherid of Ferns is accompanied by karyokinetic division of the nucleus. In the protoplasm of each spermatogenous cell the author detected a rounded granule which took up fuchsin more strongly than the surrounding protoplasm. This granule passes through a crescent-shaped stage, and ultimately develops into a thread which surrounds the nucleus. This runs along the edge of a band which does not stain so strongly, and which is the rudiment of the body of the antherozoid. It lies in the protoplasm, and is stained bright red by fuchsin. Both bands now take the form of a spiral, on which are developed the cilia. During this time changes take place also in the form of the nucleus of the spermatogenous cell, which ultimately becomes spiral, the posterior end being much thicker than the anterior. In the mature antherozoid the posterior part consists of a thick spiral chromatin-body surrounded by a thin layer of protoplasm. At the posterior end this forms an appendage, while the anterior end has a ribbon-like form, and contains the nucleus in its lower portion.

In the spermatogenesis of the Equisetaceæ a very similar succession

* Anzeig. Akad. Wiss. Krakau, 1897, 5 pp. See Bot. Centralbl., 1897, Beih., p. 248.
† Johns Hopkins Univ. Circ., xvii. (1897) p. 16 (3 figs.).
‡ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 337–45.

of phenomena was observed; but the granules which accompany the nucleus are not spherical, but crescent-shaped.

Similar bodies accompanying the nucleus and staining strongly with fuchsin have been observed also in the Characeæ; and the author points out their probable analogy to the subsidiary nuclei (*Nebenkörper*) observed in the spermatozoa of the salamander.

Mesophyll of Ferns.*—Miss M. E. Gloss finds in the structure of the mesophyll useful generic characters for Ferns. She states that in any genus the number of cells in thickness of the mesophyll is constant; the presence of chlorophyll in the epiderm is characteristic of a genus; the relative size and shape of the air-cavities is constant; the shape and arrangement of the cells is nearly constant; the presence of palisade tissue and the number of cells in its depth are also constant. Those genera which have no palisade tissue have chlorophyll in the epiderm. No connection could be detected between the form of the cells and the intensity of the light. In five species of *Adiantum* examined there was no palisade tissue; the cells of both the lower and the upper epiderm contain chlorophyll; the air-cavities are relatively large and numerous; the mesophyll is two cells in thickness. In seven species of *Nephrolepis* there was a palisade tissue of two layers, no chlorophyll in the epiderm (except in *N. molle*); the air-cavities are small; the mesophyll is usually six cells in thickness. In three species of *Polypodium* there was a palisade tissue of two layers, and no chlorophyll in the epiderm; the air-cavities are large; the mesophyll is four cells in thickness. In eight species of *Pteris* there was a palisade tissue of one layer (in *P. cretica* three layers); the air-cavities are large; the presence of chlorophyll in the epiderm is variable; also the depth of the mesophyll. *Scolopendrium* has chlorophyll in the epiderm, and no palisade tissue; the air-cavities are large; the mesophyll is nine layers in thickness.

Sporophyll of Marattiaceæ.†—Prof. F. O. Bower finds, in all the four living genera of Marattiaceæ—*Angiopteris*, *Marattia*, *Danæa*, and *Kaulfussia*—a substantial unity of type in the form and mode of formation of the sporanges, corresponding also to that of the fossil genera. In all of these a single superficial parent cell of prismatic form is to be recognised imbedded in the massive sporange when young, not in a central position, but directed obliquely towards the centre of the sorus. By periclinal division this forms internally the archespore, externally that part of the wall where dehiscence takes place by a slit or pore. The tapete arises typically from the cells surrounding the archespore. An annulus is present only when the sporanges are separate, as in *Angiopteris*.

Muscineæ.

Propagation of Mosses by Gemmæ.‡—Herr C. Correns describes in detail the various modes of vegetative propagation occurring in Mosses, and classifies them under four main heads, viz.:—(1) Belonging to the stem (bulbils); either from leafy stems and buds; or by metamor-

* Bull. Torrey Bot. Club, xxiv. (1897) pp. 432–5.

† Proc. Roy. Soc., lxii. (1897) pp. 26–8; Ann. of Bot., xi. (1897) pp. 488–9.

‡ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 374–84. Cf. this Journal, 1896, p. 332.

phosis of an entire leafless stem, and germinating by a protoneme; (2) From leaves, either deciduous or fragile; (3) From a protoneme; the bud-support may have the character either of a protoneme or of a rhizoid, according to the amount of chlorophyll which it contains; (4) From paraphyses, or paraphyse-like hairs. These are again classified under numerous subdivisions.

The following new terms or limitation of old terms are proposed:—The term "bulbil" is confined to greatly reduced shoots. When the gemma becomes detached by the splitting through the middle lamella between two cells or groups of cells, it is *schizolytic*; when by the rupture of a cell and the disorganisation of its contents, *rhexolytic*. The cell thus ruptured is a *tmema*, which may be either a *dolichotmema* or a *brachytmema*, according as it is filiform or disc-shaped.

Algæ.

Cystocarp in the Rhodymeniales.*—Mr. R. W. Phillips has studied the development of the procarp and cystocarp in several genera of Rhodymeniales (including the Bonnemaisoniaceæ, Rhodymeniaceæ, Sphærococcaceæ, and Ceramiaceæ), and finds the phenomena in *Bonnemaisonia* to differ in several respects from those of the other families of Rhodymeniales. He does not agree with the view advanced by Davis,† that the mode of reproduction in the Florideæ is frequently apogamous. In the case of *Ptilota plumosa* he had no difficulty in finding antheridial plants, and pollinoids were frequently seen attached to the trichogyne. He believes that in this, and in the allied genera, conjugation takes place between the carpogone and the auxiliary cell by means of an ooblastema-filament. In the Rhodymeniales the carpogone and auxiliary cell are always so situated that conjugation can take place between them by means of a short tube.

Chantransia.‡—Herr F. Brand discusses the relationship of the *Chantransia*-forms to the species of *Batrachospermum*, *Lemanea*, or *Thorea*, with which they are genetically connected, and contests the accuracy of the term prothallium applied to them by some authorities. He proposes in its place the term *Sohle* (sole), and compares them to somewhat similar structures, creeping and clasping organs, occurring in some green Algæ, such as *Stigeoclonium* and *Cladophora*. The infrequency of the *Chantransia*-form negatives any idea of a true "alternation of generations."

The following seven forms occurring in Central Germany are described:—(1) *C. chalybea* vars. muscicola and radians; (2) *C. pygmæa* forma typica; (3) *C. pygmæa* var. fontana; (4) *C. violacea* forma typica; (5) *C. violacea* forma fasciculata f. n.; (6) *C.* sp. indeterm., of a blue colour and distinguished by the branches thickening towards the apex; and (7) *C. Lemaneæ fluviatilis*. Of these, (1), (2), and (3) are undoubtedly forms of *Batrachospermum*, and (7) of *Lemanea*; and these the author proposes to eliminate from the genus and form for them a new generic term *Pseudo-chantransia*, retaining the generic term *Chantransia* for those forms, like (4), (5), and (6) which are not yet determined with certainty to be connected genetically with any higher form.

* Ann. of Bot., xi. (1897) pp. 347–68 (2 pls.). † Cf. this Journal, 1897, p. 148.
‡ Hedwigia, xxxvi. (1897) pp. 300–19 (5 figs.).

Porphyrodiscus, a new Genus of Florideæ.*—Under the name *Porphyrodiscus simulans* g. et sp. n., Mr. E. A. L. Batters describes a seaweed from rocks near low water-mark, Berwick. The genus, which is intermediate between *Hildenbrandtia* and *Hæmatocelis*, is thus diagnosed:—Fronds crustaceous, forming smooth firm cartilaginous roundish expansions, closely adhering to the substratum by the entire under surface; cells small, of nearly the same size in all parts of the frond, firmly united into a pseudo-parenchymatous layer; tetraspores regularly zonate, formed in external hemispherical or flat wart-like protuberances (nematheces). Paraphyses wanting or not observed; cystocarp unknown.

Melobesiaceæ.† — Herr F. Heydrich replies to the strictures of Foslie,‡ and gives further particulars respecting the structure and classification of these Algæ. The genus *Sporolithon* is maintained, and several new species are described. It differs further from *Lithothamnion* in the tetrasporanges being divided crosswise instead of in a row. Another new genus, *Epilithon*, is proposed, founded on *Corallina membranacea*, and distinguished from the remaining Melobesiaceæ in the tetrasporanges being placed in sori and not in conceptacles. The following is the complete diagnosis:—Thallus crustaceous, epiphytic on larger Algæ; at first roundish, afterwards confluent, completely coalescent by its under side to the substratum, often lobed at the margin, reddish or whitish; composed of either a single layer of cells radiating dichotomously, or of two layers, of which the lower one consists of large rectangular cells, while the upper layer is but little developed. In the neighbourhood of the sorus the thallus is composed of from two to four rows of cells. Cystocarps and antherids in conceptacles; tetrasporanges in sori, divided in a row.

Nuclear Division and Fertilisation in Fucus.§ — The examination of several species of *Fucus* has demonstrated, according to Prof. E. Strasburger, that in the oogone-nucleus the reduction in the number of chromosomes always takes place during the first process of division, after the pedicel-cell has been cut off. There is always a distinct centrosome. After the division of the nucleus into four, which immediately follows the reduction in the number of chromosomes in the rudimentary oogone, a long period of rest occurs, until the oogone has attained its full size, when the formation of eight nuclei immediately takes place. The oospheres, when they escape from the oogone, are without a membrane. In the process of fertilisation the antherozoid nucleus is not larger than the nucleole of the oosphere nucleus, but the latter has a much looser structure, and contains only a small quantity of chromatin. Shortly after the entrance of the antherozoid, its protoplasm appears to unite with that of the oosphere, and only the nucleus continues its passage, coalescing with the nucleus of the oosphere as soon as they come into contact. The male nucleus probably carries with it a centrosome, but it is too minute for this to be determined with certainty. Unimpregnated oospheres of *Fucus* did not in any case germinate, and

* Journ. of Bot., xxxv. (1897) pp. 439–40.

† Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 403–20 (1 pl.). Cf. this Journal, 1897, p. 225.

‡ Cf. this Journal, 1897, p. 417.

§ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) pp. 351–74 (2 pls.).

the only hybridisation obtained was the impregnation of oospheres of *Fucus vesiculosus* by antherozoids of *F. serratus.*

Nuclear and Cell-Division in the Sphacelariaceæ.*— Mr. W. T. Swingle has followed out these processes in several species of Sphacelariaceæ, especially in *Stypocaulon scoparium.* The following are the more important results. The apical cell is frequently of enormous size, even more than 1000 times that of the smallest tissue-cells. The size of the nucleus and of the nucleoles and the amount of kinoplasm are about in direct proportion to the size of the cell, but the chromatin framework is relatively much more strongly developed in the smaller nuclei. The cytoplasm is differentiated into two substances, the finely filamentous kinoplasm at the pole or poles of the nucleus and the foam-like trophoplasm. The kinoplasmatic radiations collect into a centrosome, which is always attached to the wall of the nucleus, and which multiplies by bipartition and remains during the whole period of rest. The old wall of the nucleus remains during the whole process of karyokinesis until the daughter-nuclei are formed, and then disappears suddenly. The formation of the achromatic spindle and of the cell-plate presents several peculiarities which are described in detail.

Conjugation in Ectocarpus. †— Referring to the doubts cast by Oltmanns on the accuracy of the observations of Berthold and himself on the isogamous conjugation of the swarmspores (gametes) of *Ectocarpus siliculosus* and *criniger*, M. C. Sauvageau reaffirms their previous conclusions, and maintains that Oltmanns' explanation of the phenomena is founded on errors of observation.

Endodictyon, a new Genus of Ectocarpaceæ.‡— Herr H. H. Gran establishes this new genus of Phæosporeæ, nearly allied to *Ectocarpus. E. infestans* is parasitic on the Bryozoon *Alcyonidium hispidum*, producing in it a dark olive-green colour, and forming on its surface irregularly spherical plurilocular sporanges.

Grafting of Siphoneæ.§—Dr. F. Noll has obtained, with one doubtful exception, only negative results in his attempts to graft or bud into one another species belonging to different genera of Siphoneæ. A complete coalescence of growth was effected, but never any actual fusion of the protoplasmic bodies of the two individuals. Neither would portions of protoplasm from different genera coalesce, like those of the same genus.

Coccoliths.‖—Dr. J. Joly and Dr. H. H. Dixon find these organisms abundantly in dredgings from the Irish Channel. Not unfrequently they are contained within the body of an amœboid organism, probably a species of *Difflugia*, but the authors do not suggest any biological connection between the two. The coccolith consists of two very thin funnel-shaped elliptical valves ; a small valve attached by a central connection within a wider one, and provided with minute radial striations sculptured apparently on the outer or convex surfaces of both valves ; between forty

* Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger) xxx. (1897) pp. 297–350 (2 pls.)

† Mém. Soc. Nat. Sci. Nat. Cherbourg, xxx. (1897) pp. 293–304. Cf. this Journal, 1897, p. 418.

‡ Vidensk. Skrift. Kristiania, 1897 (2 pls.). See Hedwigia, xxxv. (1897) Rep., p. 115.

§ SB. Niederrhein. Gesell. Natur. u. Heilk., Bonn, 1897, pp. 124–8.

‖ Nature, lvi. (1897) pp. 468–9 (2 figs.). Cf. this Journal, 1897, p. 318.

and fifty striations going round the valves. The connection attaching the valves is rounded or slightly oval, and is apparently perforated axially by two D-shaped apertures, but occasionally a single oval opening traverses the collar; or, again, the cross-piece separating the D-openings appears incomplete, and is represented by projections extending into an oval opening.

De Toni's Sylloge Algarum.* — The fourth volume of this most valuable work commences the enumeration of the Florideæ. These are first divided into the two sub-classes, the Bangioideæ and the Eufloridеæ. The first includes, besides the Bangiaceæ, the monotypic family Rhodochætaceæ, and doubtfully the Compsogoniaceæ and the Thoreaceæ. The Eufloridеæ are divided into four orders,—the Nemalioninæ, Gigartininæ, Rhodymeninæ, and Cryptoneminæ. Of these the first is fully treated, with its four families, the Lemaneaceæ, Helminthocladiaceæ, Chætangiaceæ, and Gelidiaceæ. The Gigartininæ comprise three families,—the Acrotylaceæ, Gigartinaceæ, and Rhodophyllidaceæ, which are also comprised within the volume. A most copious bibliography is appended.

Fungi.

Nuclear Division among Fungi.—Mr. R. A. Harper † has studied the processes of division of the nucleus and free-cell-formation in the ascus of *Erisyphe communis*, and points out the close resemblance to the similar processes observed by several authorities in animals. Throughout the whole process the nucleus is accompanied by a centrosphere. At the commencement of the formation of the spindle the chromatin is collected into a dense net round the centrosphere, with which it appears to be closely connected; the chromosomes are united with the centrosphere by cytoplasmic threads. When the true formation of spores commences, the apex of the nucleus is gradually drawn out into a beak. The boundary wall of the young ascospore is composed of the same kinoplasmic substance as the polar radiations and spindle fibres. The true wall of the spore, composed of cellulose, is only formed at a later period.

Mr. D. G. Fairchild ‡ has investigated the phenomena of nuclear division and impregnation in *Basidiobolus ranarum*. The chromosomes form a broad equatorial plate in a short barrel-shaped nearly cylindrical spindle. During division the wall of the nucleus appears to remain unchanged. In the process of conjugation the two nuclei fuse completely during the formation of the zygosperm. In the development from conids to zygosperms, we have probably the most rapid alternation of sexual and non-sexual modes of multiplication known in the vegetable kingdom.

Action of Gravity on the Growth of Fungi.§— By direct observation on *Sterigmatocystis alba*, M. J. Ray has determined that gravitation has a retarding effect on the growth of the lower fungi.

* Vol. iv., Patavii, 1897, lxi. and 388 pp.
† Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) pp. 249–84 (2 pls.).
‡ Tom. cit., pp. 285–96 (2 pls.).
§ Comptes Rendus, cxxv. (1897) pp. 500–1.

Parasitic Fungi.—On *Betula verrucosa*, Herr F. Thomas * finds a new species of *Exoascus*, *E. Janus* sp. n., intermediate between *E. bacteriospermus* and *E. carneus*.

M. E. Roze † asserts that it is rare to find corms of *Crocus sativus* or *vernus* entirely free from the attacks of parasitic fungus, including a *Rhizoctonia* and a *Pseudocommis*. In addition to these, he finds very frequently a *Saccharomyces* which he regards as a new species, and names *Saccharomyces Croci* sp. n. It propagates by budding, and each cell contains a single spore. The diameter of the cells varies between 6 and 2 μ.

A disease which is very destructive to the Weymouth pine (*Pinus Strobus*) is described by Prof. E. Scholz ‡ as due to the attacks of a hitherto undescribed fungus, *Rhizoctonia Strobi*, of which, however, only the mycele is at present known. It differs from *Agaricus melleus* in the absence of rhizomorphs, and it has no underground form.

Sig. G. Pollacci § records the following new species:—*Macrosporium Violæ* on *Viola odorata*; *Helminthosporium Iberidis* on *Iberis*; *H. Lunariæ* on *Lunaria biennis*; *Leptothyrium parasiticum* on *Cereus stellatus* and *C. triangularis*; *Cystosporella Cerei* on *C. stellatus*; *Pirostoma Farnetianum* on *Pandanus utilis*; *Phyllosticta Dammaræ* on *Dammara Moorei*.

Herr G. Lindau ‖ records the destruction of immense numbers of the larva of *Porthesia chrysorhœa* by *Empusa Aulicæ*, and describes in detail the life-history of the parasite, which varies from other species of the genus in the mycele occasionally breaking through the body of the host, while it differs from the true *Entomophthoræ* in never forming attachment-hyphæ.

M. H. Nomura ¶ attributes a common disease of the silkworm cocoon in Japan to the attacks of *Aspergillus flavus* and *A. glaucus*.

The disease of snowdrops is, according to M. C. A. J. A. Oudemans,** due to the parasitic fungus *Botrytis galanthina*, of which *Sclerotinia Galanthi* is the sclerote-form; and that of the peony to *Botrytis Pæoniæ* sp. n.

Mr. W. P. G. Ellis †† finds diseased tomatoes from Jersey to be attacked by associated fungi and bacteria, the fungus being identified with *Mucor stolonifer*.

Disease of the Tobacco Plant due to Thielava basicola.‡‡—Dr. V. Peglion records the occurrence of a disease affecting the tobacco nurseries of Italy. The disorder begins in the roots, and rapidly affects the whole of the plant. Microscopical examination of the black putrid parts disclosed the presence of *Thielava basicola* Zopf, a fungus belonging to the family of Perisporiaceæ, and parasitic on other cultivated plants.

Puccinia Lojkajana.§§— Sig. C. Avetta has found this rare fungus parasitic on species of *Ornithogalum*, and notes the singular fact of the

* Forstl.-natur. Zeitschr., 1897, pp. 305–14. See Bot. Ztg., lv. (1897) 2te Abth., p. 329.
† Comptes Rendus, cxxv. (1897) pp. 730–2.
‡ Verhandl. K. K. Zool.-Bot. Gesell. Wien, xlvii. (1897) pp. 541–57 (6 figs.).
§ Atti Ist. Bot. Univ. Pavia, v., 8 pp. and 1 pl. See Bot. Centralbl., lxxii. (1897) p. 184.
‖ Hedwigia, xxxvi. (1897) pp. 291–6 (11 figs.).
¶ Tokyo Bot. Mag., 1897, p. 31. See Hedwigia, xxxv. (1897) Rep., p. 138.
** Kon. Akad. Wetensch. Amsterdam, 1897, p. 455 (1 fig.). See Hedwigia, xxxv. (1897) Rep., p. 138.
†† Rep. Brit. Ass., 1897 (Toronto). See Nature, lxv. (1897) p. 601.
‡‡ Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 580–3.
§§ Malpighia, xi. (1897) pp. 236–40.

occurrence of pycnids or spermogones, with pycnospores or spermatia, accompanying the tufts of teleutospores.

Volutella.*—Dr. D. Saccardo gives some particulars regarding the life-history of this genus, and claims to have established the specific identity of *V. stipitata* with *V. ciliata*, both parasitic on a *Phytolacca.*

Lichen-Acids.†—Herr O. Hesse has isolated from various lichens the following acids, of which the composition and properties are given:—Usnic acid and atranorin, from several species; chrysocetraric acid from *Cetraria juniperina* and *C. pinastri*; cetrapinic acid from *C. pinastri*; rhizocarpic, rhizocarpinic, and psoromic acids from *Rhizocarpon geographicum*; divaricatic acid from *Evernia divaricata*; sordidasic acid from *Lecanora sordida*; caperatic acid from *Parmelia caperata*; physcion from *Xanthoria parietina* and other lichens.

Jenmania, a new Genus of Lichens.‡—Under the name *Jenmania Goebelii* g. et sp. n., Herr W. Wächter describes a lichen from British Guiana belonging to the homoömerous forms, growing in water and with the habit of an alga. There is no distinct differentiation of cortical and medullary layers. The algal constituent consists of blue-green gonids belonging to the genus *Chroococcus.*

Nucleus of the Saccharomycetes.§—According to Mr. H. Wager the nucleus of *Saccharomyces cerevisiæ* consists, in the majority of cases, of a homogeneous substance, spherical in shape, placed between the cell-wall and the vacuole, and consisting of deeply staining granules imbedded in a slightly less stainable matrix. The process of budding in a yeast-cell is accompanied by direct division of the nucleus; the division taking place, not in the mother-cell, but in the neck joining it to the daughter-cell. When a cell of *S. cerevisiæ* is about to sporulate, the nucleus is found in the centre of the cell. When dividing, its outline becomes irregular, and the granules arrange themselves in the form of a short rod; these granules separate into two groups, and each group becomes a nucleus. The two nuclei thus formed divide again, each of these four nuclei becoming the nucleus of a spore. A small quantity of protoplasm accumulates round each nucleus, membranes appear, and four spores are thus formed, standing in the remainder of the protoplasm, from which ultimately the thick spore-membranes are produced.

Nematospora, a new Genus of Saccharomycetes.‖—Dr. V. Peglion has examined the diseased hazel-nuts known in the South of Italy by the term *ammannate*, and finds them to be characterised by the presence of a large number of lysigenous cavities scattered through the tissue of the cotyledons. The tissue surrounding these cavities is infected with spores enclosed in asci, eight in each ascus. The organism to which these belong can be readily cultivated on the ordinary nutrient substrata. It is described by the author under the name *Nematospora Coryli* g. et sp. n., the genus being distinguished from other genera of

* Malpighia, xi. (1897) pp. 225–9 (1 pl.).
† Ber. Deutsch. Chem. Gesell., xxx. (1897) Heft 4. See Bot. Centralbl., lxxii. (1897) p. 102.
‡ Flora, lxxxiv. (1897) Ergänzbd., pp. 349–51 (3 figs.).
§ Rep. Brit. Ass., 1897 (Toronto). See Nature, lvi. (1897) p. 600.
‖ Atti r. Accad. Lincei, vi. (1897) pp. 276–8.

Saccharomycetes by the filiform spores, each ascus containing eight of them.

Insects and Yeasts.* —Dr. A. Berlese has made numerous investigations on the manner in which some insects, ants and flies, contribute to the diffusion, preservation, and multiplication of alcoholic ferments. By placing ants in a bottle connected with others the contents of which had been sterilised, it was shown that ants carried about them the germs of yeasts and moulds. From experiments made by exposing sterilised meat to flies, it was found that the quantity of yeasts carried by flies is about 26 times as great as that carried by the air. By inducing flies to visit sterilised grapes, these grapes were infected with *S. apiculatus*, and also with *S. pastorianus* and *ellipsoideus* and moulds. Though insects carry germs on their legs and feet, these germs are more abundant within their bodies, as was shown by a study of the excrement of meat flies and cellar midges; and not only are they more abundant, but they actually multiply. Thus a droplet of must containing about 500,000 *S. apiculatus* was given to a fly which eventually produced about 35,000,000 of these yeast cells. Moreover, it was further found that the conditions inside the intestine of insects greatly influence the development of the different yeast germs; for if an insect was fed on a mixture of *S. apiculatus* and *S. mycoderma*, the excreta at first contained both yeasts in about equal quantity; then after a time *S. apiculatus* gained the ascendancy; but if the insect were made to fast, *S. mycoderma* rapidly gained the upper hand. It was also observed that the ingluvies or crop of insects secretes a syrupy fluid suitable for the preservation and multiplication of yeast cells; and this gives reason for believing that some yeasts may be preserved during the cold season by insects. It is interesting to note that in one experiment the ants died promptly from partaking of the juice of sour grapes, a fact which is evidence in favour of the protective character of the acids in fruit juices before maturation.

Schizosaccharomyces octosporus.†—In the course of some further observations on octosporus-yeast, Dr. M. W. Beijerinck remarks that the genus *Schizosaccharomyces* at present embraces three species, *S. octosporus*, *S. pombe* (*tetrasporus*), and *S. asporus* (arrack yeast). The author's recent observations show that *S. octosporus* is responsible for the presence in nature of two races, one a sporogenous, the other a non-sporogenous form, features which might lead to the supposition that these two forms had some remote connection with *S. asporus* and *S. tetrasporus*. The yeast used in the recent researches was isolated from figs and currants. By careful separation of the ascospores from the vegetative cells, and after having been cultivated under definite conditions of environment on wort-agar (plates or tubes), it was found that when perfectly ripe, i.e. when the medium was exhausted, the colonies were of three kinds:—(1) white, containing only asci and ascospores; (2) brown, comprising only vegetative cells and ascoid cells; (3) pale brown, consisting of all three elements. On further cultivation of the brown colonies, there was constant reproduction of non-sporogenous cells. While the white colonies reproduced

* Rivista di Patologia vegetale e Zimologia, 1897. See Nature, lvi. (1897) pp. 575–7.

† Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 449–55, 518–25 (2 pls.). Cf. this Journal, 1894, p. 602.

many white ones, there were always also some brown from which the non-sporogenous form was derivable, and some mixed colonies. The "mixed colonies," when resown on wort-agar, produced brown in the proportion of 1 per cent. to white colonies.

The cells of the mature non-sporogenous race are round, becoming somewhat ellipsoidal just before fission; but in young colonies of both races the cells are very much alike, being oblong with rounded ends. The morphological difference between the two races of this yeast finds a counterpart on the physiological side; for in the non-sporogenous race the formation of trypsin is but little evident, while it is strongly marked in the ascospore form.

Into the proteolytic phenomena of the alcohol yeasts the author enters at some length, first answering the question whether the enzyme produced is pepsin or trypsin. The answer is in favour of the latter; but though having similar action under similar conditions it is not considered to be identical with pancreatic trypsin.

Saccharomyces Zopfii.*—Herr A. Artari describes a yeast isolated from sugar juice and named *S. Zopfii*, which excretes invertin and belongs to the group of true Saccharomycetes. The cells are from 3–6 μ, and are usually elliptical to spherical in shape. Spore-formation occurs not only on gypsum block, but in liquid and solid media, the most favourable temperature being 26°–29° C. This yeast exhibits a great resistance to dry heat, bearing a temperature of 130° C. for 5 minutes, and standing 67° of moist heat. *S. Zopfii* excites fermentation in saccharose solution up to 50 per cent.; also in dextrose, and to a less degree in dextrin solution. The fermentation products are alcohol, carbonic acid, and some acid not determined as to nature or quantity.

Ferments of Saké.†—Herr O. Schiewek publishes the results of observations on saké and the fungi effecting its preparation; and, though adducing little that is new relative to the physiology and morphology of *Aspergillus Oryzæ*, is able to show that in the original material, Tane Koji, there are true yeasts. The fermentation that occurs in the preparation of saké is therefore due to these yeasts, which have nothing to do with *Aspergillus Oryzæ*. The author's observations are of value, notwithstanding that Kosai and Yabe had previously given a short description of a true yeast which they isolated from saké, and they also supplement the negative results of Klöcker and Schionning and others who failed to obtain true yeasts from pure cultures of *Aspergillus*.

Protophyta.

a. Schizophyceæ.

Algal Stalactites.‡—Miss J. E. Tilden describes the formation in hot-water caves in the Yellowstone Park, U.S.A., of pendent masses of Algæ (Schizophyceæ), which she terms stalactites. The species chiefly concerned in the building up of these stalactites are *Schizothrix calcicola*, *Glœocapsa violacea*, and *Synechococcus æruginosus*.

* Abhandl. Naturf. Ges. zu Halle, xxi. (8 figs.). See Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 529–30.

† Beilage z. Jahresber. d. Breslauer evangel. Realschule, i., Ostern, 1897. See Bot. Ztg., lv. (1897) 2te Abt., pp. 292–3. Cf. this Journal, 1896, p. 96.

‡ Bot. Gazette, xxiv. (1897) pp. 194–9 (1 pl.).

Algæ (Protophyta) of Hot Springs.*—Sig. S. Spallicci has investigated the algal organisms found in all the hot springs in a certain district in Italy, and states that he finds in none of them any species peculiar to them, all the organisms found in them being derived either from the soil or from the air. The following are among the more abundant species found:—*Spirulina labyrinthiformis*, *tenuissima*, and *subtilissima*, *Detoniella lutea*, *Oscillatoria tenuis*, *Libellus aponinus*, *Denticula thermalis*, *Chroococcus membraninus*, *Hapalosiphon laminosus*, *Nitzschia thermalis*, *Anabæna rudis* sp. n., and *Micrococcus thermalis* sp. n.

Cohniella, a new Genus of Diatoms.†—In a freshwater ditch at Breslau, Herr B. Schröder finds species of *Attheya* and *Rhizosolenia*, hitherto supposed to be almost exclusively marine genera of diatoms; also *Cohniella staurogeniæformis* g. et sp. n., with the following diagnosis of the genus:— Cellulæ 5–6 μ latæ, in cœnobium instar *Staurogeniæ* consociatæ; cœnobium planum, solidum, semper a 4 cellulis constitutum, quarum margo spinis minutis præditus est; divisio asexualis in duas spatii directiones.

Diatom causing Foulness of Water.‡—Dr. A. W. Edwards records the occurrence, in a reservoir of drinking water at Brooklyn, N.Y., of enormous quantities of a diatom which he names *Asterionella flavor* sp. n., causing foulness of the water, giving off a fœtid odour, and rendering it unfit for drinking purposes. The only effective remedy appears to be the complete exclusion of light.

Cyanothrix, a new Genus of Cyanophyceæ.§—Under the name *Cyanothrix vaginata* g. et sp. n., Herr W. Schmidle describes an organism from a hot spring in New Zealand. The genus differs from its nearest allies, *Hapalosiphon* and *Mastigocladus*, in the following points:—The complete absence of heterocysts; the segmentation and swelling of the sheaths in the *Anabæna* condition of the cells; and their separation from the filament, when they may possibly be regarded as resting spores or conditions of propagation. It is probably allied to Roze's *Clonothrix*.‖

β. Schizomycetes.

Biology of Bacteria.¶—Dr. G. Schlater, starting from the assumption that there are in nature independent organisms, devoid of any demonstrable morphological differentiation, of homogeneous organisation so to speak, asserts that the large group of Bacteria is arbitrary and artificial from a systematic standpoint, and according to his view the Bacteria should be split up into independent groups with appropriate subdivisions. Following R. Altmann, he would recognise three great groups, (1) Autoblasts, (2) Monera, (3) Metamonera, according to the demonstrable amount of organisation and of differentiation of parts.

Instead of the present arrangement by which the living world is divided into Protozoa or unicellular organisms, and Metazoa, or multi-

* Riv. d' Igiene e di Medic. Pratica, x. (1897). See La Nuova Notarisia, 1897, p. 141.
† Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 367–73 (1 pl.).
‡ Amer. Mon. Micr. Journ., xviii. (1897) pp. 317–23 (1 fig.).
§ Algologische Notizen, 1897. See La Nuova Notarisia, 1897, p. 145.
‖ Cf. this Journal, 1897, p. 63.
¶ Biol. Centralbl., xvii. (1897) pp. 833–46 (5 figs.).

cellular organisms, the author would classify these organisms under three categories (1) Autoblasts, or free and independently living Bioblasts; (2) Protozoa, or colonies of cytoblasts, of such Bioblasts which have lost their independent existence; and (3) Metazoa, i.e. colonies of cells (or of such Protozoa as have forfeited their independent existence).

Bacterial Diseases of Plants.*—Mr. E. F. Smith confirms his previous statement, that a prevalent disease of hyacinth-bulbs in Holland is due to *Bacterium Hyacinthi.* Nearly related to this is an organism described as *Bacillus Phaseoli* sp. n., pathogenic to beans and other leguminous plants. It is a short rod with rounded ends, yellow, growing on various media.

Bacillus chlororaphis sp. n.†—MM. L. Guignard and C. Sauvageau describe by this name a new chromogenous microbe obtained in pure cultures of *Isaria densa.* It possesses the peculiarity of producing in many nutrient media needle-like crystals of a green pigment apparently allied to tyrosin.

Bacteria with Assimilatory Pigments.‡—Dr. A. J. Ewart finds in Java the following bacteria, which have a greenish coloration, and which show, when exposed to light, a faint evolution of oxygen:—A motile green bacterium, *B. chlorinum*; a non-motile micrococcus form, *Streptococcus varians*; two forms closely resembling Van Tieghem's *Bacillus virens* and *Bacterium viride*; a large bacillus form, occurring as short rods 2·5–3 μ broad and from 5 to 20 μ long, forming colourless refractive endosporous spores. *B. photometricum* was also abundant. This last bacterium resembles the Florideæ in containing a pigment, bacteriopurpurin, which is a compound assimilatory chromophyll. When treated with hot alcohol it splits up into two different coloured substances, chlorophyll, and a pinkish-red pigment, which shows a distinct resemblance in colour and solubility to the pigment which may be extracted from red Algæ.

New Pigment-forming Saprophyte.§—Herr W. W. Rodsewitsch, in the course of an examination of wheat affected with "Schmierbrand" (*Tilletia levis* fam. Ustilagineæ), discovered the presence of *B. megaterium*, *M. tetragenus*, *M. roseus*, and a hitherto undescribed rodlet. The latter is very thin and about 0·5 μ long; on the ordinary media it grows well between 20° and 37°, the colonies on agar resembling yellow wax; at the same time a yellow pigment is excreted. Especially luxuriant is the growth on potato and on grape-sugar-agar, which after 1–2 months is stained quite yellow. Even on bouillon the scum growth and sediment are yellow. Gelatin is liquefied. The rodlets exhibit characteristic movements when observed in hanging drops; they stain well with the usual anilin dyes, and also by Gram's method. Spore-formation was not observed, and heating for one hour at 70° kills the rodlets. The bacillus is not pathogenic to guinea-pigs. Whether the

* Bot. Gazette, xxiv. (1897) pp. 188 and 192. Cf. this Journal, 1897, p. 237.
† CR. Soc. Biol. Paris, 1894 (3 pp.). See Bot. Centralbl., 1897, Beih., p. 244.
‡ Ann. of Bot., xi. (1897) pp. 486–7. Cf. this Journal, 1897, p. 569.
§ Wratsch, 1897, No. 15, p. 436. See Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) p. 591.

rodlet is in any way harmful to wheat, and whether it may have any connection with "Schmierbrand," the author leaves undecided.

Transformation of Bacillus tuberculosis into a common Saprophyte.*—Dr. J. Ferrán succeeded, by a process of gradual acclimatisation, in cultivating the tubercle bacillus in simple meat-broth, both at incubation and at ordinary temperature. Under these conditions the bacillus assumes cilia and becomes motile. It is thicker and the joints are longer. By the addition of litmus-blue-milk-sugar it was shown to produce acid. The specific virulence is diminished so much that it takes 5–10 ccm. to infect a guinea-pig; the tuberculous pus from these animals is, however, still highly toxic. The reaction of the modified bacillus to the Gruber-Pfeiffer reaction shows that, while it is truly of tuberculous origin, yet it is closely allied to *B. coli* and *B. typhosus*. The tubercle bacillus of birds behaves in a similar way. The author also states that he has found in the fæces of man, horse, and cow, a *B. coli* which has the same staining reactions as the tubercle bacillus. Cover-glass preparations stained by Lubimow's method are not decolorised by 20 per cent. H_2SO_4. The bacillus loses this property on cultivation, and even in the fæces after some hours.

Blood and the Identification of Bacterial Species.†—Dr. A. S. Grünbaum, in an article on the identification of bacterial species by means of blood, gives an interesting summary of how serum-diagnosis was brought about. The chief merit is ascribed to Durham and Gruber, who were the first to show how valuable Pfeiffer's reaction might be made. Pfeiffer first remarked the phenomenon after injecting a mixture of cholera vibrios together with a small quantity of serum of a cholera-immunised animal into the peritoneal sac of a normal animal. Durham and Gruber showed that the reaction occurred, not only *in vivo*, but also *in vitro*, and that it held good for several kinds of organisms. In the course of his remarks the author points out that the agglutinin is distinct from the bactericidal and paralysing substances in immune or other serum; and in considering the question it must also be borne in mind that the normal serum of some animals, such as man and horse, possesses a certain amount of agglutinative power which is approximately equal for at least three kinds of organisms, *B. coli*, *V. typhosus*, and *V. choleræ*. Hence it becomes a question whether the normal agglutinin becomes increased, or whether special ones only are produced as the result of infection. If the latter, then there must be an accumulation of different kinds of agglutinin, &c., in the blood. Presumably the latter is the case, for it is found necessary, in the diagnosis of typhoid, to dilute the serum, in order to avoid any error due to the presence of normal agglutinin.

Physiology and Morphology of the Acetic Acid Bacteria.‡—The researches carried on by Herr W. Seifert as to the morphology and physiology of the acetic acid bacteria are on similar lines to those of A. T. Brown, who worked with a *Bacterium aceti*, an organism different in some respects from that called by the same name by Hansen. The

* Barcelona, 1897. See Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 483–4.
† Science Progress, i. (1897) pp. 616–26.
‡ Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 337–49, 385–99.

author cultivated his organisms in hay decoction, and those examined were *B. Pasteurianum* Hansen, *B. Kützingianum* Hansen, *B. aceti* Brown, and *B. aceti* Hansen. The conclusion the author arrived at was that the oxidation power of acetic acid bacteria with regard to the monatomic primary alcohols diminishes with an increasing quantity of carbon, and that *B. Pasteurianum*, as far as the polyatomic alcohols and glucose are concerned, has, with the species tested, the weakest fermentative power.

Relation of Insects and Rats to the Spread of Plague.*—Mr. E. H. Hankin cites some instances of plague which show that there is no necessary connection between infection of animals and outbreaks of the disease among human beings. From a long series of researches on the relation of ants to plague, he has found that these creatures neither die of the disease, nor retain the infection for any time. Moreover, the infection of ants from plague rats is variable; for in some localities where plague was prevalent, ants were found to be infected, but in others not. While several cases of plague were known to have been due to direct infection from rats, other epidemics occurred without a single rat being affected. On the other hand, an outbreak of plague may occur among rats that does not affect human beings.

Purification of Sewage by Bacteria.†—Dr. Rideal describes several methods at present in use for disposing of sewage, the most satisfactory being that known as the Exeter system; and one of the chief objects of the author is to show the importance of the preliminary disintegration of organic matter before the final oxidation of the elements. This preliminary disintegration is apparently mainly effected through the agency of anaerobic bacteria such as *B. prodigiosus* and *B. fluorescens liquefaciens*, and others, and is not merely a process of oxidation requiring only air or oxidising chemicals to bring about the purification. The importance of bacteria is further seen in the nitrification and denitrification which go on during the destruction of putrescible organic matter, and it is the knowledge of how these organisms act which has made the recent systems of sewage purification on biological lines possible. The general principle of self-purification through the aid of micro-organisms was first enunciated by Dupré in 1887, and has been worked out both in the United States and in England.

Diagnosis of Typhoid-like Bacilli in Suspected Water.‡—Dr. J. Kister records the occurrence of a typhoid-like bacillus in well water suspected of harbouring the *Bacillus typhosus*. The morphological and cultural characters were scarcely distinguishable from those of the true typhoid bacillus, though colonies on potato showed slight, but not constant differences. The deciding test was the serum-reaction. This was negative, both macroscopically and microscopically:—a good example of the value of the serum reaction.

Capsule of Anthrax Bacillus.§—By staining with anilin water—fuchsin or gentian violet—with phenol-fuchsin, or with Loeffler's methylen-blue solution, Herr F. Kern has been able to demonstrate the

* Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 437–8.
† Journ. Soc. Arts, xlvi. (1897) pp. 81–93, 115–6.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 497–500.
§ Tom. cit., pp. 166–9.

presence of a capsule in anthrax bacilli cultivated on agar, bouillon, gelatin, serum, and potato. The preparation covered with the staining solution was heated 4–6 times at intervals of one minute until the solution vaporised, then washed with and examined in water. By this procedure it was found that anthrax bacilli obtained directly from the animal body or from cultures, were invested with a capsule which is an integral part of the bacillus. The capsule is more easily demonstrated in the bacilli taken from the body than in those from cultures. Each bacillus has its own particular sheath, and the boundary between the capsules of any two adjacent bacilli is indicated by a thin transverse line. The shape of the capsule in culture-bacilli varies with the age of the culture.

Morphology and Biology of the Tubercle Bacillus.*—Herr G. Marpmann, after alluding to his illustration of a specimen of tuberculosis sputum which shows normal bacilli, rodlets with bulbous expansions, branchings, and some long filaments, remarks that the tubercle bacillus belongs to the cellulose fungi, all of which are aerobes, cellulose being formed only in the presence of air and never by anaerobes. On the other hand, anaerobes are prone to form certain gases, H-compounds, such as carburetted hydrogen, sulphuretted hydrogen, and also ammonia and phosphuretted hydrogen. The author more especially deals with the production of the last-named gas, and in connection with the cultivation of anaerobes, and of the tubercle bacillus. Three media containing phosphorus are mentioned:—(1) gelatin or agar, with phosphate of lime and glycerin, (2) agar or gelatin with glycerin-phosphate of lime, (3) lecithin. The latter is prepared from ox brains by boiling in alcohol, filtration, and evaporation, the yellowish mass being afterwards pressed between folds of blotting-paper. The medium is rendered germ-free by repeated heating to 50° C. Anaerobes and tubercle bacilli grow luxuriantly on lecithin. The tubercle bacilli give indications of PH_3, they can vegetate in the absence of air, and form both reduction and oxidation products.

Passive Immunity in Diphtheria.†—The experiments made by Dr. Bomstein, who injected dogs and guinea-pigs with diphtheria antitoxin, show that the passive immunity derived from the antitoxin is not only transitory, but diminishes in the blood in quite a definite and regular manner. From the dog it disappears altogether by the 18th day, and from guinea-pigs by the 22nd. The fall, as shown by the curves on the charts, is greatest to the 6th day, after which the diminution is slower until its final disappearance. As antitoxin is excreted in the urine only in quite a minute quantity; and as it is not to be found in the viscera, the author infers that it undergoes some chemical change within the body.

Bacillus Ellenbachensis alpha and Alinit.‡—Herr R. Hartleb states that alinit is a yellowish-grey powdery substance containing about 2·5 per cent. of nitrogen. It is apparently made from Leguminosæ or potato, and consists of starch and albumen. In the dry powder a microbe exists as ovoid resting spores, which in liquid media develop into fila-

* Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 582–6 (1 pl.).
† Tom. cit, pp. 587–92.
‡ Bot. Centralbl., lxxii. (1897) pp. 229–31.

ments, while still later rodlets and spores appear. The microbe was isolated by Caron, and named by him *B. Ellenbachensis alpha*. According to the isolator (Caron), the microbe has the power of collecting nitrogen and converting it into a form assimilable by plants, and to such an extent that soil inoculated with the organism returns 135 per cent. without even the necessity of manuring. The author, in conjunction with Prof. Stutzer, has examined the morphological and physiological characters of this bacillus. They find that it belongs to the group of hay bacilli; hence its formation of long filaments and endogenous spores. They further found that in the presence of nitrogenised media there was a distinct loss of nitrogen, the compounds being split up into amines, ammonia, and apparently also free nitrogen. They therefore came to the conclusion that the alinit bacteria would exert no useful effect in husbandry.

Experimental Typhoid Fever.*—M. P. Remlinger finds that it is possible to impart to rats and rabbits, by feeding them with infected material, a disease which, from bacteriological and morbid anatomy points of view, is extremely like the typhoid fever of man. Out of eight rabbits fed on contaminated food, four remained free from morbid symptoms, and did not exhibit the serum reaction. Two recovered after fever, emaciation, and diarrhœa, their blood giving the typhoid reaction. Two died; these in addition to the phenomena just cited, had inflammation and ulceration of the small intestine, and enlargement of the mesenteric glands and spleen. From the latter pure cultures of *B. typhosus* were procured. Very similar results were obtained with rats.

Bacteriology of Acute Articular Rheumatism.†—Dr. P. Achalme describes an anaerobic bacillus which he has isolated from cases of acute articular rheumatism. It was first detected in the fluids of a person dead of rheumatic fever, and was afterwards discovered in the blood of patients suffering from this disease. In the human body it exactly resembles in size and shape *Bacillus anthracis*; while in cultures its length varies with the quality of the medium, being very short in those containing much carbohydrate, while in simple bouillon or serous fluid it is longer, and almost filamentous in human urine and peptonised gelatin. It is easily stained by anilin dyes and by Gram's method. In young cultures the bacilli exhibit slow inconstant movements which soon cease and are easily stopped. Terminal spores are formed, and these will stand boiling for three minutes. They are obtained only with difficulty.

To obtain successful cultures it is absolutely necessary to exclude oxygen. The optimum temperature is from 30°–38°. Solid media are useless for isolation purposes. The best media are alkaline bouillon, especially horse bouillon, while the addition of glucose, lactose, or glycerin increases the proliferation. Milk is a useful medium, and the culture on human urine is interesting, inasmuch as urates are precipitated. Salicylate of soda added in the proportion of one gramme to the litre prevents any development.

During cultivation the bacillus gives off hydrogen and carbonic acid, and not infrequently odorous products; it coagulates casein and dilute serum, and liquefies gelatin. Starch is liquefied without being converted

* Ann. Inst. Pasteur, xi. (1897) pp. 829–36 (4 figs.). † Tom. cit., pp. 845–59.

into sugar, and saccharose is fermented without inversion. The microbe is extremely pathogenic to animals (guinea-pig, mouse, rabbit, frog). The principal phenomena are serosanguinolent œdema of cellular tissues, with sometimes necrosis, pleurisy, endocarditis, myocarditis, and pericarditis.

Examination of Oysters for Pathogenic Microbes.*—M. M. Ad. Sabatier, A. Ducamp and J.-M. Petit have examined for pathogenic microbes the oysters cultivated at Cette, especially for *Bacillus coli communis* and *B. typhosus*. In oysters which had been kept at Cette for six months, and also in those recently delivered from Marennes, neither microbe was present. In a second experiment oysters were placed in a wire cage. The cage was submerged in a canal in front of one of the main drains of the town, and the oysters examined in from 25 days to one month. In this series the number of microbes present was found to be great, but they chiefly belonged to one species, *B. fluorescens liquefaciens*, though *B. luteus* and *M. fervidosus* were occasionally found. In a third series oysters were injected with pure cultures of *B. coli* and *B. typhosus*, and, after a sojourn of 4 to 12 days in their natural medium, were examined bacteriologically. Neither *B. coli* nor *B. typhosus* was found.

Bacterium pathogenic to Phylloxera and Acarina.†—M. L. Dubois isolated from a mixture of earth and manure a microbe which is pathogenic to certain Hemiptera. It is found under two forms:—as thin wavy filaments, 4–7 μ long and $0\cdot3$–$0\cdot4$ μ broad, and as a coccus $0\cdot2$–$0\cdot3$ μ in diameter. It would seem that these cocci are not spores, for in certain cultures they form almost the whole of the growth. The organism is stainable, but only with difficulty, by the ordinary methods. It is anaerobic, and the optimum temperature lies between 20° and 30°.

Astasia asterospora.‡—From observations made on an endosporous bacterium, *Astasia asterospora*, Prof. A. Meyer has obtained results which, if confirmed, may revolutionise the present views on the position of the Schizomycetes. From the spore membrane escapes a flagellated rodlet which forthwith swims away. After having frequently divided it comes to rest, and, in company with others, forms spherical colonies in which spore-formation takes place. Each rodlet contains one or two nuclei demonstrable by means of ruthenium-red and iodopotassic iodide, which behave quite like the nuclei of Hyphomycetes. The protoplast also contains one or more axial vacuoles. When the rodlet is ready for sporing it begins to swell. At one end appears a vacuole, close to which the nucleus betakes itself. As the vacuole grows, plasma-filaments extend into it, the site of the future spore becomes more highly refractive, and finally becomes sharply defined from the periplasm. The spore-membrane next begins to contract, and as it does so the nucleus wanders off to the periphery, where it is lost sight of. Eventually the embryo spore becomes invested with a doubly contoured membrane. The rodlet has become a sporange.

* Comptes Rendus, cxxv. (1897) pp. 685–8. † Tom. cit., pp. 790–1.
‡ SB. Gesellsch. z. Beförderung d. gesammt. Naturwiss. zu Marburg, No. 5, July 1897. See Bot. Ztg., lv. (1897) 2te Abth., pp. 289–91. See also Flora, lxxiv. (1897) pp. 185–245 (1 pl.).

Microbe of Yellow Fever.*—Dr. G. M. Sternberg, who some years ago was engaged in investigating the origin and prevention of yellow fever, now identifies the *Bacillus X* described by him in 1889, as the microbe isolated by Sanarelli, and designated *Bacillus icteroides*. It has similar morphological appearances, cultural characters, and toxic effects, to those ascribed to *B. icteroides*, and it seems extremely probable that the author just missed being the first in the field from too much diffidence, though, of course, the methods of bacteriology have greatly advanced since the report was published.

Yellow Fever and Micrococcus xanthogenicus.†—The organism of yellow fever described by Dr. D. Freire is a micrococcus, *M. xanthogenicus*, having a diameter of 1–2 μ and two or three cilia. It has no special arrangement; it is easily stained and cultivated. It is aerobic, liquefies gelatin, is reproduced by spores, and in winter becomes encapsuled. On peptonised gelose the colonies at first are white, but later yellow or brown. The cultures are at first highly toxic, but repeated passages diminish their virulence. Intraperitoneal injections are followed by rapid emaciation, fever, dyspnœa, jaundice and sometimes epistaxis. Trepanning infection is still more toxic, the animals dying in 48 hours with symptoms analogous to those of yellow fever, especially fatty degeneration of the liver and acute nephritis.

Attenuated cultures of *M. xanthogenicus* reproduce in animals and man a mild form of yellow fever which, the author claims, confers immunity; for since 1883 he has inoculated more than 13,000 persons, the mortality being from 4–6 per cent.

Bacillus of Subacute Gaseous Gangrene.‡—M. Chavigny describes a mobile microbe much resembling *B. coli*, and which appears to be the same as that called by San Felice *Bacillus pseudo-œdematis maligni*. The bacillus was isolated from a case of wet gangrene of the leg following on a simple fracture. In aerobic bouillon cultures gas is abundantly formed, and solid media (gelatin and gelose) fragmented. When cultivated in bouillon and *in vacuo*, the mobility of the bacillus becomes diminished and there is a tendency to form short chains. The bacillus is extremely pathogenic to guinea-pigs, mice, and rabbits. Injection into dogs produces suppuration and sloughing. By mixing cultures of this coliform bacillus and *Staphylococcus pyogenes aureus*, the effects were rendered more severe, though the staphylococcus toxin was found to interfere with the growth of the bacillus *in vitro*. Bouillon cultures, at first alkaline, become acid on the third or fourth day, and from the eighth regain their alkalinity. Filtered at the latter stage the cultures are found to contain a substance which gives rise to similar, but less marked, symptoms to those of living cultures.

Pathogenic Bacillus found in the Yemen Ulcer.§—M. M. Crendiropoulo has found in the Yemen ulcer a small bacillus with rounded ends, mobile and easily stained. It is easily cultivated on peptonised bouillon. The medium soon becomes turbid, deposits in flakes, becomes strongly alkaline, and exhales a fœtid odour. Milk is coagulated. On

* Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 145–65 (1 pl.).
† Comptes Rendus, cxxv. (1897) pp. 614–6. Cf. this Journal, 1892, p. 535.
‡ Ann. Inst. Pasteur, xi. (1897) pp. 860–4. § Tom. cit., pp. 784–9.

gelose the colonies are roundish, humid, and yellowish. Gelatin is liquefied. On potato the growth is abundant, and yellowish or greyish in colour. The optimum temperature is 38–40°. The organism, which is strictly aerobic, is extremely pathogenic to rabbits and pigeons, and the local manifestations after subcutaneous injection present a certain resemblance to the tropical ulcer.

Streptococcus of the Aleppo Boil.*—Drs. M. Nicolle and Noury Bey have isolated a *Streptococcus* from nine cases of Aleppo boil, and they are of opinion that this organism is a specific one, partly on the ground that it is uninfluenced by antistreptococcus serum, and partly from finding it in all the cases examined, and thrice in a pure condition. There is nothing specially characteristic from a morphological point of view. On most media the cultures are typical and abundant. Milk is always coagulated. It does not thrive on potato. To animals it is only slightly virulent; for on the average 2 ccm. of a bouillon-serum culture 48 hours old, at 37°, takes 10 days to kill a rabbit weighing 1500 grm.

New Infectious Disease of Cattle.†—Dr. G. Bosso describes a disease of cattle, which was diagnosed from the most prominent symptoms as either an acute infectious nephritis or acute infectious myelitis, and which belongs to the class of hæmorrhagic septicæmias. The chief morbid appearances were ecchymoses, great enlargement of the spleen, and acute nephritis. Bacteriological examination of the spleen and blood showed the presence of oval bacteria with rounded ends and central constriction. The bacteria are motionless, $1 \cdot 5\ \mu$ long and $0 \cdot 5$–$0 \cdot 8\ \mu$ broad; but in the kidney they are often $2 \cdot 7\ \mu$ long. They stain easily with the usual dyes, and also with Gram's method. On gelatin which is not liquefied the colonies are small, round, sharply defined, and of a greyish-yellow hue. On glucose agar the bacteria grew well. Meat-broth with glucose and glycerin soon became turbid, and much gas was produced. In milk the bacteria developed freely, but the medium was not coagulated. On acid potato the development was slight, but on alkaline potato the growth was luxuriant and of a yellowish-brown colour. Animals (guinea-pigs, rabbits, mice) inoculated with cultures died. Histological examination of the kidney showed the presence of the bacteria in the lymphatic and blood-vessels, and that profound changes had occurred in the Malpighian glomeruli.

Effect of Intravenous Injection of Tuberculous Caseous Matter.‡—Dr. N. Rosa injected two series of rabbits (15 and 10) with sterilised caseous matter obtained from tuberculous lymphatic glands. In the first series the caseous material was sterilised in an autoclave, in the second by passing it through a Chamberland filter. In both series the results were entirely negative, the injected material being apparently quite innocuous, and having none of the toxic effects displayed by sterilised cultures of tubercle bacilli.

* Ann. Inst. Pasteur, xi. (1897) pp. 777–83.
† Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 537–42 (1 pl.).
‡ Tom. cit., pp. 433–6.

MICROSCOPY.

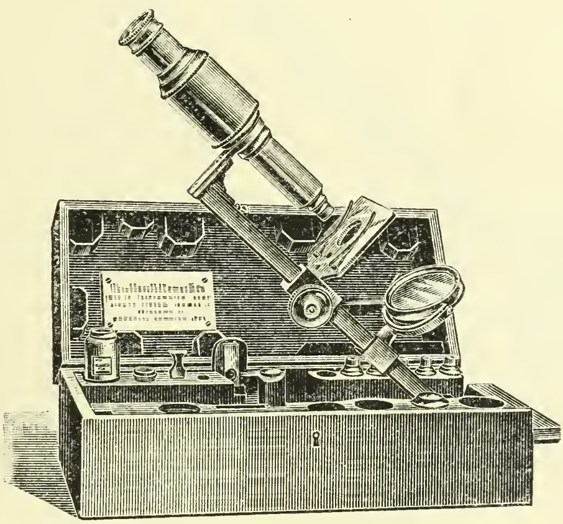
A. Instruments, Accessories, &c.*

(1) Stands.

Sir David Brewster's Microscope.†—At the meeting of the Society, held on November 17, 1897, the President made the following remarks on a Microscope exhibited by Mr. C. L. Curties, which had belonged to Sir David Brewster (fig. 1).

He said that it was used by Sir David Brewster prior to the year 1838. The owner, Mrs. Brewster Ferguson, had presented it to the British Museum, and before sending it there, had kindly sent it through Mr. C. L. Curties for exhibition to the Fellows of the Royal Microscopical Society.

Fig. 1.



At that time Sir David Brewster endeavoured to reduce spherical aberration by constructing lenses of media possessing higher refractive indices than glass, by which means a flatter curve was obtained for any lens of given focus, and for this purpose garnet, sapphire, and diamond were used.

The President said that the Fellows would have an opportunity of judging for themselves the quality of the original garnet lens, as it was exhibited in the room.

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

† There is no maker's name on the instrument; it is similar in construction, and also in its peculiar fitting in its box-foot, to those made by Dollond. Therefore Dollond may with reason be presumed to be its maker.

He had very carefully examined this instrument, and had made measurements of all its parts and calculated its focal distances, and thought it would be interesting to give these particulars. Like many of these older Microscopes, it was fixed to the box, but to the inside and not upon the outside as was usually the case. It could not be taken out of the box, as it was fixed to the inside with a compass joint. Size of box, 12·8 in. long by 5·5 in. wide, by 5 in. deep.

The total length of the body from eye-cap to nose-piece is $7\frac{1}{2}$ in., and from nose-piece to field-lens 5·3 in.

The stage measures $2\frac{1}{4}$ by $3\frac{1}{4}$ in., and is fitted with rackwork by means of which it is adjusted to focus, and there are spring clips provided for holding the slide.

The concave mirror is 2 in. in diameter, with a focus of $3\frac{1}{4}$ in.; no plane mirror is provided.

The pillar is in length $9\frac{3}{4}$ in., and in section $\frac{1}{2}$ in. square; the limb is fixed, the centre projecting 1·8 in. beyond the pillar.

The eye-piece has a doublet compound eye-lens formed of (1) a bi-convex lens with ratio of radii (probably) 1 : 2, the flatter side being toward the eye, diameter 0·8 in., focus 1·3; (2) placed close to the first, an equiconvex lens, diameter 0·9 in., focus 1·5 in.; (3) a field-lens placed at a distance of 1·5 in. from the inner eye-lens; this is also equiconvex, diameter 1·5 in., focus 2·7 in. The joint focus of the two eye-lenses being 0·9 in., and of the whole eye-piece 1·25 in., giving it a magnifying power of × 8.

The objectives he found to be as follows:—

No. 1, equal to about a 1 in., power × 50—achromatism bad—shows coarse areolations of *Triceratium favus*, and ribs in main cut suctorial pipe in blow-fly's tongue.

No. 2, equal to about a 1/2 in., power × 85—achromatism good—will not show *T. favus*.

No. 3, about a 1/3, power × 120, resolves coarse structure of *Eupodiscus Argus* and ribs in main cut suctorial pipe of blow-fly's tongue; achromatism not so good as that of No. 2.

No. 4, about a 1/7, is the garnet lens, power × 280, resolves primary structures in *T. favus*, definition very bad.

No. 5, about a 1/9, power × 360, lens equiconvex, achromatism fairly good, resolves all the bars and small hairs in blow-fly's tongue, and primary structure of *Coscinodiscus*.

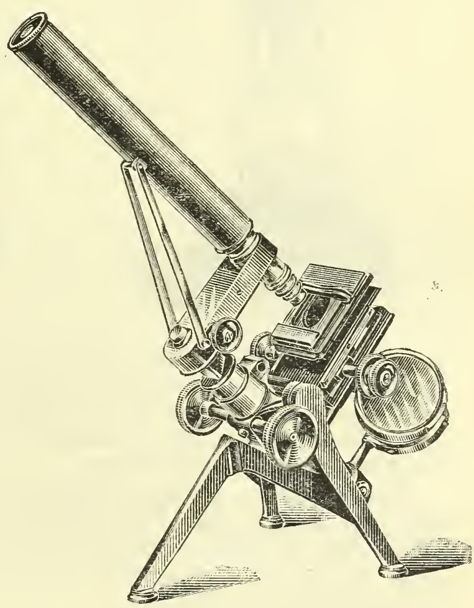
No. 6, about a 1/10, the best of the series, a doublet, plano over equiconvex, power × 400, achromatism fairly good, resolves *Cymbella gastroides*, *Actinocyclus Ralfsii*, and all details of blow-fly's tongue.

The low power has a large opening, and is consequently very fluffy, but there is a minute hole only at the back of the higher powers, by which the aperture is cut down and rendered exceedingly small. The resolving power is therefore, in the case of the very best lens of the series, only about equal to a $1\frac{1}{4}$ in. objective at the present day.

Two Old Microscopes.—At the meeting of the Society held on December 15, 1897, the President drew attention to two old Microscopes exhibited by Mr. C. L. Curties. The first of these was a Hartnack model, non-inclinable, push-tube coarse, and direct acting screw fine adjustments, plain stage with small round hole, concave mirror, and metal plate-foot. This instrument had an archaic look on account of the plate-foot, but it was possible to fix an approximate date by the names "Hartnack and Prazmowski" which were engraved upon the tube, Mr. Prazmowski having joined the firm of Hartnack in 1862. There was also another point about this Microscope which helped to fix its date, and that was the Society's screw, this screw having been introduced on November 12, 1857. With regard to the horse-shoe foot, this was adopted by Oberhäuser at the instigation of Mr. Abraham, a Microscope-maker in Liverpool in 1847. This Microscope showed therefore a reversion to the old type.

The next Microscope (fig. 2) possessed a rare form of Powell and Lealand's fine adjustment. It would be remembered that the first adjustment introduced by Mr. Powell was a stage adjustment; a Turrell stage was raised by means of three inclined planes below it, which were moved by a fine screw with a divided head like that of a micrometer, each division equalling the 1/6000 in. The date of this was 1833. The Society purchased one of these Microscopes in 1841, and this instrument was upon the table before the meeting. Mr. Powell then, in 1841, altered the entire form of his Microscope, by copying the Jackson model, and by adding a very perfect form of fine adjustment consisting of a cone advancing by means of a fine screw. It was this kind of adjustment, the slide on the Jackson limb, which was so largely employed to-day in the Microscopes of Messrs. Baker, Beck, Swift, and Watson. Mr. Powell's next idea was to adopt the bar movement, the fine adjustment being a long lever of the first order as used at present, but it was interesting to note that the side screw was retained, the Microscope now exhibited being an example of this rare form. This Microscope was dated 1846. Very soon after this the fine adjustment screw was placed in the vertical position it still occupied. He believed that the screw was first placed in the vertical position on the portable Microscope, and he thought it would be found so figured in the first edition of Quekett in 1848. The bayonet-jointed cap to the eye-piece was also a feature of this instrument.

Fig. 2.



The President also called attention to an interesting old Culpeper and Scarlet Microscope (fig. 3), which differed slightly from those in the Society's collection, three of which were on the table for comparison. The octagonal form of Marshall's box foot was retained, but the legs were slightly scrolled, instead of being straight, as in the form figured by Smith in his 'Optics,' 1738. Jones, who made a Culpeper Microscope in 1797, placed it on a square box foot, and scrolled the legs more highly, probably for the purpose of giving more room for manipulating the stage

Fig. 3.

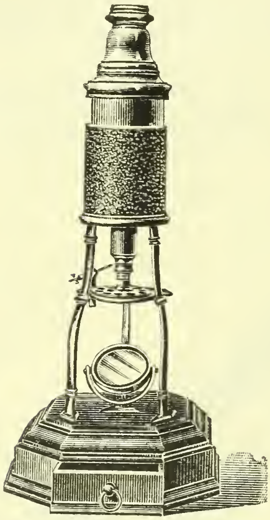
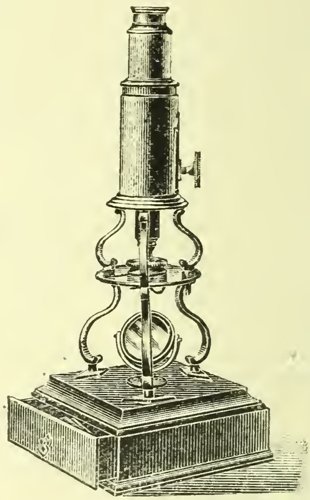


Fig. 4.



and the mirror. In the most elaborate form of this kind of Microscope the body is made of brass, and is fitted with rack-and-pinion coarse adjustment, a fine example of which was lately presented to the Society by Mr. More (fig. 4). The instrument now before the meeting was a very early example with scrolled legs.

How to Make a Microscope Stand.*—Mr. W. E. Field gives instructions, illustrated by numerous working drawings, for the construction of a high-class stand; the various operations, from the making of patterns to the finishing of the instrument, being described, especially the details of the metalwork for each part.

(3) Illuminating and other Apparatus.

Repsold's New Self-Registering Micrometer.† — A. Kowalski describes the results of readings taken by an application of this device to an astronomical transit instrument. The principle of the micrometer is that a clockwork arrangement releases or arrests a thread movable over the fixed micrometer threads; and its great value is the almost complete elimination of the correction due to personal equation. The author gives an account of his experience, which seems decidedly favourable.

* English Mechanic, lxvi. (1897) pp. 171, 193, 217, 239, 263, 287 (31 figs.).
† Bull. Acad. Imp. Sci. St. Pétersbourg, May 1897.

(4) Photomicrography.

Monochromatic Light for Photomicrography.*—Mr. A. D. Pretzl enumerates the chief light-filters thus :—Zettnow's chromate of copper, ammonio-sulphate of copper, Fehling's solution, and potassium bichromate, besides signal green, chromium green, and other coloured glasses; although the light they allow to pass is by no means monochromatic, but practically the whole of the spectrum with certain portions dampened down. In order to make the action of screens thoroughly understood, the following tables of reference are necessary :—

Fraunhofer Lines.	Wave-Length. λ	Fraunhofer Lines.	Wave-Length. λ
A	759	E	527
B	687	F	486
C	656	G	430
D	589	H	397

Distribution of Colours (after Listing).

	λ		λ
Red	723–647	Bright blue	491–455
Orange	647–586	Blue violet	455–424
Yellow	586–534	Violet	424–397
Green	534–491		

Zettnow's cupro-chromate filter allows light from wave-lengths 570–550 to pass, and is made by dissolving 160 grains of pure dry cupric nitrate and 14 grains of chromic acid in 250 c.cm. of water. The thickness of liquid should be 1 cm. The ammonio-sulphate of copper allows light from 475–400 wave-lengths to pass, and this is prepared by dissolving finely powdered sulphate of copper in four times its weight of liquid ammonia (sp. gr. 0·96). When diluted or with a thin stratum of solution, light of 515 λ will get through.

Fehling's solution cuts off the extreme red and the ultra-violet. The potassium bichromate absorbs the violet, blue, and bluish-green, according to its strength and thickness.

Landolt's filters, as used for polariscopic work, should be equally good for microscopic work, and the following directions for making them may be useful.

Red filter.—Crystal violet, 5 BO, 0·05 grm. should be dissolved in a little alcohol and diluted to 1000 c.cm. with water, in a trough 20 mm. thick; this gives a red band with a broad blue violet band, which can be absorbed by a 10 per cent. solution of potassium chromate. The red stripe left begins about λ 718 and ends abruptly at λ 639.

Yellow filter.—Dissolve 30 grm. of nickel sulphate in 100 c.cm. of water, and in a thickness of 20 mm. this absorbs the red only; a 10 per cent. solution of potassium chromate in 15 mm. thickness absorbs the blue, and a 15 mm. thickness of 0·025 grm. of potassium permanganate in 100 c.cm. of water absorbs the green, leaving λ 614 to λ 574.

Green filter.—Cupric chloride ($CuCl_2$, $2H_2O$), 60 grm. dissolved in 100 c.cm. water, and 20 mm. thickness, passes the green and blue, and a

* English Mechanic, Dec. 1897, pp. 358–9.

10 per cent. solution of potassium chromate in 20 mm. thickness absorbs the blue, leaving λ 540 to λ 505.

Bright blue filter.—Doppelgrün, SF 0·02 grm. dissolved in 100 ccm. of water and in 20 mm. thickness, leaves a narrow red band, a broad green band with blue; and 15 grm. of cupric sulphate dissolved in 100 c.cm. of water in 20 mm. thickness, absorbs the red and green, leaving λ 526 to λ 458.

Dark blue filter.— 0·005 grm. of crystal violet 5BO dissolved in 100 ccm. of water in 20 mm. thickness, and the sulphate of copper solution as used above, also in 20 mm. thickness, allow λ 478 to λ 410 to pass.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Plankton Gathering.†—Mr. G. Murray recommends, for use with deep-sea plankton, a cylindrical silk bag, about 1½ ft. long and 3 or 4 in. wide. This was tied to the nozzle of the hose, there being a lateral overflow vent near the top of the bag. On pumping through this with the donkey engine from an intake pipe 8 ft. below the surface, good results were obtained. This contrivance enables the operator to work while steaming, and is often convenient when the weather is too rough for tow-netting. The fixative and preservative employed was a 0·5 per cent. solution of chromic acid; good results were also obtained with Fleming's solution, and with platinic chloride of various strengths.

Culture of Diatoms.‡—Dr. H. van Heurck publishes a *resumé* of M. Miquel's admirable methods for the artificial cultivation of diatoms. The cultures are divided into ordinary and pure, and subdivided into cultures of fresh-water and salt-water diatoms.

(1) Ordinary cultures of fresh-water diatoms are grown in a fluid containing salts and organic substances. The saline nutriment is prepared in two solutions:—A. Sulphate of magnesium 10 grm., chloride of calcium 10 grm., sulphate of sodium 5 grm., nitrate of ammonium 1 grm., nitrate of potassium 2 grm., nitrate of sodium 2 grm., bromide of potassium 0·2 grm., iodine 0·1 grm., water 100 grm. B. Phosphate of sodium 4 grm., chloride of calcium sic. 4 grm., hydrochloric acid 2 c.cm., perchloride of iron liquid at 45° 2 grm., water 80 grm. These solutions are mixed when required for use, in the proportion of 40 drops of A and 20 drops of B to 1 litre of tap-water, and then are added 5 cgrm. of wheat straw and a similar quantity of earth moss, previously washed in boiling water. Small cultures may be made in wide-necked flasks plugged with cotton-wool; large cultures in crystallisers, or in the square jars formerly used as electric accumulators. It is useful to sterilise the fluids in a water-bath for a quarter of an hour at 70°. The medium is inoculated with living frustules. The cultures should be kept from the sun and exposed to a northern light at 10°–30° C. The growth of green algæ may be diminished by reducing the light.

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

† Journ. of Bot., xxxv. (1897) pp. 387–8.

‡ Zeitschr. f. angew. Mikr., iii. (1897) pp. 193–8, 225–36.

Every 10 or 15 days the water lost by evaporation should be replaced by sterilised water, and if the cultures drag, their growth may often be stimulated by adding a few drops of solutions A and B.

(2) Culture of marine diatoms is easily done in sea-water. If, however, natural sea water cannot be obtained, it may be replaced by dissolving sea-salt 250 grm., sulphate of magnesium 20 grm., chloride of magnesium 40 grm., in a litre of water, and when required for use adding 9 litres more. To the sea-water are added the solutions A and B, just as for fresh-water diatoms, and also a little *Zostera* leaf.

(3) Pure cultures of diatoms are obtained by the fractional method, or by isolating a single healthy specimen. The former procedure is effected by mixing one drop of diatomiferous fluid with 100 ccm. of nutritive fluid, and diluting 1 ccm. thereof with 99 ccm. of fresh fluid. The last solution is then distributed in ten Freudenreich's flasks and cultivated. In this way cultures of a single form may be finally obtained and further examined in a cell devised by Miquel (see p. 130).

Dr. van Heurck then gives the methods and formulæ used by the late Mr. C. Haughton Gill. The fluid from which Mr. Gill obtained the best results was composed as follows:—Solution A. Chloride of sodium 10 parts, sulphate of sodium 5 parts, nitrate of potassium 2·5 parts, acid phosphate of potassium 2·5 parts, water 100. B. Filtered spring water 100 vols., solution A 0·5 vol. To this solution is added a sufficient quantity of slaked lime to neutralise the acidity of the liquid, and a small quantity of precipitated silica. Finally, a small quantity of sterilised grass infusion or diatom broth, obtained by prolonged boiling of a large quantity of fresh diatoms in water. After filtering the broth, it is preserved in hermetically sealed tubes. Fine bone-scrapings were also added, and occasionally well washed grass roots.

Though the foregoing gave very excellent results, Mr. Gill, in the last year of his life, adopted a fluid more like that of Miquel. This was a mixture of four different solutions:—

Solution i. Pure crystallised phosphate of sodium 2; pure crystallised chloride of calcium 4; pure syrupy perchloride of iron 0·5; pure hydrochloric acid 1; water 100.

Solution ii. Pure crystallised sulphate of magnesium 4; pure crystallised sulphate of sodium 4; pure crystallised nitrate of potassium 4; common salt 8; bromide of potassium 0·2; iodine 0·2; water 100.

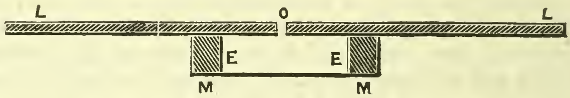
Solution iii. Pure crystallised carbonate of sodium 4; water 100.

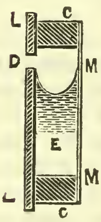
Solution iv. Silicate of calcium, precipitated and washed, 25; water 75.

Of each of these solutions 3 ccm. were taken and mixed with 1 litre of tap or sea water, and the mixture distributed in Erlenmayer's flasks of 100–200 ccm. capacity, which were filled up to a height of 3 ccm. The flasks were plugged with cotton-wool, sterilised, and left for at least one week before being inoculated. Solution iii. has a double action, for it neutralises the acidity of the fluid and precipitates half of the calcium as useful carbonate. Mr. Gill was of opinion that the purity of the substances used was highly important, especially of the perchloride of iron, the ordinary samples often containing arsenic, one of the most fertile causes of failure. Direct sunlight was harmful, and the culture flasks were placed facing W.N.W., a screen of pale-green glass being interposed. The flasks were inoculated with one or more frustules isolated by means of a capillary tube.

Miquel's Cell for Pure Cultures of Diatoms.*—Dr. H. van Heurck describes Miquel's cell for the pure cultivation of diatoms. To a slide having a circular hole 2 mm. in diameter towards its upper side is fixed a ring, and to the ring a circular cover-glass. In this way is made a cell with a lateral aperture, which can be held vertically or horizontally. The slide is allowed to rest during the cultivation on the cover-glass upon which the deposits form, and hence these cultures may be examined with the highest powers.

Fig. 6.





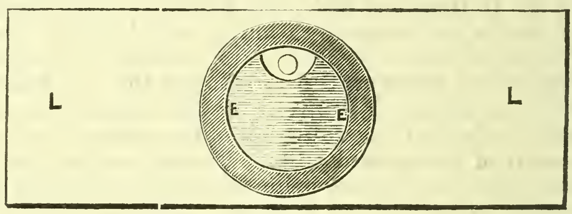


Fig. 5. Fig. 7.

Fig. 5.—Transverse section of cell: L L, slide; D, aperture of 2 mm.; *c c*, ring; M M, cover-glass; E, cultivation fluid.
Fig. 6.—Longitudinal section: O, aperture.
Fig. 7.—View of cell from Microscope bent at an angle.

Cultivating Gonococcus.†—Dr. A. Wassermann has found that *Gonococcus* grows best on a medium which contains uncoagulated serum-albumen and pepton. The coagulation of the serum by boiling is prevented by the addition of casein-sodium phosphate (nutrose), a substance which also promotes the growth of *Gonococcus.* The medium is made by putting 15 ccm. of pig's serum in an Erlenmeyer's flask, diluting with 30-35 ccm. of water, and then adding 2–3 ccm. of glycerin, and finally 0·8 grm. (2 per cent.) of nutrose. The flask is then well shaken in order to properly mix the ingredients, after which it is heated to boiling. It is sterilised in 20–30 minutes. The sterilised solution may be kept in this condition for future use, and suffices for 6–8 plates. When required for use, a number of 2 per cent. pepton-agar tubes are liquefied and mixed in equal parts with the serum fluid, and the mixture poured into Petri's capsules. When set, the medium is ready for use. The serum and agar must be mixed at between 50° and 60°. If the pig's serum is very rich in albumen, it is advisable to mix the 15 ccm. with 40 ccm. of water instead of 35 ccm.

* Zeitschr. f. angew. Mikr., iii. (1897) p. 230.
† Berlin. Klin. Wochenschr., 1897, p. 685. See Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 486–7.

Nutrient Gelatin with High Melting-point.*—The three chief points to be carefully attended to in obtaining a gelatin medium with high melting-point are, says Prof. J. Forster, the height of the temperature acting on the gelatin, the duration of the action, and the concentration of the gelatin. In practice, this amounts to observing that the temperature should never exceed 100°, and should not be protracted longer than 40 minutes, and that the gelatin should amount to 5 per cent.; for it was found by experiments conducted for the purpose that the melting-point of gelatin was lowered by protracted boiling, and by the greater amount of water in the medium. It was further determined that above 5 or 6 per cent. the melting-point was but little higher than at these amounts; consequently on the whole it was more advantageous to compose the medium with 5 per cent. On these lines a nutrient gelatin is produced which, after standing for 24 hours, has a melting-point between 29° and 30° C.

Capsule for Anaerobic Cultivation.†—Dr. M. Beck has devised a modification of Petri's capsule which renders this apparatus useful as a moist chamber, and for the cultivation of anaerobic organisms. By giving an S-bend to the flange of the cover, two furrows or grooves are

Fig. 8.

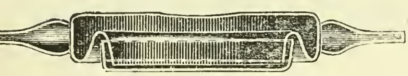
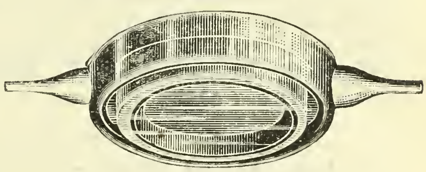


Fig. 9.



produced, the upper one of which serves for the reception of water when the capsule is to be used as a moist chamber. By the addition of a couple of lateral tubes any gas can be introduced. When required for anaerobic cultures, the lower furrow is filled with paraffin and fixed to the edge of the capsule by mere pressure. In this way an air-tight chamber is produced.

Seminal Fluid as a Nutritive Medium.‡—Dr. A. Cantani, jun., obtained pure seminal fluid by removing the testicle and spermatic cord and squeezing out the fluid on to the surface of oblique agar. As the fluid was removed aseptically, sterilisation and antiseptic precautions were avoided.

Testicular juice which was smeared over the surface of oblique agar was obtained by cutting through the testicle, and removing the juice with a platinum loop. The tubes were afterwards incubated for 10 hours.

Though most bacteria grew fairly well on the seminal media, only influenza bacilli gave really good results.

Influence of the Reaction of the Medium on Bacterial Growth.§—Herr M. Deelemann has made experiments for the purpose of ascer-

* Centralbl. Bakt. u. Par, 1te Abt., xxii. (1897) pp. 341–3.
† Tom. cit., pp. 343–5 (2 figs.). ‡ Tom. cit., pp. 601–4.
§ Arb. a. d. K. Gesundheitsamt, xiii. (1897) pt. 3. See Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) p. 355.

taining whether the proportion of alkali advocated by Maassen and used in the Imperial Laboratory at Berlin is the correct one, viz. 1·035 ccm. per cent. normal soda solution to 1 litre litmus-blue neutral bouillon, and also whether the addition of caustic soda or of soda is more advantageous for bacterial growth. Twenty different species of bacteria were used for the research. The conclusions the author arrived at were:—

(1) The addition of soda for the great majority of the bacteria examined was found to be more advantageous than caustic soda. In a small number of bacteria there was no difference between the two. With diphtheria the growth was usually better with caustic soda than with soda. With anthrax the growth was invariably better with caustic soda.

(2) A slight addition of alkali beyond the litmus-blue neutral point was advantageous for most bacteria, only *B. pyocyaneus* and *B. cyanogenus* thriving better on neutral media.

(3) The optimum lay between 0·34–1·7 ccm. per cent. normal caustic soda solution, and 0·39–1·95 ccm. per cent. normal soda solution. The addition of 1·15 per cent. of crystallised soda over the litmus-blue neutral point, corresponding to 1·05 ccm. per cent. normal caustic soda solution, as used by Maassen, seems therefore suitable for most bacteria.

(4) The limits for good growth lay generally between 1·7–3·4 ccm. per cent. normal caustic soda solution and 1·95–3·9 per cent. normal soda solution. With diphtheria, however, the limits reached were only 1·0 ccm. per cent. and 1·17 ccm. per cent.; while with *B. ruber Plymouth*, *B. erythrogenes*, *V. Miller* they were 5·1 ccm. per cent. and 5·85 ccm. per cent. respectively.

(2) Preparing Objects.

Apparatus for Filtering Bacterial and other Fluids.*—Dr. F. G. Novy describes a filtering apparatus, the principal advantage of which is that the positive pressure from the compressed air co-operates with the negative pressure of a pump in filtering the fluid, so that in 3–5 minutes 250 c.cm. of water can be passed through.

The essential parts of the apparatus are a glass cylinder, and a Chamberland bougie, which is inserted within the cylinder. The latter has a flange at the lower end, by means of which, through the intermediation of clamps and caoutchouc rings, it is firmly fixed to the bougie.

Simple Steam Steriliser.†—Dr. F. G. Novy recommends a simple apparatus for steam sterilising. The lower part is the ordinary Hoffmann's iron water-bath, 18–20 cm. in diameter. The upper part, made of copper, has a perforated bottom. Inside are soldered two rings $1\frac{1}{2}$ cm. broad, of perforated copper, one about 4 cm., the other about 12 cm. from the bottom. The object of these rings is to prevent the culture tubes from touching the sides. The lid is furnished with a tube for the escape of the steam.

(4) Staining and Injecting.

Staining Yeast-Cells.‡—Herr O. Busse, in his work on yeasts as causes of disease, recommends the following method for staining these

* Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 337–9 (2 figs.).

† Tom. cit., p. 340 (1 fig.).

‡ 'Die Hefen als Krankheitserreger,' Berlin, 1897. See Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) p. 349.

organisms. Stain for 15 minutes in alum-hæmatoxylin, wash in water, and then stain with very dilute phenol fuchsin (1 part Ziehl's solution with about 20 parts of distilled water) for 30 minutes to 24 hours. After this, decolorise and dehydrate for 15 seconds to 1 minute in alcohol, then 95 per cent. spirit followed by absolute alcohol, xylol, and balsam.

Method of Treating Bacteria difficult of Staining.*—M. L. Dubois adopted the following procedure when dealing with bacteria difficult of staining. To 10 ccm. of a 25 per cent. solution of tannin, a solution of ferrous sulphate was added until the liquid was of a black colour. The mixture was heated to 50°, and the cover-glass films immersed therein for 25 minutes. The cover-glass was next transferred without being washed to a 1 per cent. solution of potash. After 15 minutes the film was washed, and finally hot-stained with anilin-oil fuchsin solution, and the preparation examined in water.

Rapid Staining of Tuberculous Sputum.†—Dr. N. P. Andrejew recommends the following method for staining tuberculous sputum. The cover-glass films are first stained in the usual way with the phenol-fuchsin solution, and are then treated with the following mixture:—(1) hot 10 per cent. potassium chlorate solution, 100 ccm.; (2) acid green (Grübler) 1 grm.; (3) 25 per cent. pure sulphuric acid 15 ccm. The mixture, after having been well shaken and filtered, forms a dark green fluid in which the stained cover-glass is immersed until the film becomes of a green or bluish-green hue (about 1 minute). After this the cover-glass is thoroughly washed with tap-water, and then dried on blotting-paper. It may be examined at once, or mounted in the usual way.

The chief advantages claimed by the author for this method are that, as green is the complementary colour to red, the red stained objects are better seen, and also that only two solutions are required.

Intra-Vitam Staining.‡—Herr A. M. Przesmycki has made a long series of experiments on *intra-vitam* staining, and has improved the methods. His general results are thus summed up:—Different organisms react differently, the various organs differ in their receptivity, even in the same animal; different parts of the same organs may be differentiated; the parts coloured *intra vitam* lose their colour after death, or when the organism is placed in fresh water without any pigment; the method makes it possible to show certain details which are not demonstrable in any other way.

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

Preserving Sea-Anemones.§—N. Kholodkovsky recommends douching sea-anemones (in a little sea-water) with 40 per cent. formol diluted ten times with fresh water. The animals die uncontracted, and the colours remain for at least two weeks, when the author—somewhat prematurely perhaps—communicated his recipe.

* Comptes Rendus, cxxv. (1897) p. 791.
† Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 593-7.
‡ Biol. Centralbl., xvii. (1897) p. 353.
§ Bull. Soc. Zool. France, xxii. (1897) p. 161.

Flemming's Fixing-Solution.*—Herr D. M. Mottier recommends the following composition for studies in nuclear division in plants:—

1 per cent. chromic acid	.. ..	16 ccm.
2 per cent. osmic acid	.. ..	3 ccm.
Glacial acetic acid	.. ..	1 ccm.

Preservative Fluids for Botanical Specimens.†—M. J. Chalon recommends a saturated or 3 per cent. solution of boric acid for preserving vegetable specimens. This was the only one out of ten different solutions which gave satisfactory results. The solution is improved if 1 to 5 per cent. sodium sulphate be added.

The other solutions tried were, 2 per cent. calcium chloride; 0·25 per cent. chromic acid; chromo-acetic acid; Müller's fluid; salicylic acid; carbolic acid; corrosive sublimate thymol; sodium sulphite. The use of formalin in 3 per cent. solution is alluded to, but its advantages or disadvantages are not mentioned.

(6) Miscellaneous.

New Method of Observing Stomates.‡—Prof. F. Darwin thus describes a new method used by him for observing the opening and closing of stomates:—"A strip of horn sheet 8–9 mm. long by 3–4 mm. wide is fastened by one end to a small block of cork so that the horn lies flat on any surface on which the instrument is placed; the horn bearing at its free end a bristle to serve as index. When it is placed on a damp surface the index instantly rises to an angle of 20–50°, or even more, whereas it remains flat on a dry surface. A paper scale being fixed to the cork block serves to read off the movement; when applied to leaves, e.g. a hypostomatal leaf, the reading is zero on the upper side, and varies on the under side according to the state of the stomates; 50° means an extreme amount of variation, 30° a fair degree, 10° a small degree."

Detection of Typhoid Bacilli in Fæces by Elsner's Method.§—Dr. S. Sterling writes in praise of Elsner's method for the detection of typhoid bacilli in the fæces. As previously stated, the essential feature consists of potato-gelatin with 1 per cent. iodide of potassium, which medium is found to be unsuitable for most of the microbes from fæces, and has the further merit of distinctly differentiating the colonies of *B. coli* from those of typhoid, those of the former being yellowish and granular and of fast growth, while those of the latter are small transparent droplets. The author states that his percentage of positive results with Elsner's method is 66, while other procedures did not give a higher percentage than 16·5.

Method of rapidly Identifying the Microbe of Bubonic Plague.‖—The method devised by Mr. E. H. Hankin and Surgeon-Captain B. H. F. Leumann for rapidly identifying the plague bacillus is derived

* Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) p. 170.

† Bull. Soc. Roy. Bot. de Belge, xxxvi. (1897) pp. 39-46.

‡ Proc. Cambridge Phil. Soc., ix. (1897) pp. 353–8.

§ Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 334–6. Cf. this Journal, 1896, p. 357.

‖ Tom. cit., pp. 439–40.

from the observation that in old agar cultures large and peculiar involution forms are common; and in that about to be described those involution forms may under favourable conditions be obtained within 24 hours, and thus become a means for rapidly identifying the plague microbe. The microbe is to be inoculated in agar containing 2·5–3·5 per cent. of salt, and incubated at 37°. In 24, and certainly within 48 hours, every single bacillus will be swollen up and altered so that they resemble spheres, spindle-shaped, or oval bodies, and occasionally torulæ, appearances which cannot easily be mistaken for any other known microbe. In the case of certain bacilli having a superficial resemblance to those of plague, isolated involution forms recalling those of plague may be met with, but it will never occur that the whole culture is so changed.

In carrying out the test it appears to be necessary to first cultivate the microbe on ordinary agar and then transfer it to salt agar. The authors have also found that potassium bromide or iodide can be used in the place of sodium chloride in a strength of about 2 per cent., but this variation of the method does not seem to present any special advantage.

Microscopic Study of Alloys.*—The following notice of M. Charpy's important work on this subject appears in the issue of 'Nature' for November 4, 1897, with the signature " T. K. R."

"The study of metals with the Microscope proceeds apace, and is now becoming as generally pursued among metallurgists as the determination of melting-points has been during the last five years. Since the appearance of Prof. Roberts-Austen's article on 'Micrographic Analysis' of iron and steel, a large amount of work has been done; but most observers still devote themselves more or less exclusively to the study of this metal, attacking unsolved problems which seem to have great industrial importance. This tendency is unfortunate from some points of view; for the complex constitution met with in that protean element makes it less easy to explain the observed appearances until, by work on simpler alloys, a better acquaintance with the whole subject has been obtained. M. Charpy is one of those who has resisted the temptation offered by the alloys of industry, and in a recent paper has given some interesting results of his investigations on binary alloys which are well worth re-statement.

"It is now fairly established that microscopic examination gives an immediate analysis of alloys, which is all the more valuable for differing in its results from chemical analysis, since these differences indicate the existence of definite compounds, and elucidate the structure in other ways. The immediate analysis is now made with the aid of a planimeter, as Sauveur recommended, by which the ratio of the areas occupied in the microscopic field by the various constituents can be measured. The metal or metals forming each of these constituents can often be indicated by their colour, hardness, and, above all, the effects on them of various reagents, and thus a full account of the alloy can be given.

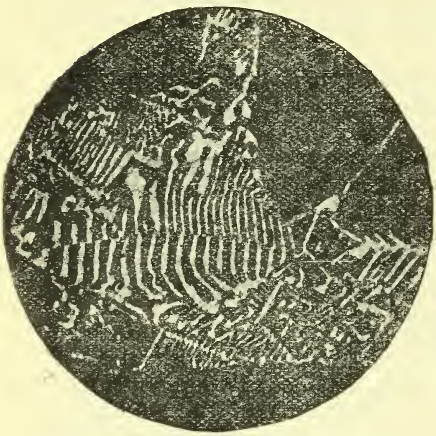
"In the normal type of constitution of binary alloys, crystals of one

* 'Étude Microscopique des Alliages Métalliques.' Bull. Soc. d'Encouragement, ii. (1897) p. 384.

of the metals, or of a definite compound of the two, are seen enveloped in a second constituent, which is generally the eutectic alloy, containing both elements in a very finely divided state. The composition of the eutectic mixture remains constant, whilst the amount of isolated crystals varies with the percentage composition of the alloy. The limiting cases of a pure definite compound or metal, and of a pure eutectic mixture, may be grouped with these alloys.

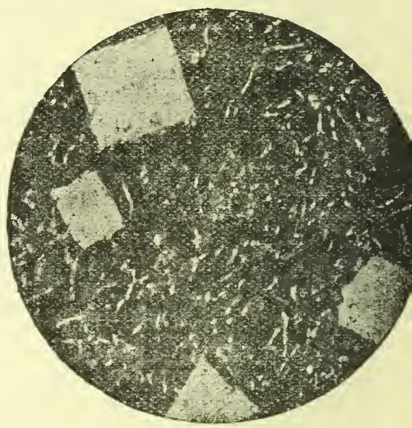
"Eutectic alloys vary in appearance according as they have been cooled slowly or quickly. In the latter case, the surface is uniformly striated, but the crystals or crystallites are so small that it is difficult to obtain satisfactory photographs of them. When the solidification is slow, however, the separation into lamellæ is strongly marked, especially when viewed under high powers, and this structure is highly characteristic of eutectic alloys, being easily traced in any of them whatever the

Fig. 10.



Alloy of silver, 66 per cent.; antimony, 34 per cent.

Fig. 11.

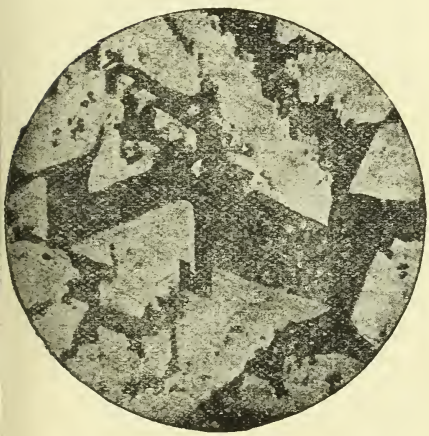


Alloy of tin, 90 per cent.; antimony, 10 per cent.

metals in the alloy may be. It is well shown in fig. 10, which represents an alloy containing silver 66 per cent., antimony 34 per cent., magnified 500 times; the metal has been treated with sulphuretted hydrogen, which has blackened the silver and left the antimony unchanged. In the same figure some straight edges can be seen, in which the ramifications end, and which sketch out shapes resembling those of crystals of antimony. The presence of these crystallites or incipient crystals in eutectics constitutes one of the resemblances between them and the micro-felsitic basis observed in many igneous rocks, and it seems likely enough that if light transmitted through these alloys could be examined, it would show that they are on the borderland between crystalline and amorphous matter.

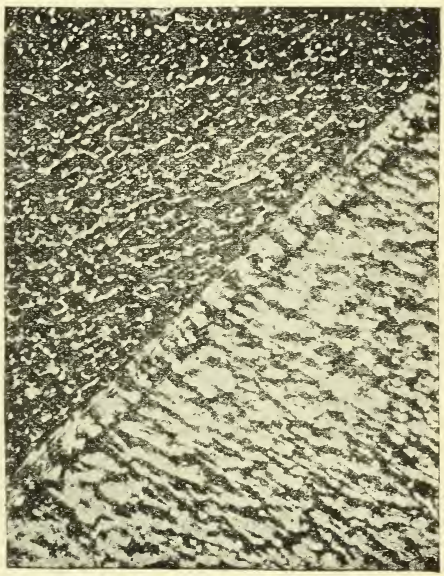
"Besides the normal type of binary alloys, in which eutectics are observable, there is a second type consisting of alloys of metals which form isomorphous mixtures with each other. These alloys, whatever may be their composition, consist of only one species of crystals, which fill the whole space, the composition and the properties of the alloys usually varying in a continuous manner in each crystal. The number of metals capable of forming isomorphous mixtures with each other is small, the bismuth-antimony alloys being the only ones out of fourteen series investigated by M. Charpy in which this property was found to exist; but, on the other hand, there are many cases of definite compounds of two metals isomorphous with one of them. Thus, for example, microscopic study has enabled M. Charpy to detect a compound of tin and antimony containing about 50 per cent. of tin and isomorphous with antimony,

Fig. 12.



Alloy of tin, 75 per cent.: antimony, 25 per cent.

Fig. 13.



Pure gold. × 1000 diameters.

although the freezing-point curve, worked out by Roland-Gosselin, and consisting of three branches having their concavities upwards, and meeting in two angular points or maxima, gives no direct indication of the relation between these metals.

"In fig. 11, in which the alloy containing 10 per cent. of antimony is shown, the cubical crystals appear to consist of the 50 per cent. alloy set in a eutectic magma. Fig. 12 shows the alloy with 25 per cent. of antimony. As the proportion of antimony in the whole mass approaches 50 per cent., these crystals invade the whole field, and numerous minute cracks appear, on the edges of which is seen a secondary crystallisation without the interposition of an intermediate substance. This structure is characteristic of a pure or homogeneous substance, as in the beautiful micro-sections of pure gold prepared by Osmond and Roberts-Austen,* one of which is reproduced in fig. 13. When the proportion of antimony is increased above 50 per cent., a eutectic magma shows no signs of reappearing. Similarly in the tin-antimony series, there is evidence of a compound containing 20 per cent. antimony and isomorphous with silver, and in the silver-tin series a compound containing 30 per cent. of tin also appears to be isomorphous with silver. An investigation of the triple alloys of these metals would be interesting, as probably affording fresh examples of isomorphous series."

* Osmond and Roberts-Austen, 'On the Structure of Metals, its Origin and Changes,' Phil. Trans., clxxxvii. (1896) A, pp. 417–32.

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on December 15th, 1897, at 20 Hanover Square, W., The President (E. M. Nelson, Esq.) in the Chair.

The Minutes of the Meeting of 17th November last were read and confirmed, and were signed by the President.

The President said no doubt most of those present were aware of the loss the Society had sustained by the death of one of their best known Fellows, Mr. Thomas Curties, who had not only done a great deal towards advancing microscopy, but had been of great assistance in many ways both to the Royal Microscopical Society and to the Quekett Microscopical Club, and especially in reference to the number of Fellows whom he had induced to join. All who knew him would be very sorry to hear of the loss they had sustained.

Mr. Measures said he had brought for exhibition a lens which Carl Zeiss considered to be an advance on his previous lenses for low power photography. In illustration of its performance he had brought for comparison two large photographs, one of which was taken with a projection apochromatic lens of 35 mm., and the other with the new lens, "planar," of the same power, under exactly the same conditions, $\times 31\frac{1}{4}$, and same camera extension, viz. 44 in. The photographs being of the same object (a spider) and of precisely the same size, would speak for themselves. These lenses were made of 20, 50, 75, and 100 mm., and the price of any of these was 6*l*. Of these the 20 mm. and 50 mm. were fitted with the Society's screw to fit the nose of the Microscope in addition to the usual flange for direct attachment to the camera front.

Mr. T. Comber said he had examined these photographs before the meeting. Low power photography was not much in his line, although he had occasionally used a lens of 35 mm. All he could say was that if the photographs before them showed properly the comparative merits of the two lenses, there was no doubt in his mind that the new combination was a very great advance upon the old one; he thought the prints fully illustrated this.

The President said he could quite endorse what Mr. Comber had said with regard to these lenses; he thought there could be no doubt that the difference in covering power between these two lenses was enormous.

The thanks of the Society were, upon the motion of the President, unanimously voted to Mr. Measures for bringing these lenses to their notice.

The President said that two very interesting Microscopes had been kindly lent to him by Mr. C. L. Curties for exhibition that evening.

The thanks of the meeting were voted to Mr. C. L. Curties for the loan of these instruments (see p. 124).

Mr. E. B. Stringer's paper 'On a new Form of Photomicrographic Camera and Condensing System' was, in the absence of the author, read by Mr. F. W. Watson Baker, the apparatus described being exhibited in the room with oxyhydrogen lamp complete.

Mr. T. Comber said he had only seen the arrangement since he came into the room. As his work was done by sunlight, artificial illumination was a subject which he did not know much about. He had consequently very little to say, except that the source of illumination appeared to him to be a very valuable arrangement for those persons who were obliged to do their work by artificial light. The method of obtaining a parallel beam also seemed to be a most excellent one. Looking at the image projected on the card, however, it did not seem to be quite flat, so that the picture was sharp in the centre, but fell off towards the margin of the field. Possibly this might be in some measure due to the objective, but in any case the apparatus seemed to possess great potential powers.

Mr. F. W. Watson Baker said that the want of flatness of field was obviously due to the objective, the one used for the purpose of exhibition being a 1/6 in. oil-immersion having a numerical aperture of 1·30.

The President said that he had had the advantage of seeing the apparatus at work at Messrs. Watson's. It was on an entirely different plan to his own apparatus, because he never used any optical arrangement between the light and the substage condenser, except a heat interceptor and screens. There was, moreover, no fixed position for his Microscope, as he preferred to centre his plate to the axis of the Microscope rather than the Microscope to the plate. It was, however, a case of *tot homines tot sententiæ*, especially with photomicrographers. The reduction in the pressure of the gas was most important, a low pressure of gas being necessary to obtain a small and steady light. He had not used zirconium, but from what he had seen that evening, he thought it a most excellent form of artificial light. The adjustability of all the parts was an excellent idea, because they could be quickly and accurately centered. With regard to the apparent divergence of the beam issuing from the water trough, it was due to the magnification of the system, and not to the want of parallelism of the pencils, as had been suggested; a Galilean opera or field glass would produce the same effect. He would conclude by congratulating Mr. Stringer on his success.

The thanks of the Society were unanimously voted to Mr. Stringer for his paper, and to Mr. Baker for reading it on that occasion.

Prof. Bell said that a selection of slides of sections of *Echinus* spines from the Tucker Collection in the Society's Cabinet, were exhibited under a number of Microscopes in the room that evening.

Prof. Bell having intimated that the next meeting of the Society would be its Annual Meeting, read a list of nominations for Officers and Council to be then submitted for election. He also said that the Council had appointed Mr. Dadswell to act on their behalf as Auditor of the Treasurer's accounts for the past year, and asked the Fellows present to elect another Auditor to act for them.

Mr. J. M. Allen was then proposed by Mr. J. M. Offord, seconded by Mr. J. W. W. Baker, and unanimously elected Auditor on behalf of the Fellows of the Society.

It was announced that the Society's Rooms would be closed from December 24th to January 3rd, inclusive.

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

The Society:—A selection of slides of sections of *Echinus* Spines, principally from the Tucker Collection in the Society's Cabinet.

An old Culpeper and Scarlet Microscope sent by Mr. George T. Harris.

A Prazmowski Microscope,* and an old Powell and Lealand Microscope, date 1846, lent for exhibition by Mr. Chas. L. Curties.

Mr. Stringer:—Apparatus illustrating Mr. Stringer's paper, exhibited by Messrs. Watson and Sons.

Mr. J. W. Measures:—Lenses made by Zeiss for low-power photomicrography, with two specimen prints. These lenses are also suitable for ordinary photography, and have flanges to fit an ordinary camera.

New Fellows:—*Ordinary* Fellows:—Dr. John W. H. Eyre, Rev. Walter Fielder, Mr. George Hind.

Honorary Fellow:—Mr. Arthur Bolles Lee.

ANNIVERSARY MEETING

HELD ON THE 19TH OF JANUARY, 1898, AT 20 HANOVER SQUARE, W., THE PRESIDENT (E. M. NELSON, ESQ.) IN THE CHAIR.

The Minutes of the meeting of 15th December last were read and confirmed, and were signed by the President.

Prof. Bell said they had received three donations for the Library, which were worthy of some remark. The first of these was a copy of the 'Transactions of the British Institute of Preventive Medicine,' one of the youngest of their scientific societies, but one which he believed would prove to be a very important society indeed. It was the first of their Transactions which was now presented.

The two other works were partly in exchange for the Journal of the Society, but were of very much greater value, and were presented by the Trustees of the British Museum; one was a Catalogue of the Jurassic Bryozoa in the British Museum; and the other the third volume of the Catalogue of the Madreporarian Corals in the British Museum. These were works of undoubted value.

The thanks of the Society were unanimously voted to the donors.

* The following is engraved on the draw-tube of this Microscope:—

Mon. E. Hart & A. Praz
A. Prazmowski, Sucr.
Rue Bonaparte 1,
Paris.

The President said he had much pleasure in presenting, on behalf of Mr. G. T. Harris, the old Microscope to the Society which had been exhibited at the last meeting. It was described on that occasion, and was upon the table before them; he felt sure they would unite in giving a hearty vote of thanks to Mr. Harris for thinking of the Society in this way (see p. 125).

A vote of thanks for this donation was then put from the chair, and carried unanimously.

Prof. Bell read a letter which had been received from Mr. Arthur Bolles Lee, thanking the Society for the honour conferred upon him by his election as an Honorary Fellow of the Society, at their meeting in December last.

Prof. Bell then read the Report of the Council for the year 1897, as follows:—

REPORT OF THE COUNCIL FOR 1897.

FELLOWS.

Ordinary.—During the year 1897, 27 new Fellows were elected, whilst 10 have died, 42 have resigned, and 19 have been removed from the list for non-payment of subscriptions, and other causes. The increase by 13 as compared with last year in the number of new Fellows is very satisfactory, but this is unfortunately outweighed by the considerable increase in the number of resignations.

Honorary.—One Honorary Fellow, Prof. J. J. S. Steenstrup, has died. In his place, Mr. Arthur Bolles Lee has been elected; the vacancy caused by the death of M. Pasteur was filled during 1897, by the election of Prof. G. B. De Toni.

The list of Fellows now contains the names of 516 Ordinary, 1 Corresponding, 50 Honorary, and 84 ex-Officio Fellows, being a total of 651.

FINANCES.

Subscriptions.—The Council note with much satisfaction the considerable increase in the amount received by annual subscriptions, and they trust that the punctuality of the Fellows and the efforts of the Finance Committee will result in a continuance of this very satisfactory condition of affairs. They have, however, to point out that the total amount for this year has been considerably increased by the arrears which have been collected.

Journal.—The financial condition of the Society at the end of last year compelled the Council to effect some radical changes in the management and size of the Journal. To their regret these changes resulted in the loss of the Editor and of one of the Sub-editors; the regret of the Council was expressed in the following Resolution which they believe the Society will endorse.

"The Council feel that they cannot accept Prof. Bell's resignation of the position of Editor of the Journal of the Society without expressing their deep regret that he has felt such resignation to be necessary, and their cordial sincere thanks to him for the skill and care he has so long given to the discharge of his duties, to which the present high standing of the Journal is in great measure attributable."

The expenses of the Journal are still very considerable in proportion to the total income of the Society, and the Council feel that they cannot for long expect Mr. Bennett, Dr. Hebb, and Mr. Thomson to abide by the self-denying ordinances which they have accepted. In other words, the roll of the Fellows must be increased in numbers.

INVESTMENTS.

The satisfactory appearance of the yearly balance sheet will, on inspection, be found to be due to a sale of Indian Stock, by which 416*l.* 10*s.* 4*d.* was brought into the income account. By dint of severe economy the Council hope to be able shortly to reinvest part of the income of the Society.

INSTRUMENTS AND APPARATUS.

Owing to the generosity of Messrs. Baker, Beck, Ross, and Swift, the Society's working Microscopes have been thoroughly overhauled and put into repair free of cost.

The firm of Mr. Chas. Baker, besides putting in working order a large binocular and a monocular of their make, were good enough to see to a small Crouch, a monocular and a binocular (makers' names unknown), and to repair the Abbe condenser made by them for the small Ross binocular.

Messrs. Beck, besides putting in working order two binoculars, a "Star" Microscope, and apparatus, have fitted a substage condenser, with iris diaphragm and stops, to their small binocular, thus making the instrument much more efficient and useful.

Messrs. Ross have put in order two binoculars, and about twenty pieces of apparatus.

Messrs. Swift and Son put in working order a monocular and two binoculars of their manufacture, with eye-pieces and three substage condensers, and fitted a new diagonal rack-and-pinion coarse adjustment to one of the binoculars.

CABINET.

The cabinet of slides has during the past two years been examined by the Treasurer, needful repairs effected, and the slides arranged and numbered.

The first 4000 slides, representing the original collection of the Society, exclusive of the diatoms and the Tucker, Farrants, and Wallich donations, are now registered, and a sufficient index prepared to render them available for reference.

The diatoms are being examined by Mr. T. Comber; many will probably be rejected as being useless, owing to decay and various accidents.

Belonging to the old collection is the cabinet of about 1700 slides presented by the executors of the late Admiral B. W. Tucker, of Trematon Castle, Saltash, Cornwall. They consist largely of bone and tooth sections, and will supplement the valuable collection presented some years ago by the late Joseph Beck.

The collection of about 900 slides presented by Mrs. Farrants are chiefly the work of the late Robert Farrants, and as might be expected from one so skilled in manipulation, are fine examples of the preparations made some thirty or forty years ago.

The cabinet of Dr. Wallich has not yet been thoroughly examined. It contains over 900 slides representing much of the donor's work in India, during voyages, and elsewhere. These slides are one of the most valuable portions of the Society's collection.

The new series commences with over 400 slides of radulæ of Mollusca, presented by Mr. Charles Rousselet. This is a valuable collection, and with nearly 100 slides already in the Society's possession, makes this subject well represented.

Other large groups are the Marine Algæ by Mrs. Clarke of Whitby, about 200 Polyzoa by Miss Jelly, and the collection of Oribatidæ, illustrating his monograph, presented by Mr. Michael.

LIBRARY.

Mr. F. A. Parsons was early in 1897 appointed Assistant-Secretary.

Mr. J. J. Vezey, in the absence of Mr. W. T. Suffolk, read the Treasurer's Report and Audited Balance Sheet for the year 1897 (see opposite page).

Mr. Vezey said that, in the absence of the Treasurer, it would not be expected that he should say much as to the accounts now presented, but he should like to explain that the total sum received under the head of subscriptions was nearly double the amount for the same item in the previous year. This was owing to the collection of a large number of arrears; a great effort had been made during the past year to get these in, and the result was that about 340*l.* had been received under this head. Another very satisfactory feature he should like to point out, was that for the first time within his memory the whole of the liabilities of the Society had been met and included in the year's accounts, and indeed there was not a single item owing at the end of the year. It must not be forgotten, however, that the result had only been arrived at by selling out some of the Society's investments, and it was earnestly hoped that these would be restored before long. Mr. Vezey desired to impress on Fellows the necessity of increasing their numbers if the Society was to go on satisfactorily in the future.

Mr. J. M. Allen moved that the Report of the Council, and the Statement and Balance Sheet presented by the Treasurer, be received and adopted, and that they be printed and circulated in the usual way. He felt sure those present would regard these reports as satisfactory, and would feel that they were greatly indebted to the Treasurer for the result of his special efforts during the year.

Mr. C. L. Curties having seconded the motion, it was put to the meeting by the President and carried unanimously.

The President said their next business would be the election of Officers and Council for the ensuing year. Ballot papers containing the

THE TREASURER'S ACCOUNT FOR 1897.

Dr.

1897.		£ s. d.
To Balance from 1896		104 0 5
,, Admission Fees		56 2 0
,, Annual Subscriptions—		
1890	£1 11 6	
1891	1 11 6	
1892	1 11 6	
1893	2 2 0	
1894	18 7 6	
1895	76 2 3	
1896	241 1 6	
1897	638 17 11	
1898	26 15 6	
1899	3 2 6	
		1011 3 8
,, Compounding Fee		31 10 0
,, Interest on Investments		36 12 9
,, Proceeds of Sale of 3% India Stock 380*l.* 17*s.* 3*d.*		416 10 4
,, Sale of Journal up to December 1896		368 4 9
,, Advertisements		50 17 5
,, Catalogues sold		0 6 9
,, Reprints sold		5 5 0
,, Periodicals sold		0 15 0
,, Donation		2 2 0
,, Screw Tools sold		12 11 0
,, Sundries		1 8 0
		£2097 9 1

Cr.

1897.		£ s. d.
By Rent, Coals, Attendance, &c.		166 6 0
,, Salaries, Reporting, Commission, &c.		158 16 5
,, Books and Binding, 1896 and 1897		148 8 3
,, Expenses of Journal—		
Arrears of 1896.		
Printing	£542 4 4	
Illustrations	67 14 4	
Editors	115 5 0	
		725 3 8
1897.		
Printing	£380 0 2	
Illustrations	32 8 6	
Editors	204 9 3	
		616 17 11
,, Refreshments		13 10 0
,, Stationery, &c.		22 15 10
,, Fire Insurance		3 10 0
,, Petty Cash		27 15 9
,, Solicitor's Commission, &c.		4 10 0
,, Cost of Screw Tools		35 11 1
,, Gas and Operator for Lantern		1 1 0
,, Engrossing Jubilee Address		2 2 0
,, Repairs		1 15 8
,, Balance to 1898		169 5 6
		£2097 9 1

Investments, 31*st December*, 1897.

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.

W. T. Suffolk, *Treasurer.*

We have examined the foregoing Account, and compared the same with the Vouchers in the possession of the Society, and verified its Securities as above mentioned, and find the same correct.

Edward Dadswell }
J. Mason Allen } *Auditors.*

names of the Fellows nominated at the last meeting of the Society were distributed in the room. He would ask Messrs. J. M. Allen and C. L. Curties to act as Scrutineers on that occasion.

The President then read his Annual Address, in which he epitomised the history and work of the Society during the past year, concluding with an explanation of the practical construction of achromatic doublets and triplets, the formulæ for which he illustrated by diagrams drawn upon the board. (The address will be printed *in extenso.*)

Mr. A. D. Michael felt sure that everyone present would wish to join in returning a very hearty vote of thanks to Mr. Nelson for the address to which they had just had the pleasure of listening. With regard to the latter portion of the address it was perhaps hardly possible at the moment to fully appreciate its value, because of the difficulty felt by most persons in grasping lines of figures as they were read out, but there could be no doubt that when they had the matter before them in print, and it was possible to read it in full, they would find it to be a most valuable and instructive communication. That a portion of it should have to be passed over at the time was not at all an unusual occurrence, as many of the most valuable papers brought before the various learned societies were frequently taken as read for similar reasons; but he believed he was right in saying that when this address was printed *in extenso* it would be a most valuable addition to their Journal, and would be of great assistance to all who desired to construct lenses upon correct principles. He had great pleasure in moving that the best thanks of the Society be given to the President for the address which he had delivered to them that evening.

Mr. G. C. Karop said it was his privilege to second this vote of thanks; there could be no doubt that this address would be of inestimable value to many of those who were interested in the problems of optical construction.

Mr. Michael said that as this motion was obviously one which could not be put from the chair, he had great pleasure in putting it, "That this meeting returns its hearty thanks to the President for the address which they have just heard.

Carried by acclamation.

The President said that he must thank Mr. Michael for proposing, Mr. Karop for seconding, and the Fellows present for the very kind way in which they had received his address, and for the vote of thanks they had passed. It was always a pleasure to him to do what he could in the interest of the Royal Microscopical Society.

The President announced that the Scrutineers had handed in their report, from which it appeared that all those gentlemen whose names were printed on the list had been duly elected. For his own part he could only again thank them for their renewed confidence, as shown by his election for a further term of office as President of the Society.

The following is the list of Officers and Council elected :—

President—Edward Milles Nelson, Esq.

Vice-Presidents—Robert Braithwaite, Esq., M.D., M.R.C.S., F.L.S.; A. D. Michael, Esq., F.L.S.; *The Hon. Sir Ford North; J. J. Vezey, Esq.

Treasurer—William Thomas Suffolk, Esq.

Secretaries—Rev. W. H. Dallinger, LL.D., F.R.S; *R. G. Hebb, Esq., M.A., M.D., F.R.C.P.

Twelve other Members of Council—C. Edmund Aikin, Esq., B.A., M.R.C.S.; Conrad Beck, Esq.; *Prof. F. Jeffrey Bell, M.A.; Alfred W. Bennett, Esq., M.A., B.Sc., F.L.S.; *Rev. Edmund Carr, M.A., F.R.Met.S.: *T. Comber, Esq., F.L.S.; Edward Dadswell, Esq.; George C. Karop, Esq., M.R.C.S.; Thomas H. Powell, Esq.; Charles F. Rousselet, Esq.; *John Tatham, Esq., M.A., M.D., M.R.C.P.; *Rev. A. G. Warner.

Curator—Charles F. Rousselet, Esq.

Mr. J. J. Vezey said that a resolution had been entrusted to him to move, and he accepted the duty with very great pleasure; it was "That a hearty vote of thanks be given to the Treasurer and Honorary Secretaries of the Society for their services during the past year. The Treasurer had during the year been doing, as they had already heard, invaluable service in the rearrangement of the Cabinet, as well as attending to his other duties. Reference had already been made to the work of one of the Secretaries, and he was sure the Fellows of the Society would wish to accentuate what had fallen from the President with regard to Prof. Bell. He had been rarely absent from his post, and had managed the Society's meetings with great ability. With regard to Dr. Dallinger, it was universally regretted that his health has not permitted him to attend all the meetings during the past year, but it was satisfactory to know that his absence was not due to any want of interest in the Society, and he was sure the Fellows would agree with him that it was an honour to the Society that so distinguished a man as Dr. Dallinger should remain one of its Honorary Secretaries.

Mr. Ersser having seconded the motion, it was put to the meeting by the President, and carried unanimously.

Prof. Bell said that, as on former occasions, the retiring nature of his colleagues again rendered it necessary for him to return thanks for them. In doing so he should like to add his testimony to the extraordinary amount of time which the Treasurer had given not only to his own special duties, but also to the cabinet of the Society upstairs, and he should like to echo the words of Mr. Vezey with reference to Dr. Dallinger—it *was* a great honour to have him as a Secretary to the Society. References had been made very kindly to himself; it was Dr. Johnson who had said that no man ever did anything consciously for the last time without a feeling of regret; but when a man had been going on with the same thing for fifteen years, he thought this feeling might be altered, and some sense rather of relief might be associated with it. Fifteen years was a long time to look back upon, and as he had inflicted himself upon them so

* Those with an asterisk (*) have not held during the preceding year the office for which they are elected.

often during that period, he would refrain from doing so further on that occasion, except again to thank them.

Mr. T. Comber said that another vote of thanks had been placed in his hands, and this was to the Auditors and Scrutineers. The Scrutineers had no doubt performed a duty which was responsible, if not altogether arduous; but the duties of the Auditors must have been both responsible and arduous. He had great pleasure in moving that the best thanks of the Society be given to the Auditors and Scrutineers for their services.

This motion having been seconded by Mr. Beck, was put to the meeting from the chair and unanimously carried.

New Fellows.—The following gentlemen were elected *Ordinary* Fellows of the Society:—Mr. Philip E. B. Jourdain and Mr. Edward Larmer.

JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.
APRIL 1898.

TRANSACTIONS OF THE SOCIETY.

II.—*The President's Address.*

By Edward M. Nelson.

(*Read January 19th*, 1898.)

My first and pleasing duty at the close of my year of office as your President is to publicly thank the Officers and Council for their loyal support, and to acknowledge the unremitting and cordial assistance I have received from every one of them throughout the year.

The work of the Council during the past session has been considerably greater than that of any preceding session within my remembrance, and probably greater than that of any previous session since the foundation of the Society; and this quite apart from any consideration of the work of the various sub-committees appointed for special duties.

In this connection I ask the Society to signify its high appreciation of the valuable services which have been, and still are being, rendered to it by Mr. J. J. Vezey. Although an exceedingly busy man, he has found time to work here day after day and often late at night in the interests of the Society. Only those who are familiar with the inner life of the Society are in a position to adequately appreciate the value of his labours; but I can assure you that without fee or reward Mr. Vezey has placed his rare tact, sound judgment, and thorough knowledge of business, as well as much of his valuable time, freely at the disposal of this Society.

The subject of Finance has received the serious consideration of the Council during the past year, and a Sub-Committee has been appointed to assist the Treasurer in rearranging the accounts. I am glad to be able to state that the result of their labours has been the introduction of some useful reforms. The list of Fellows has been thoroughly revised, the names of a large number whose whereabouts had not been known for some years have been removed; and although by this process of revision the roll of Fellows seems to have been considerably reduced, yet the names which are still retained are such as may be relied on to fulfil their duties to the Society.

It is with great satisfaction that I call your attention to the fact that in the cash statement for this year all the known liabilities have been met; and, so far as I know, it is the first time for many years that the Treasurer has been able to state that there is not a single unpaid account owing by the Society. This result has been reached by painful effort; investments have] been sold and expenses cut down in all directions, but I believe that the Society is now on a more satisfactory basis than has been the case for a long time past.

It has been one of the chief aims of your Council during the past year to promote a real and lively interest in Microscopy at the several meetings of the Society. The marked improvement in the attendance of Fellows at the monthly meetings would seem to show that the endeavours of your Council have not been wholly in vain.

Conjointly with the increased attendance at the meetings there has been an increase in the number of new Fellows elected during the past year; but I wish nevertheless to urge on you that it is of the utmost importance that all should do what they can to swell the roll of Fellows, as the very existence of the Royal Microscopical Society depends upon it.

All Microscopists, whether Fellows of this Society or not, will be glad to hear that the gauge of the "Society's Screw" has been perfected and placed on a satisfactory and permanent basis. For the future, therefore, in the manufacture of screw tools it will be impossible to vary the gauge except between very small limits, and all accumulation of errors will be entirely prevented.

The thanks of the Society are specially due to Mr. Conrad Beck for the trouble he has taken in this matter.

I have to thank those Fellows who, in answer to my request of last year, have written expressing their views to me with regard to the future management of our Journal. The Journal has been a source of grave anxiety to the Council; indeed it would have been financially impossible to continue the abstract index of Zoological and Botanical literature had not Mr. Bennett, Prof. Thomson, and Dr. Hebb generously come to the assistance of the Council. Even under the present more favourable circumstances, you will observe, if you will examine the balance sheet, that not only is the abstract index above referred to the largest item in our expenditure, but that it absorbs almost the whole of our income. It is, however, right to point out that much of the amount charged for printing in this year's account ought really to have been included in the accounts for last year. Through the kindness of the gentlemen whom I have named, the annual cost of the Journal has been considerably reduced, but the Council will still have to consider in the immediate future how far they are justified in expending so much of the Society's income on the one item of the Journal. It is not an easy question to determine what proportion of each number shall be devoted to Zoology and Botany, so that sufficient room shall be left for dealing adequately with Microscopy proper, which subject is, after all, the *raison d'être* of this Society. While we are anxious to provide Fellows residing outside London with a Journal which shall keep them *au courant* with what is going on in our special subject, we must remember that this Society was founded, and that it still exists, for other purposes beside those of Journal publication.

We have serious responsibilities to discharge with regard to our Cabinet of Objects, to our Cabinet of Instruments, and to our Library. With the exception of a small sum for the repair of our Slide Cabinet, nothing has been expended on it for years, and our collection would now be in a deplorable condition had not Mr. W. T. Suffolk kindly come to our assistance with his time and special knowledge of slide mounting. You have already been informed of the manuscript catalogue of 4000 objects which Mr. Suffolk has written and generously presented to the Society; this represents but a small portion of his work. I am sure the Fellows will appreciate his untiring efforts for the preservation and rearrangement of our collection of Microscopic Objects.

On our Cabinet of Instruments the Society has spent scarcely anything for many years past. At the present time this valuable and representative collection of Microscopes is, as you are aware, in a very unsatisfactory condition. During the past year an effort has been made to rearrange the entire collection, and for the better preservation of this valuable portion of the Society's property your Council have appointed a Curator. Mr. Rousselet, whose practical methods and knowledge in regard to Microscopy are known to many of you, has kindly accepted the post. The Council feel sure that under his able management this important department will not be neglected in future. During the past session the more modern instruments have been repaired and put in order by their respective makers free of charge. I am sure that the Society will accord to Messrs. Baker, Beck, Ross, and Swift their hearty thanks for their generous action in this matter.

Our Library cannot be said to be in a satisfactory state while so many books and publications of purely Microscopical interest still remain unbound. Your Council have had this matter under their consideration, but have not felt justified in authorising any expenditure upon the Library during the past year.

As several Fellows have both written and spoken to me with regard to the commercial value of the advertising space in our Journal, I may say that the Council have been dealing very carefully with this subject, and a new arrangement has been entered into which it is hoped will bring a larger income to the Society under this head.

Before leaving this part of my address let me point out that the number of papers read last year was only eight, while the average number appearing in the last ten volumes of the Monthly Microscopical Journal had been 28 per annum. I am aware that as the sciences of Botany, Zoology, Geology, &c., progress, there arises an increasing tendency to what is known as specialisation. And thus it comes to pass that many original biological investigations, which not very long ago would have been discussed before our Society and recorded in our columns, now find their way to the Proceedings of other Societies which division of labour has called into existence in recent years, and this notwithstanding the fact that the true solution of the problems involved frequently depends on critical examinations with the widest apertures and the most perfect appliances of modern Microscopy. If this Society is to live a vigorous life an improvement must take place in this respect; let me therefore urge that those Fellows who are doing original microscopic work will contribute at least some of their papers to this Society.

Finally, the thanks of the Society are due to our Assistant-Secretary Mr. Parsons, who assumed office at a period of exceptional difficulty, and who has fulfilled his duties entirely to the satisfaction of your Council. This concludes what may be called the official part of my address, which relates to the work of the Council as well as to the management and control of the Society; but before beginning the second part let me say a few words on the changes that have taken place among our staff of officers in the course of the year just closed. Prof. Bell, who has been an abstractor for the Journal for the last eighteen years, one of our Secretaries for fifteen, and our Editor for seven years, has now resigned these posts. During these years the zoological abstract has been conducted with such marked ability as to have elicited commendation, not only in this country, but abroad. The Society has already becomingly expressed its thanks to him for his valuable services in these several capacities during such an extended period, and I feel sure the Fellows will most willingly accord their tribute of appreciation of the work he has done.

Considerable activity has been displayed in the department of Microscopy during the past year. First, with regard to the theory of the Microscope, there has been another contribution to the literature of the "Abbe theory," by the President of the American Microscopical Society, Dr. A. Clifford Mercer, who is a Fellow of this Society, and well known to many of us. The pamphlet, which consists of 76 pages, 35 photos, and several woodcuts, is entitled 'An Experimental Study of Aperture as a factor in Microscopic Vision.' In it the author combats the Abbe idea of microscopic vision being a thing *sui generis*, and regards the laws of undulatory light, as already enunciated for the telescope and photographic camera, as applicable to the Microscope; he utterly condemns the narrow cone and oblique light, and considers the 3/4 axial cone as the most suitable method for Microscope illumination, and bases his resolving limit accordingly. Some important experiments are described which demonstrate the correctness of Lord Rayleigh's limit of resolution for circular apertures as contrasted with that calculated by Sir George Airy. With regard to the Abbe theory, Dr. Mercer says, "Resolution in the Abbe theory may be said to increase by jumps. So long as the central image of the source of light alone is to be seen at the back of the objective resolution is not present. The aperture may be increased without change in the contraction of the diffraction pattern, and in accompanying resolution, so long as the central image alone is to be seen at the back of the objective. But the moment the increase in aperture is sufficient to uncover, or admit, one flanking spectrum image resolution is present. With greater increase in aperture no improvement in the picture as to the contraction of the diffraction pattern, and as to accompanying resolution, is to be seen until another spectrum image is uncovered or admitted. On the other hand, with full cone illumination, resolution increases continuously, and not by jumps or by periodic accessions." With regard to the use of oblique light the author says, "Photos 2, 3, and 4 are a pictorial warning for a second time, now a warning against the use of oblique illumination in ordinary work as a means of increasing, or of attempting to exhaust, the resolving power of the Microscope. At the same time it becomes evident that every substage should be provided with a means by which its condenser may be accurately centered, and that every student using the Microscope should be familiar with a method of centering his substage condenser. These general rules should be accompanied by another: the substage condenser should be as well made as the best objective, and should be used with an ever present appreciation of its power to improve or injure the picture of microscopic vision."

It is plain, therefore, that American Microscopy as enunciated by the President of its most influential Society has rebelled against the Abbe theory. Let me recommend all interested in this subject to read this important paper.

Apparatus.—There is a dissecting Microscope stand with a very well arranged polariscope described in the Journal;* it is an instrument that will commend itself especially to petrologists. At the March meeting, Prof. Wright exhibited his adaptation of a ghost micrometer for the purpose of counting blood-corpuscles; † this admirable plan will no doubt greatly assist those who have this kind of computations to make. The ghost micrometer for linear measurements was the invention of Dr. Goring; ‡ it has however been reinvented several times,§ but this adaptation of Prof. Wright's is original. We next have a new mechanical stage with an extended transverse movement.‖

And then there are six kinds of photomicrographic apparatus, of which two are simple, one for daylight, one for lamp, one for electric, and one for limelight illumination.

Passing over the simpler forms of apparatus which do not call for any special notice, we come to Mr. J. E. Barnard's for electric illumi-

* Journal R.M.S., 1897, p. 163. † Tom. cit., p. 245.
‡ 'Micrographia' (Pritchard and Goring), 1837, p. 51.
§ M.M.J., ix. (1873) p. 2. ‖ Journal R.M.S., 1897, p. 185.

nation.* This has an arc lamp fitted with mechanism for hand control of the carbons; there is also a subsidiary image of the carbons cast on a side screen for the purpose of assisting regulation; by these means a perfectly steady light can be maintained. The drawback in the use of the arc light for photomicrography seems to be that unless a bull's eye is employed it is hardly possible to cover any ordinary object, because the image of the incandescent crater as minified by the substage condenser presents such an exceedingly small surface.

Mr. E. B. Stringer's photomicrographic camera † is very elaborate, being fitted with a powerful condensing apparatus, each portion of which is capable of being independently centred. The specially interesting feature in this instrument is the control of the gas and the beautiful and uniformly illuminated disc of zircon, which is about 1/4 in. in diameter.

Next we have a binocular dissecting Microscope by Zeiss ‡ fitted with two objectives; the eye-pieces having Porro erectors by which an ortho-stereoscopic image is obtained. This apparatus is only suitable for low powers, but yields very beautiful effects.

Finally, two ancient Microscopes have been presented to the Society. The first being a second contribution to our cabinet by Mr. James More, jun., of a Microscope of the Culpeper type; § this, which is fitted with a rackwork adjustment, was probably made by Jones (*post* 1797). The other, the gift of Mr. George T. Harris, is an older example of the same pattern; ‖ in this the octagonal box foot is retained, the legs are slightly scrolled, and the body is covered with shagreen; its date may be put back to *circa* 1750.

Those about to name new diatoms should, before doing so, read Mr. T. Comber's excellent paper ¶ on 'The Limits of Species in the Diatomaceæ.'

Two interesting old Microscopes have been lent for exhibition. One formerly belonged to Sir D. Brewster,** with which he worked until the year 1838. This contained the garnet lens which was constructed for the purpose of reducing the spherical aberration, but which in reality introduced greater errors than it was intended to remove.

The second old instrument was a Powell and Lealand,†† which was important, inasmuch as it possessed a transitional form of fine adjustment.

With regard to Microscope objectives, while apochromatism remains for the most part where it was, considerable progress has taken place during the past few years in the improvement of semi-apochromats. The colours of the uncorrected dispersed rays have become less violent,

* Journal R.M.S., 1897, p. 600. An extended account of this is in press.
† An account of this is in press.
‡ Journal R.M.S., 1897, p. 602. § Tom. cit., p. 181, and 1898, p. 126, fig. 4.
‖ Op. cit., 1898, p. 126, fig. 3. ¶ Op. cit., 1897, p. 455.
** Made by Dollond, Journal R.M.S., 1898, p. 123, fig. 1.
†† Journal R.M.S., 1898, p. 125, fig. 2.

and the apertures have been correspondingly increased. This is a promising field, but for the future we must look to the chemist and glass manufacturer, rather than to the optician, for further improvement. Durable glass possessing more favourable optical qualities than any as yet catalogued is required for the production of better lenses.

The semi-apochromatic oil 1/12 has had its aperture enlarged, so that its Optical Index is now 10·8 against 10·4. Messrs. Leitz have made lately a fine oil 1/10 for the long tube with an O.I. of 13·0. Their No. 5 (formerly known as P 7) which is a 1/4 with an O.I. of 18·6, is a remarkably fine lens. Unfortunately it requires a tube only 4½ or 5 inches long to obtain correction on a common balsam-mounted object with a thickish cover-glass.

It is high time to speak out against this modern craze for objectives corrected for very short tubes, such as 100–120 mm. I suppose the supply is equal to the demand, and if the truth were known, the demand is occasioned by purchasers who have not the very slightest idea when their objectives are in or out of correction, and who regard and use a Microscope merely as if it were an enlarged magnifying glass. Probably the best results are to be obtained when objectives are corrected for a 10-in. optical tube, which is equivalent to about 8¾-in. (222 mm.) mechanical tube.

Coming to more recent times, Messrs. Swift have issued a series of semi-apochromats of very fine quality. It is neither the rule nor the custom here to enter into the question of the cost of apparatus, but the exceptional fall, which every one must have observed, in the price of Microscope objectives of high quality, possessing large optical indices, has been so remarkable that it cannot be passed over. For example, the above-mentioned oil-immersion 1/10 is about the same price as a first class 2/3 in. was when I took up Microscopy in 1866. Messrs. Swift, who were the pioneers in this country of cheap objectives which had optical indices worth speaking of, have issued their latest series at prices quite on a par with those which obtain on the Continent. Nor is this reduction of price confined to semi-apochromats, for both Messrs. Powell and Swift make fluorite apochromats at prices which I believe opticians on the Continent have not yet reached.

Semi-apochromatic condensers also have been greatly improved; both Messrs. Beck and Watson make excellent condensers at a price hitherto unheard of. With regard to condensers, it must be borne in mind that the finest condenser can be reduced to the level of a most inferior one unless the slip, the object under examination is mounted upon, be of a certain thickness. There has been a fashion among mounters for a long time past of putting up selected and test specimens on "extra thin" slips. This was done in order to facilitate the employment of a very oblique beam of illumination in one or more azimuths. The fallacy underlying this kind of illumination has been pointed out *ad nauseam*.

Therefore the *raison d'être* for the "extra thin" slip has gone, but the mischief that it does with the wide-angled cone of axial illumination remains, which is, that it prevents an aplanatic wide-angled cone being obtained. I have always been of opinion that there should be a gauge for the thickness of slips as well as for their size. One-fifteenth of an inch is a very common size for ordinary slips, and would make an excellent standard. The "extra thins" are about half that amount, and must be regarded as quite useless; for if an object, such as a diatom, which possessed interesting fine secondary structure, were mounted on such a slip, the probability is that the secondary structure would for ever remain invisible.

On the Construction of Achromatic Doublets and Triples.

The above is the title of my own paper, which I am about to present for your kind acceptance to-night. As you have already been listening to me long enough, you will be glad to hear that a large part of the paper is mathematical, and consequently unreadable; therefore I propose merely to go over a few points dealt with in the paper, and leave the mathematics for the Journal. The subject is a large one, far too large for any single address, consequently only a portion of the ground can be traversed; the portion chosen for to-night may with propriety be called the middle portion; for dispersion, which necessarily is the beginning of the matter, will be dismissed in a few words, and the end of the subject will not be reached by a long way.

By the term "achromatic lens" a lens is meant that is capable of bringing two separated portions of the spectrum to the same focus, while an apochromatic lens brings three separated portions to the same focus. To-night, however, we shall deal with the achromatic lens.

If we take any equiconvex lens, we shall find that it possesses an amount of a certain kind of chromatism, and that this amount of chromatism depends on the focal length of the lens, its diameter, and the substance of which it is composed. Now, if we take an equiconcave lens made of similar substance and of the same diameter and focal length, we shall find that it possesses an opposite kind of chromatism, but of the same amount as that in the first lens. If, therefore, we place these two lenses together, we shall have an achromatic doublet of the simplest construction, the chromatism of the one lens being destroyed by an equal amount of an opposite kind of chromatism in the other. The achromatism of this doublet will be of a very perfect kind, because all the portions of the spectrum are united at the focus. But the combination is of no practical value, owing to the great length of its focus, which is infinite, because the whole of the convergence obtained with the convex lens has been exactly neutralised by the diverging power of the concave.

Now, if we can obtain a different substance for the concave that will yield a greater quantity of opposite chromatism for a given focus, then we need not make its focus so short. In other words, a concave of a longer focus will supply the requisite quantity of opposite chromatism to neutralise the chromatism in the convex.

A useful achromatic combination can therefore be constructed by uniting a short focus converging lens made of a less dispersive substance with a long focus diverging lens made of a higher dispersive substance. The object, therefore, of this paper is to show how useful achromatic combinations of any given focal length can be made.

In the first place, we must have two glasses possessing different optical qualities, called dispersive powers. In order to determine the dispersive power of any glass, we must know the refractive indices of that glass for three different portions of the spectrum. For our purposes, the three portions indicated by the three Frauenhofer lines C, D, and F will suit. C and F are called the extremes and D the mean. When these data are known the dispersive power can be found by dividing the difference of the refractive indices of the extremes by that of the mean, less one. This is written $\frac{\mu_F - \mu_C}{\mu_D - 1}$; its reciprocal or $\frac{\mu_D - 1}{\mu_F - \mu_C}$ is known by the symbol ν.

Method I.—Let ν be the reciprocal of the dispersive power of the less dispersive medium, and ν' that of the higher dispersive medium. (In the Jena glass catalogue the values of ν are printed in heavy type.) Then ν' is the focus of the positive lens, and ν that of the negative lens; these when combined will make an achromatic doublet.

(It will be noted that the ν of the crown glass denotes the focus of the flint lens, and *vice versâ*; in other words, they are crossed over.)

Example I.*—Taking the glasses in the Jena catalogue marked No. 23 and 39, we find $\nu' = 32 \cdot 0$ = the focus of the positive lens, and $\nu = -51 \cdot 2$ = the focus of the negative lens. We have now to find F the focus of this combination; it will be

$$\frac{\nu' \nu}{\nu' + \nu} = \frac{32 \cdot 0 \times -51 \cdot 2}{32 \cdot 0 - 51 \cdot 2} = \frac{-1638 \cdot 4}{-19 \cdot 2} = 85 \cdot 33.$$

It will be of material assistance if we reduce this to a combination whose focus $= 1 \cdot 0$; we must therefore divide the foci of the lenses forming the combination by the focus of the combination.

Thus:

$$f = \frac{32 \cdot 0}{85 \cdot 33} = \cdot 375; \; f' = \frac{-51 \cdot 2}{85 \cdot 33} = - \cdot 600; \text{ and } F = 1 \cdot 0.$$

* A Fellow of the Royal Astronomical Society (also a Fellow of this Society) who, by publishing for so many years a fortnightly article in the 'English Mechanic,' has done so much to enkindle the scientific spirit in this country, has expressed a strong opinion that all formulæ should be accompanied by examples worked out. This recommendation of his will be adopted throughout this paper.

As these two division sums can be performed by slide rule, and the combined focus 85·33 found by Mr. Tamblyn-Watts' calculator,* the above is a simple as well as rapid method, as the values can be found by inspection without having recourse to any arithmetical process whatever.

Method II., which is the simpler for arithmetical calculation. We have the following well known two equations for finding the values of f and f', viz.

$$\frac{1}{f} + \frac{1}{f'} = \frac{1}{F}; \qquad \frac{1}{\nu f} + \frac{1}{\nu' f'} = 0.$$

Putting $F = 1 \cdot 0$ and combining, we have

$$f = 1 - \frac{\nu'}{\nu}; \qquad f' = 1 - \frac{\nu}{\nu'}.$$

Let $n\dagger = \frac{\nu'}{\nu}$; and n' = its reciprocal ‡ or $\frac{\nu}{\nu'}$; then $f = 1 - n$; $f' = 1 - n'$; and $F = 1 \cdot 0$.

Example 2.—Using the same glasses as before, we have $\nu = 51 \cdot 2$, and $\nu' = 32 \cdot 0$; then $n = \frac{32 \cdot 0}{51 \cdot 2} = \cdot 625$.

The reciprocal of $\cdot 625 = 1 \cdot 600 = n' = \frac{51 \cdot 2}{32 \cdot 0}$;

Then $f = 1 - \cdot 625 = \cdot 375$; and $f' = 1 - 1 \cdot 600 = - \cdot 600$; $F = 1 \cdot 0$, which is the same result as obtained above.

We now have to find the radii; but as they will depend on the form of lens we wish to construct, it will be better to give a general formula that will be suitable for every case. First, however, we must agree to the convention employed with regard to the signs of the radii. The radii of all surfaces which are convex towards the left hand will be considered positive, and of all those which are concave towards the left hand negative. Example, the radius of the first surface of a biconvex lens will be positive, and of its second surface

* Journal R.M.S., 1897, p. 1.

† In 1827 Sir J. Herschel wrote his work on Optics (published in Ency. Metrop., art. 'Light'), and in 1829 Henry Coddington's celebrated book appeared. These two books are still regarded as standard works, and have never been surpassed. Both these eminent mathematicians use a convention of signs which makes the focus of a converging lens positive and that of a diverging one negative, and the symbol ω to denote the dispersive *ratio*. W. N. Griffen wrote a treatise on Optics (2nd ed., 1842) in which he reversed this convention, by making the focus of a converging lens negative, &c., and ω to denote the dispersive *power*. (The Gauss method is given in this book.) In Parkinson's 'Optics,' which is a reprint of Griffen's work omitting Gauss' method, this altered convention is maintained. It surely is a great pity to introduce such confusion of signs and symbols without obtaining any commensurate advantage. In this paper the refractive index will be denoted by μ, the term commonly adopted by English authors; but owing to the above mentioned confusion with regard to the dispersive *ratio*, n will be used for it.

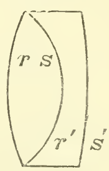
‡ The reciprocals of all numbers from 1 to 10,000 are given in Barlow's Tables (Spon, price 4*s*. 6*d*.), a most useful book for opticians.

negative; similarly, the radius of the first surface of a biconcave is negative, while that of its second surface is positive. A meniscus, whether converging or diverging, when it is turned so that its surfaces are convex towards the left hand, will have both its radii positive; but when it is turned the opposite way they will both be negative. All distances measured from left to right are positive, in the contrary direction negative.*

The type of lens that we shall select for our general formula will be a biconvex doublet, having its contact curves of the same radii.

Case 1.—Let r, s be the radii of the positive lens, and r', s' those of the negative lens (fig. 14). Then $r' = s$.

Fig. 14.



Let μ be the refractive index of the glass of which the positive lens is composed, and μ' that of the negative lens.

Let W be the ratio of the radii of the exterior surfaces r and s'; then $W = \frac{-s'}{r}$; let f be the focus of the positive, and f' that of the negative lens.

Let $a = (\mu - 1)f$, and $b = (\mu' - 1)f'$.

Then

$$s = \frac{(W+1)ab}{Wa - b} = r'; \quad r = \frac{as}{a+s}, \quad s' = \frac{bs}{b-s} \quad \text{or} \quad s' = -Wr.$$

Example 3.—It is required to construct an achromatic doublet (F = 1·0), using the same glass as above, which shall have the radius of the exterior surface of its negative lens twice that of the exterior surface of its positive lens; thus $-s' = 2r$; then W = 2.

Glass No. 23; $\mu = 1\cdot5368$; $f = \cdot375$ as above.

Glass No. 39; $\mu' = 1\cdot6734$; $f' = -\cdot600$ as above.

$$a = (\mu - 1)f = \cdot2013; \quad b = (\mu' - 1)f' = -\cdot4040;$$

$$s = \frac{(2+1)ab}{2a - b}. \qquad ab = -\cdot08133; \; 3ab = -\cdot244. \quad 2a = \cdot4026; \; 2a - b = \cdot8066.$$

$$s = \frac{-\cdot244}{\cdot8066} = -\cdot3025 = r'.$$

$$r = \frac{as}{a+s}. \qquad as = -\cdot06089; \; a + s = -\cdot1012.$$

$$r = \frac{-\cdot06089}{-\cdot1012} = \cdot6017.$$

$$s' = \frac{bs}{b-s}. \qquad bs = \cdot1222; \; b - s = -\cdot1015.$$

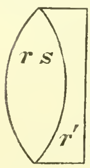
$$s' = \frac{\cdot1222}{-\cdot1015} = -1\cdot204 = -2r. \qquad F = 1\cdot0.$$

* These conventions are the same as those employed by Sir J. Herschel.

The lens has therefore been constructed, and it fulfils the required condition that its posterior surface has twice the radius of its anterior surface.*

If it was required that the doublet should be equiconvex, then $W = 1$, and $s = \dfrac{2\,a\,b}{a - b}$; the other radii being found as before, thus $r = \dfrac{a\,s}{a + s}$; and $s' = -r$; and $r' = s$; and similarly with any other ratios of r and s'.

Fig. 15.



We will now investigate the other cases which are included in our general formula.

Case 2.—Let the negative lens have a plane exterior surface (fig. 15). Then $s' = \infty$, and $W = \infty$.

Therefore $s = b$, and $r = \dfrac{a\,s}{a + s}$; $r' = s$; and $s' = \infty$.

Example 4.—We found above that $b = -\cdot 4040$; this then is the radius of the contact curve, s; r can be found by putting this value for s in the formula $\dfrac{a\,s}{a + s}$, a being $\cdot 2013$

$r = \dfrac{\cdot 2013 \times -\cdot 4040}{\cdot 2013 - \cdot 4040} = \cdot 4012$. All the radii are therefore determined, and it will be observed that the crown is practically an equiconvex. F, the focus of the combination, $= 1 \cdot 0$. The lens is therefore constructed.

Case 3.—Let the positive lens have a plane exterior surface (fig. 16). Then $r = \infty$ and $W = 0$. Therefore $s = -a$; and $s' = \dfrac{b\,s}{b - s}$; $r' = s$ as before.

Example 5.—We found above that $a = \cdot 2013$; the radius of the contact curve s is therefore $-\cdot 2013$; this is also the value of r'; $b = -\cdot 4040$; therefore $s' = \dfrac{-\cdot 4040 \times -\cdot 2013}{-\cdot 4040 + \cdot 2013} = -\cdot 4012$; $F = 1 \cdot 0$.

* When Barlow's Tables are at hand, the following is a simple method of finding the radii. Let c be the reciprocal of a, d that of b, and e that of s.

Then $\dfrac{1}{r} = c + e$, and $\dfrac{1}{s'} = e - d$.

Thus $c = 4 \cdot 968$, $d = -2 \cdot 475$, and $e = -3 \cdot 306$;

and $\dfrac{1}{r} = 1 \cdot 662$; $r = \cdot 6017$; $\dfrac{1}{s'} = -\cdot 831$; $s' = -1 \cdot 203$.

The reciprocal method has not been inserted in the text, because it is not so rapid for computing by means of a slide rule.

It may be as well to state here that Prof. Fuller's spiral slide rule, which reads to 4 significant figures, is very suitable for optical computations. If logarithms are employed, a capital 5-place table of numbers by Sang is published by Blackwood, price 6*d*. Chambers' new 'Mathematical Tables,' price 4*s*. 6*d*., which contains a 7-place logarithmic table of numbers, and natural and logarithmic canons of trigonometrical functions to 1′ of arc, is an excellent work.

The lens is therefore constructed. It will be seen that s' has the same numerical value as r, and s half the value of s, in the preceding example.

Case 4.—Let it be required to construct a triple consisting of two biconvex lenses enclosing an equiconcave (fig. 17).*

FIG. 16.

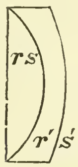


FIG. 17.

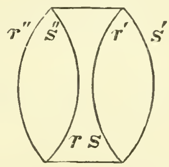
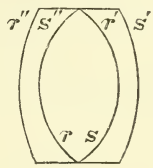


FIG. 18.



This is composed of two precisely similar doublets of the form in Case 2 (fig. 15), placed with their plane surfaces in contact. But as two doublets each of $F = 1 \cdot 0$ would make a combination whose $F = 1/2$ it is necessary in order to keep the focus of the triple $1 \cdot 0$ to multiply all the radii by 2.

Case 5.—To construct a Steinheil triple (fig. 18).

Here we have two doublets with their plane surfaces in contact, of the form in Case 3 (fig. 16).

The procedure in order to make the focus of the triple $1 \cdot 0$ is precisely similar to the preceding case, viz. to double all the radii.

Therefore with the above mentioned glasses a triple of the form in fig. 17 of $1 \cdot 0$ in. nominal focus can be constructed by making all the radii $\cdot 8$ in., and one of the form in fig. 18 by making the radii of the exterior surfaces $\cdot 8$ in., and those of the contact surfaces half as much, or $\cdot 4$ in.

Example 6.—It is required to construct a triple of the form in fig. 17 of Chance's Hard Crown and Dense Flint (Jena catalogue Nos. 8 and 36 respectively). Here we have for No. 8, $\mu = 1 \cdot 5179$ and $\nu = 60 \cdot 2$, and for No. 36, $\mu' = 1 \cdot 6202$, $\nu' = 36 \cdot 2$. $n = \dfrac{36 \cdot 2}{60 \cdot 2}$ $= \cdot 6013$; $n' =$ reciprocal $= \dfrac{1}{\cdot 6013} = 1 \cdot 663$; $f = 1 - \cdot 6013$ $= \cdot 3987$ and $f' = 1 - 1 \cdot 663 = - \cdot 663$. $a = \cdot 3987 \times \cdot 5179$ $= \cdot 2065$; $b = - \cdot 663 \times \cdot 6202 = - \cdot 4112$.

Let $r'' s''$, $r\, s$, $r'\, s'$ be the radii; then as in Case 2 we have $s'' = b$ $= - \cdot 4112$; and $r'' = \dfrac{a\, s''}{a + s''}$;

$$a\, s'' = - \cdot 8491; \quad a + s'' = - \cdot 2047; \quad r'' = \frac{- \cdot 8491}{- \cdot 2047} = \cdot 415.$$

* A solid eye-piece for a telescope formed by a lens of this construction was exhibited in London at the Great Exhibition, 1851, by Mr. Reade.

Doubling these radii, we have $r'' = \cdot 830$ and $s'' = -\cdot 822$.

Our lens is therefore constructed, and the values of the radii are as follows (fig. 17).

$$\begin{array}{lll} r'' = +\cdot 830 & r = -\cdot 822 & r' = +\cdot 822 \\ s'' = -\cdot 822 & s = +\cdot 822 & s' = -\cdot 830 \end{array} \qquad F = 1\cdot 0.$$

Example 7.—It is required to construct a Steinheil triple of the same glass. Let the radii be $r'' s''$, $r s$, $r' s'$ as in fig. 18. $a = \cdot 2065$ and $b = -\cdot 4112$ as above.

Then taking the posterior half of the triple we have, by Case 3 (fig. 16),

$$s = -a = -\cdot 2065; \quad \text{and } s' = \frac{b\,s}{b - s}; \quad b\,s = \cdot 8491;$$

$$b - s = -\cdot 2047; \quad s' = \frac{\cdot 8491}{-\cdot 2047} = -\cdot 415.$$

Doubling these radii we have $s = -\cdot 413$ and $s' = -\cdot 830$. The lens is therefore constructed, and the radii * are (fig. 18)

$$\begin{array}{lll} r'' = +\cdot 830 & r = +\cdot 413 & r' = -\cdot 413 \\ s'' = +\cdot 413 & s = -\cdot 413 & s' = -\cdot 830 \end{array} \qquad F = 1\cdot 0.$$

It is now necessary to point out that in all the above examples no account has been taken of the thickness of the lenses; therefore the foci of these achromatic combinations will be only approximately correct; therefore the quantity F, which in these cases is shorter than the true focus, may be termed the Nominal Focus of the combination. We will next investigate the method of ascertaining the True Focus of a combination; but first rules for determining the thickness of a lens must be given.

There are several methods by which the thickness of a lens may be determined. The first and most usual is to draw the lens out to scale and measure it; the second is easily performed by the help of Barlow's tables in which are given the squares and square roots of all numbers from 1 to 10,000. Let t be the thickness, d the diameter of a plano-convex lens, and r its radius, then $t = r - \sqrt{r^2 - \frac{d^2}{4}}$.

If the lens is biconvex it will be necessary to treat it as consisting

* The radii r'' in Example 6 and s' in Example 7 might easily be found with the assistance of a reciprocal table, as in the previous examples. Thus in Example 6 we have $c = \frac{1}{a} = 4\cdot 843$; $e = \frac{1}{s''} = -2\cdot 432$; then $\frac{1}{r''} = c + e = 2\cdot 411$; $r'' = \cdot 415$, as before.

For the Steinheil in Example 7 we have $d = \frac{1}{b} = -2\cdot 432$; $e = \frac{1}{s} = -4\cdot 843$; then $\frac{1}{s'} = e - d = -2\cdot 411$; $s' = -\cdot 415$.

of two plano-convex lenses having their plane surfaces in contact; the thickness of each must be found and the results added together. If the lens is a converging meniscus its thickness will be the difference between the thickness of the two planos.

Example 8.—Let the lens be biconvex, the radii being 1·16 and 2, the diameter d being 2.

$$t = 1 \cdot 16 - \sqrt{1 \cdot 346 - 1} = 1 \cdot 16 - \sqrt{\cdot 3460}\,^* = 1 \cdot 16 - \cdot 588 = \cdot 572.$$

$$t' = 2 - \sqrt{4 - 1} = 2 - 1 \cdot 732 = \cdot 268.$$

$$t + t' = \cdot 572 + \cdot 268 = \cdot 840 = \text{the thickness of the lens.}$$

The third method is to divide the diameter by twice the radius. This quotient is a natural sine, which must be looked out in the column of *natural* sines in Chambers' Tables; the line in which this figure occurs must be followed across the page until the column of versed sines is reached. Take this versed sine and multiply it by the radius; the product will be the thickness of the plano-convex. A biconvex or a meniscus must be divided up into planos as in the previous case.

As the division and multiplication can be performed by slide rule, this method is very rapid.

Example 9.—Find the thickness of a plano-convex lens whose diameter $d = 2$, and radius $r = 1 \cdot 5$.

Here $\frac{d}{2\,r} = \cdot 6666$ = natural sine of $41° - 48'$. The natural versed sine of this angle is ·255. Then $\cdot 255 \times 1 \cdot 5 = \cdot 382$, the thickness.

When the radius is large in proportion to the diameter, an increase in the diameter will only cause a small relative increase in the thickness, but as the radius approaches the diameter in equality a small increase in the diameter will add considerably to the thickness. In achromatic combinations the limit of utility is reached when the diameter of the combination is equal to $2\,r \sin 60° = 1 \cdot 732\,r$.

Example 10.—The radius of the contact curve of the Steinheil triple (Example 7) is ·413. What is the greatest diameter that ought to be given to the combination? Ans. $\cdot 413 \times 1 \cdot 732 = \cdot 715$. But this is a maximum, in practice it would be better to use $1 \cdot 6\,r$, the diameter in this case would be ·66.

Having by one of the above plans determined the thicknesses of the lenses, we must proceed by the Gauss method to find the focal lengths of the combination. The data are the refractive indices μ, μ',

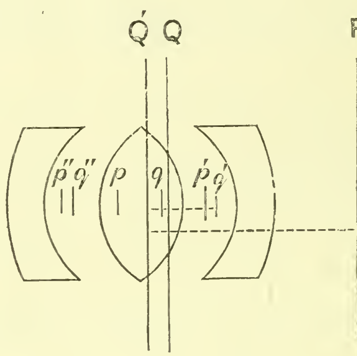
* Note, great care must be exercised in looking out the square root; for the square root of 346 is 18·60, while that of 3460 is 58·82. Now, as the square root of ·346 is ·5882, it is necessary to look it out in the four figure columns as 3460, and then alter the decimal place. If, on the other hand, the figure had been 3·46, it must be looked out as 346, and the decimal place altered to 1·860.

the radii $r'' s''$, $r s$, $r' s'$, the thicknesses t'', t, t', and the foci f'', f, f' of the lenses.

Example 11.—Taking then for an example (Case 5, Example 7, fig. 18) of two diverging menisci of flint enclosing an equi-convex of crown, we have $r'' = \cdot 830$, $s'' = \cdot 413$, &c.: $\mu = 1 \cdot 5179$, $\mu' = 1 \cdot 6202$, we may call the thicknesses of the menisci $t'' = \cdot 1 = t'$, and determine t, the thickness of the equi-convex, by calculation (see Example 9) as $\cdot 387$, assuming the diameter of the lens to be $\cdot 7$.

We first have to find the principal points p'' and q'' of the flint diverging meniscus, and its focus f''; this is accomplished by going through the following arithmetical computation, which is quite straightforward, and may be quickly accomplished by the help of a slide rule. Great care must be exercised with regard to the signs of the quantities throughout. In fig. 19 the lenses have been separated for the sake of clearness.

Fig. 19.



$$r'' = \cdot 830 \qquad r = \cdot 413 \qquad r' = -\cdot 413 \qquad t'' = \cdot 1$$

$$s'' = \cdot 413 \qquad s = -\cdot 413 \qquad s' = -\cdot 830 \qquad t = \cdot 387$$

$$\mu' = 1 \cdot 6202 \qquad \mu = 1 \cdot 5179 \qquad t' = \cdot 1$$

$$g'' = \frac{t''}{\mu'} = \frac{\cdot 1}{1 \cdot 6202} = \cdot 06172;$$

$$(\mu' - 1)\, g'' = \cdot 6202 \times \cdot 06172 = \cdot 03828;$$

$$-g'' r'' = -\cdot 06172 \times \cdot 830 = -\cdot 05123;$$

$$-g'' s'' = -\cdot 02549; \qquad r'' s'' = \cdot 3428;$$

$$s'' - r'' + (\mu' - 1)\, g'' = -\cdot 3787 = h'';$$

$$(\mu' - 1)\, h'' = -\cdot 2349 = k'';$$

$$p'' = \frac{-g''r''}{h''} = \frac{-\cdot 05123}{-\cdot 3787} = \cdot 1353\,;$$

$$q'' = \frac{-g''s''}{h''} = \frac{-\cdot 02549}{-\cdot 3787} = \cdot 0673\,;$$

$$f'' = \frac{r''s''}{k''} = \frac{\cdot 3428}{-\cdot 2349} = -1\cdot 459.$$

$$g = \frac{t}{\mu} = \cdot 255\,; \qquad (\mu - 1)g = \cdot 1321\,; \qquad -gr = -\cdot 1053\,;$$

$$-gs = \cdot 1053\,; \qquad rs = -\cdot 1706\,;$$

$$s - r + (\mu - 1)g = -\cdot 6939 = h\,;$$

$$(\mu - 1)h = -\cdot 3594 = k\,; \qquad p = \frac{-gr}{h} = \cdot 1517\,;$$

$$q = \frac{-gs}{h} = -\cdot 1517\,; \qquad f = \frac{rs}{k} = \cdot 4747.$$

$$d = \cdot 0844\,; \qquad df = \cdot 04006\,; \qquad f''f = -\cdot 6926\,;$$

$$f'' + f - d = -1\cdot 0687\,;$$

$$Q = q - \frac{df}{f'' + f - d} = q - \frac{\cdot 04006}{-1\cdot 0687} = q + \cdot 03748\,;$$

$$\phi = \frac{f''f}{f'' + f - d} = \frac{-\cdot 6926}{-1\cdot 0687} = \cdot 6481.$$

$$D = \cdot 04692\,; \qquad Df' = -\cdot 06846\,; \qquad \phi f' = -\cdot 9456\,;$$

$$\phi + f' - D = -\cdot 8578\,;$$

$$Q' = q' - \frac{Df'}{\phi + f' - D} = q' - \cdot 0798\,;$$

$$F = \frac{\phi f'}{\phi + f' - D} = 1\cdot 102.$$

Working distance = distance of the focal point from last surface of lens = $\cdot 887$.

Magnifying power $\frac{10}{F} - 1 = 8\cdot 07$.

We see that the first principal point p'' is $\cdot 1353$ distant from the vertex of r'', it is positive and therefore it is measured towards the right hand; the second principal point q'' is $\cdot 0673$, also measured towards the right hand from the vertex of s''. The true focus $f'' = -1 \cdot 459$. Next we have to find p and q the principal points of the crown equi-convex. This is done in precisely the same manner, but s being negative makes $-g\,s$ positive, and $r\,s$ negative; h being also negative, p is positive and q negative; the first is therefore measured to the right, and the second to the left, and both points are situated within the lens. The true focus, which is $\cdot 4747$, is positive.

We have next to combine the left-hand diverging meniscus with the equi-convex lens, and to find the second principal point of this combination, which we will call Q, and its true focus ϕ. Now, although these lenses are in physical contact, yet, optically speaking, they are not so; we must therefore first determine the optical distance d between the lenses; this is the distance between the second principal point q'' of the diverging meniscus and the first principal point p of the equi-convex; this obviously is $\cdot 1517 - \cdot 0673 = \cdot 0844$.

By going through another arithmetical calculation, we find that the second principal point Q of the combination is situated at a point $\cdot 03748$ to the right hand of q, and therefore $\cdot 1142$ to the left of the posterior surface of the equi-convex lens; the focus of the combination is $\cdot 6481$ and is positive.

This doublet combination must now be combined with the second diverging meniscus. It will be unnecessary to calculate the principal points $p'\ q'$ and focus f' of the second meniscus, as the lens is perfectly symmetrical with the first lens, all we have to do is to put $p' = -q''$, $q' = -p''$, and $f' = f''$; both the radii being negative, p' and q' will also be negative, and therefore will be measured from the proper vertices to the left.

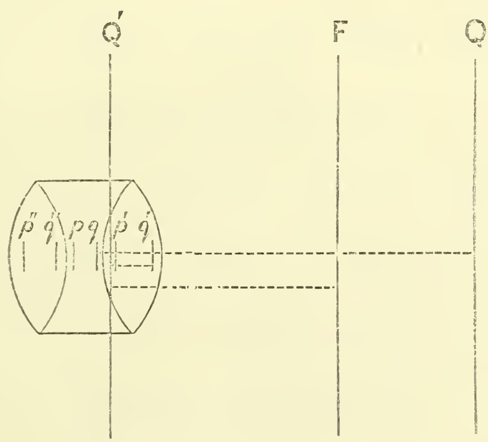
The optical distance D, between the doublet and the right hand diverging meniscus, must now be determined, it is the distance Q p', both these points lie inside the equi-convex crown lens, Q being $\cdot 1142$ and p' $\cdot 0673$ from its posterior surface; D therefore is $\cdot 1142 - \cdot 0673 = \cdot 0469$; it is positive because measured towards the right.

The last computation, which is similar to the one preceding it, shows us that the posterior principal point Q$'$ is $\cdot 0798$ to the left of q'; now as q' is $\cdot 1353$ to the left of the vertex of s' (see p'' in the first meniscus) Q$'$ is $\cdot 2151$ to the left of the posterior surface of the triple; the true focus of the triple is $1 \cdot 102$; this is measured from Q$'$, it therefore is situated $\cdot 887$ from the last surface. Consequently, the magnifying power of the combination is $8 \cdot 07$, and its working distance is $\cdot 887$.

Example 12.—We will now go through the same process with the other triple (in Example 6, Case 4, fig. 17), consisting of two bi-convexes enclosing an equi-concave.

There is nothing needing any special explanation with regard to the principal points and foci of the separate lenses, but when the two first are combined you will notice that the second principal point Q is situated about 2·3 in. to the right of the posterior surface of the equi-concave lens. Careful attention is required when the doublet combination is combined with the other bi-convex, for you will observe that the distance D from the second principal point Q of the doublet to the first principal point p' of the second bi-convex is measured from left to right, it is therefore negative, and its sign has to be changed in the expression $\phi + f'' - D$.

FIG. 20.



$$r'' = \cdot 830 \quad r = -\cdot 822 \quad r' = \cdot 822 \quad t'' = \cdot 4$$
$$s'' = -\cdot 822 \quad s = \cdot 822 \quad s' = -\cdot 830 \quad t = \cdot 1$$
$$\mu = 1 \cdot 5179 \quad \mu' = 1 \cdot 6202 \quad t' = \cdot 4$$

$$g'' = \frac{t''}{\mu} = \cdot 2635; \qquad (\mu - 1)\, g'' = \cdot 1365;$$
$$-g''\, r'' = -\cdot 2187; \qquad -g''\, s'' = \cdot 2166;$$
$$r''\, s'' = -\cdot 6823; \qquad s'' - r'' + (\mu - 1)\, g'' = -1 \cdot 5155 = h'';$$
$$(\mu - 1)\, h'' = -\cdot 7849 = k''; \qquad p'' = \frac{-g''\, r''}{h''} = \cdot 1443;$$
$$q'' = \frac{-g''\, s''}{h''} = -\cdot 1429; \qquad f'' = \frac{r''\, s''}{k''} = \cdot 8693.$$

$$g = \frac{t}{\mu'} = \cdot 06172; \qquad (\mu' - 1)\, g = \cdot 03828;$$
$$-g\, r = \cdot 05073; \qquad -g\, s = -\cdot 05073;$$

$$r s = - \cdot 6757 ; \quad s - r + (\mu' - 1) g = 1 \cdot 6823 = h ;$$

$$(\mu' - 1) h = 1 \cdot 0434 = k ; \quad p = \frac{- g r}{h} = \cdot 03016 ;$$

$$q = \frac{- g s}{h} = - \cdot 03016 ; \quad f = \frac{r s}{k} = - \cdot 6476.$$

$$d = \cdot 1731 ; \quad d f = - \cdot 1121 ; \quad f'' f = - \cdot 563 ;$$

$$f'' + f - d = \cdot 0486 ; \quad Q = q - \frac{- \cdot 1121}{\cdot 0486} = q + 2 \cdot 307 ;$$

$$\phi = \frac{- \cdot 563}{\cdot 0486} = - 11 \cdot 584.$$

$$D = - 2 \cdot 1339 ; \quad D f' = - 1 \cdot 855 ; \quad \phi f' = - 10 \cdot 07 ;$$

$$\phi + f' - D = - 8 \cdot 581 ; \quad Q' = q' - \frac{- 1 \cdot 855}{- 8 \cdot 581} = q' - \cdot 2162 ;$$

$$F = \frac{- 10 \cdot 07}{- 8 \cdot 581} = 1 \cdot 174.$$

Working distance = $\cdot 8135$
Magnifying power = $7 \cdot 52$

We may here notice that owing to the greater thickness of this lens its true focus differs more from its nominal focus than the focus of the Stenheil did in Example 11. Its magnifying power for this reason is also less, being $7 \cdot 5$.

Loups are often found to possess less power than they are stated to have, the power being calculated on the nominal, instead of on the true focus.

Before passing on we must complete our examination of the Gauss method by considering the cases when one of the surfaces is plane. In a plano-convex or plano-concave lens, when $r = \infty$, $h = \infty$, $p = g = \frac{t}{\mu}$ and $q = 0$. This means that p lies within the lens at a distance of $\frac{t}{\mu}$ from the plane surface, and q is at the vertex of s; the focus $f = \frac{- s}{\mu - 1}$.

Turning the lens round, we have $s = \infty$; p is at the vertex of r, $q = \frac{- t}{\mu}$, and $f = \frac{r}{\mu - 1}$.

We now come to the consideration of the various forms that can be given to the achromatic doublet represented in Case 2 (fig. 15).

First the bi-convex lens may be cut in two, fig. 21, and the exterior plano-convex may be placed with its plane side in apposition to the plane side of the plano-concave; this forms the triple front of old achromatic objectives (fig. 22).

Fig. 21.

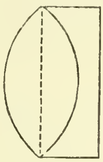


Fig. 22.

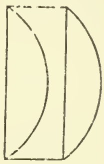
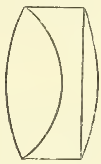


Fig. 23.



Secondly, the exterior plano-convex that was cut off in the previous example is equivalent to two equal plano-convex lenses of double the radius; one of these may be left in its original position, and the other placed against the plano-concave as in the previous example. This will form an equi-convex triple (fig. 23).

The advantage gained by these forms is that the conditions which affect the spherical aberration and the curvature of the field, are altered, while those which control the achromatism are undisturbed.

Setting aside the smaller error of spherico-chromatic aberration it matters not in what order the component lenses are placed, so far as the achromatism is concerned, but it makes a very great difference with respect to spherical aberration and curvature of the image. Therefore, by suitable alterations in the form of the achromatic doublet, considerable control in these respects can be secured, without appreciably disturbing the achromatism.

I must now bring this unfinished subject to a close, with many apologies for the imperfect manner in which it has been dealt with, and with many thanks for the patient attention you have given me.

III.—*The Application of the Electric Arc to Photomicrography.*

By J. Edwin Barnard, F.R.M.S., and Thos. A. B. Carver, B.Sc.

(*Read* 17*th November*, 1897.)

In its application to photomicrography the electric arc presents many important advantages. In addition to its inherent simplicity, the high degree of intensity and the smallness of the area of the incandescent source, effect corresponding improvement of the image, and render short exposures practicable. Photographic results which would not be available with other sources of illumination can further be obtained from nearly opaque objects. It has, however, hitherto been employed with small success; and it was with the object of localising the difficulty, and if possible rectifying it, that the investigation to be described was undertaken.

The result of numerous trials of the best form of automatic lamp available showed that, although the arc was working under constant conditions so far as the most careful adjustment could secure, the photographs obtained were subject to wide variation. Not only did the results of equal exposure demonstrate fluctuations in the intensity of the light, but shadows and diffraction phenomena were produced which were only to be attributed to decentration of the illuminant. The difficulty was even accentuated by the fact that at times the most perfect results were obtained; but their reproduction was a matter entirely of chance. Our first experiments were therefore devoted to the analysis of the behaviour of the arc when thus controlled. The method we adopted was to project an image of convenient size upon a screen provided with lines, in reference to which the movement of the image could be referred.

Our observations showed that, although working under apparently constant conditions, the arc was subject to wide fluctuations, on account of the movement of the carbon points due to the feeding mechanism, and of the incandescent point travelling round the carbon as the result of the variations in the length of the arc. In order to test the true effect of these variations, the automatic mechanism was replaced by a simple form of hand-fed apparatus, in which absolute positiveness and steadiness of movement was secured, so that the conditions observed could be reproduced and studied at length.

No further experiment was, however, necessary to show that in the unsteadiness of the feeding motion of the carbons lay part at least of the decentering action to which were to be ascribed the variations we had observed in the photographic result.

With regard to the effect of inconstancy of the length of the arc, our results showed that so long as the carbons were maintained at a constant critical relative distance the intensely incandescent crater, from which practically the whole of the useful light is derived, remained absolutely motionless and of constant intensity, affording from a photomicrographic point of view an almost perfect illuminant. So soon, however, as the slightest lengthening of the arc occurred, the incandescent crater is lost, owing to the arc at once travelling round the positive carbon, playing successively upon different parts, and never remaining long enough in one place to allow the high incandescence and constancy of position secured when running under

Fig. 24.

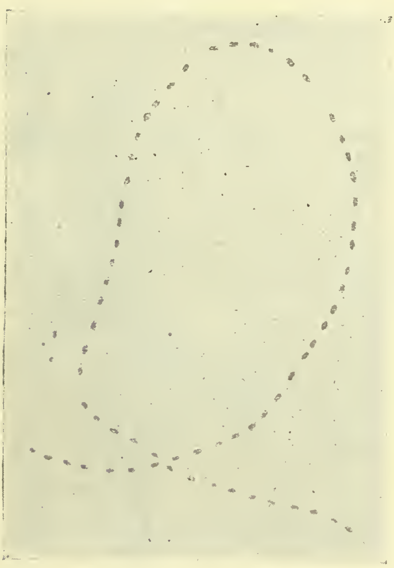


Fig. 25.

the critical condition we have described. In order to more directly test the effect of the small variations we had observed, two photographs were taken: one with the crater of the positive carbon truly central (fig. 24), and the other (fig. 25) with the crater decentred by an amount, indicated by projection, corresponding to the fluctuations of the automatic lamp.

We were thus led to realise the importance of higher accuracy in the adjustment of the position and length of the arc; and to consider means whereby it could be secured. The necessarily intermittent action of any automatic mechanism, the action of which can only be started as the result of the very factor it was our object to avoid, viz. lengthening of the arc, forced us to the conclusion that such constancy and accuracy of movement could only be attained by such a simple positive hand-fed apparatus as that to which we have alluded. The form we designed to meet the condition is shown in fig. 26.

The carbons are held in V-clamps sliding upon two rigid vertical rods, and their relative positions can be varied by the right and left handed screw A; the position of the pair, that is of the arc as a whole, being controlled by the screw B. The lamp is mounted upon a boss sliding upon a tube, and has movements through the angle of inclination and in a line at right angles to the line of collimation.

Fig. 26.

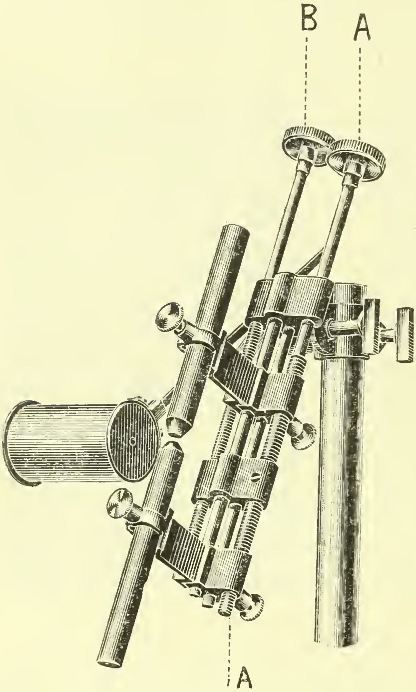
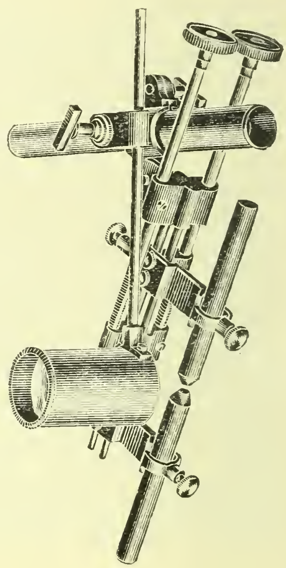


Fig. 27.



With such mechanism the arc was fed to maintain its truly central position and constant condition, in reference to the graduations upon the screen, and any difficulty in its use entirely disappeared, and the reproduction, even with the highest powers, of the best photographic results became a matter of ease.

It remained to design means whereby the indications of the projected image could be observed in a smaller compass, and we were ultimately led to adopt a pin-hole casting an image upon a screen of ground glass provided with the necessary reference lines. Such an apparatus we designed as part and parcel of the feeding mechanism, providing it with a universal motion and a clamp, so that, the light having been adjusted to be truly central, the indicator can be placed in a position to then read correctly upon the ground glass. In fig. 27 the lamp is shown, with pin-hole camera attached, at right angles to the optical axis.

The question of inclination of the carbons to the vertical was investigated by means of an apparatus giving revolution of the arc about a horizontal axis passing through itself.

The critical inclination is obviously the greatest at which none of the light from the crater is cut off by the negative carbon, when the length of arc has been adjusted to the greatest that gives constancy in the position of the crater.

The critical angle we found to be about 27° to the vertical, and at this angle the two essential conditions are secured, viz. the greatest amount of light was thrown forward from the crater of the positive carbon and the light from the negative is thrown to the back, and consequently eliminated as a second and harmful source.

It is of course understood that the current employed throughout these experiments has been a continuous one. It remains to state how ill the alternating current adapts itself to such an application.

None of the conditions which our experiments with continuous current showed to be so primarily essential are present. In the first instance, the arc can never be adjusted to give that constancy of one incandescent source which we were led to place at the root of any success in the use of the arc. Again, the carbons are equally incandescent, so that it is impossible to regard the arc as a single source of illumination. These essential difficulties are further regardless of minor physical inconveniences, such as the noise, which, although they might not form barriers to its use, are nevertheless absent with continuous current.

We venture to think that, could the electric arc be regarded as a reliable source of light, it would be much more largely employed in optical apparatus where constancy of position and intensity of the source of light are essential, and can only express the hope that our results demonstrate the ease with which these conditions can be accurately secured.

IV.—*A new Form of Photomicrographic Camera and Condensing System.*

By E. B. Stringer, B.A.

(*Read* 15*th December*, 1897.)

The apparatus which Mr. Watson Baker has kindly undertaken to submit to the Society on my behalf, is an attempt to facilitate the work of photomicrography, especially with high powers, and to afford an illuminating system more perfectly corrected, more powerful, and more under control, than has hitherto been available.

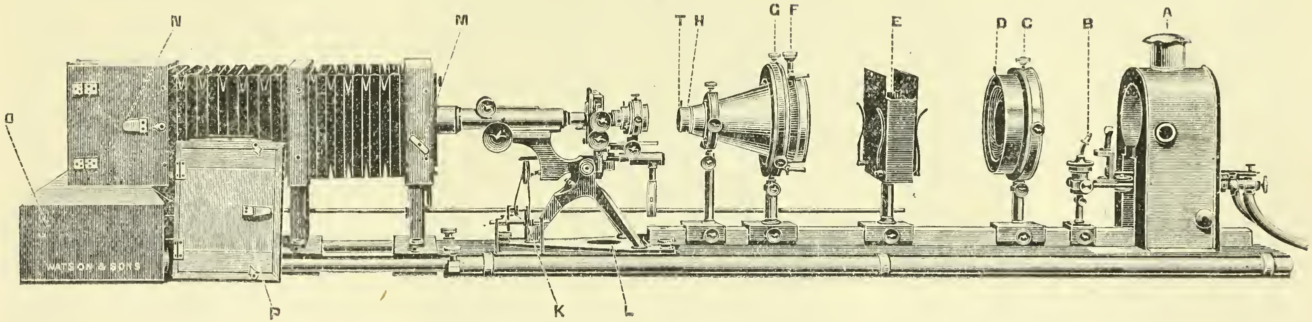
The baseboard is confined to that part of the apparatus which carries the illuminating system and Microscope, the further end of the camera being supported by a massive wooden block. To this are attached two long brass tubes, on which slide the supports for the bellows, and which themselves slide in slightly larger tubes attached to each side of the baseboard. By drawing out these inner tubes with the block, and sliding the bellows supports the other way, the camera can be extended to 40 inches, or it may be closed up to 11 inches; but at whatever length it may be used, there is no baseboard projecting beyond the end of it, and the focusing screen is always in the most convenient and accessible position, namely at the end of the bench, where the worker can be comfortably seated. Also the firm support of the massive wooden block is always immediately beneath it, conferring the greatest possible solidity and freedom from vibration.

A door is provided at the side of the camera for the examination and adjustment of the image *in situ*, when a white card is substituted for the ground glass or other screen.

If it should be necessary, though in practice it very seldom is, to look down the Microscope when it is in position, the camera can readily be drawn backwards altogether out of the way of the observer's head. And it will be seen that the whole camera can in a moment be entirely removed, and the Microscope used, if so desired, for screen projection.

I have found that the secret of avoiding vibration is to clamp down nothing, but to let everything rest by its own weight on as large a surface as possible. To increase this effect, and to bring the apparatus into firm and intimate contact with the bench (and also to help to absorb vibration), it has underneath it a layer of sheet cork one-eighth of an inch thick, below which is another layer of felt also one-eighth of an inch thick; on these it rests with great firmness, and at the same time slides easily enough when pushed.

Fig. 28.



B, Oxyhydrogen jet with zirconium cylinder, covered by the cowl A when working.

C, Doublet parallelising condenser, with centering screws.

D, Iris diaphragm.

E, Holder for trough and light-filtering media.

F, Plano-convex lens $4\frac{1}{4}$ in. diameter, with centering screws G.

H, Plano-concave lens, with iris diaphragm T.

K, Connecting pulleys between focusing rod of camera and fine adjustment of Microscope.

L, Triangular frame in which Microscope feet are placed.

M, Flap shutter.

N, Door through which image is observed on card screen, &c.

O, Solid block of mahogany on which camera body is fixed and supported.

P, Dark slide.

At the end of the baseboard next the camera is a triangular plate of brass, having three holes into which the round feet of the Microscope (Watson's H Edinburgh stand) accurately fit, the feet passing completely through the holes and resting on the board beneath, which is here covered with cloth. At the three angles of the plate are three milled screws, passing through holes which (when the screws are unclamped) are large enough to allow about a quarter of an inch of free movement in each direction. When the Microscope is first put down, these screws are released, and the Microscope shifted until it is found to be exactly centered. The screws are then firmly clamped, and are never again touched. The Microscope can now be instantly put down in an accurately central position into the holes which receive the feet, and as easily taken up again. This enables the Microscope used for ordinary observation to be employed for photography with as much ease and accuracy as the permanently fixed instrument found in some arrangements.

The small model instrument is preferred, not only because it is lighter and more convenient to move about, but also because its optic axis when in the horizontal position is lower; thus the optic axis of the whole apparatus, and consequently its centre of gravity, is lower, and its stability and freedom from tremor the greatest possible. The small light body-tube also confers a greater sensitiveness on the fine adjustment than can be obtained in the full-sized instrument; and it will be shown farther on how the small tube may be used, without any danger of flare from internal reflection.

The "turn out" device is dispensed with as being unnecessary where the Microscope is not fixed down. All adjustments are easily made, with the powerful illumination provided, by projecting the image on to a screen of white card.

The front of the camera has sliding movements in both directions, by which the connecting flange can be once for all adjusted to exactly meet the eye-piece of the Microscope. Behind it is the usual flap shutter for making the exposures, worked by a large milled head outside the camera.

The focusing arrangement adopted is the one in which an endless cord passes over the fine adjustment screw and round two other pulleys below and on each side of it, by which any lateral drag on the Microscope is altogether avoided. These pulleys can be changed, and used of various sizes, those for high power work being as small as it is possible to make them, so that a very slow movement is easily obtained. The focusing rod passes through the block at the end of the camera, and terminates in a large milled head, which, whatever length of camera may be in use, is always close to the focusing screen and the left hand of the worker.

In extending or closing up the camera there is only one screw to be released, namely, the small one which clamps the focusing pulley on to the focusing rod. The clamping screws on the ends of the lateral tubes and those on the bellows supports are adjusted to a convenient tightness, and are not afterwards touched.

The condensing system, the oxyhydrogen jet, and a small lantern of sheet iron, are all carried on the optical bench, which I have found it a great improvement to make square in section, instead of prismatic as has been usual heretofore. With the condensing system many difficulties were at first experienced, until Mr. E. M. Nelson very kindly interested himself in the matter, and computed a new set of condensers, following the same general plan as I had done, but making them larger ($4\frac{1}{4}$ inches in diameter) and employing the new Jena glasses. These, after one or two final alterations, proved entirely successful, and the result (the perfection of which is due to Mr. Nelson's optical knowledge and skill) is an illuminating system perfectly achromatised, and almost perfectly aplanatic, and moreover of much greater power than has hitherto been available, affording a beam of great intensity, and of that slight divergence which is best suited to the working of the substage condenser.

The working of the whole system is as follows:—The light from the jet is first parallelised by the doublet condenser, which consists of two plano-convex lenses having their plane sides turned towards the radiant, the one next the radiant being a quarter of an inch less in diameter than the other, and the focal length of the combination being $2\frac{3}{4}$ inches, taking up an angle of 70°.

The parallel beam passes across an interval of about 10 inches, through the screen or trough of coloured solution carried by the intervening support, and enters the plano-convex lens $4\frac{1}{4}$ inches in diameter (having its convexity turned the other way to minimise the aberrations), by which it is converted into a converging cone. This, after passing through the water in the chamber between the lenses, is again parallelised by the much smaller plano-concave lens, and emerges from it as a parallel, or more strictly speaking a slightly divergent pencil, rather less than an inch in diameter, and enters the substage condenser. The plano-concave lens is of highly dispersive glass, and perfectly achromatises the whole system.

The converging arrangement is clamped at such a distance from the substage condenser as to throw a spot of light rather larger than the opening in the condenser diaphragm. The smaller the radiant point, or the larger the opening in the diaphragm, the greater this distance should be. The best average distance is about $2\frac{1}{2}$ inches from the substage ring as it stands at present. This also allows ample room for putting down and taking up the Microscope, and for using the mirror when the Microscope is in place, if it should be necessary to do so. For "dark ground" work, or in using the Lieberkühn, the small iris may be removed, and the nose of the converging system slid right up into the substage ring, so that there is no loss of light whatever.

The small weighted cone regulator, attached either to the main or to a tube of compressed hydrogen, supplies gas to the "mixed" jet (which has a much smaller nipple than usual) at a pressure of 2 inches of water; so that, with the hydrogen tap full open, the light is always of the same power, and exposures may be timed with certainty. The oxygen is better taken at a higher pressure direct from a tube having only the usual spring regulator, and controlled by the screw tap of the jet; but it is as well that the spring should be a weak one. The zirconia cylinder which is used, with the jet directed on to the end of it, gives an incandescent point almost as small as the electric arc, and is at the same time much more manageable, and in every way superior to lime for the present purpose. With it the beam emerging from the first combination is almost perfectly parallel. If a larger radiant such as a lamp-flame or Welsbach burner be used, it is much better to bring up the back combination as near to the other as the intervening support will allow.

It will be noticed that not only is the emergent beam entirely robbed of its heat by passing through so large a depth of water, but the jet is, in virtue of the whole arrangement, removed to so great a distance from the Microscope, that there can be no indirect communication of heat, such as might affect the focal adjustment in high power work. The illumination is also of such power that very deep and approximately monochromatic screens may be used, with moderate exposures; and excellent work may thus easily be done with objectives which are not apochromatic.

The device of the parallelising plano-concave lens is of course originally due to Kingsley, who first employed it in a Microscope for screen projection about the middle of the present century, and it has since been used by Mr. Lewis Wright in his oxyhydrogen lantern Microscope, now so well known.

The large iris in front of the combination next the light is an important feature. By it the substage condenser is focused and centered, and when it is shut down to the right extent, it will be found (besides rendering the whole system perfectly aplanatic) to entirely cut off that surplus light, which when reflected from the inside of the Microscope tube and objective mount, causes so much trouble and so many failures in photomicrography. So that it is no longer necessary to use a specially large tube, and the small tube, with the greater sensitiveness it confers upon the fine focal adjustment, can be retained. If no light whatever is to strike the sides of the tube (though a little does not of course matter) the diaphragm of the substage condenser must not be opened beyond its full aplanatic aperture.

There is, besides, a small iris beyond the plano-concave parallelising lens which cuts off any remaining stray light, and is also used for centering.

The whole system is provided with centering screws, and it, like the Microscope, is centered once for all and never again touched. The only adjustment that has to be made with each fresh exposure is the centering of the light itself (which is for this purpose provided with very sensitive centering screws), and the adjustment of its distance from the condensers, which will be found to vary a little when diffferent objectives and substage condensers are used. The small sheet-iron lantern slides in grooves on each side of the optical bench, and, when slid backwards, gives easy access to these screws.

Finally, it must be said, that to employ this illuminating arrangement to the greatest advantage, it is necessary that the substage condenser be proportioned in power as well as in aperture to the objective. The more nearly the power of the substage condenser approaches that of the objective, the wider can the large iris be opened, and the greater is the intensity of the illumination; but it is the intensity alone which is affected; the aperture of the substage condenser, whatever it may happen to be, remaining unaltered. The best results appear to be obtained when the condenser is about one-half the power of the objective.

If this proportion be pretty closely maintained, and the other conditions are fairly equal, as is often the case in the general run of work, the exposure varies but little with varying magnifications, averaging about two seconds with a light yellow screen and a plate of medium rapidity.

The apparatus was made for me by Messrs. Watson in the summer of 1896, and I must, in concluding, express my thanks to them for the care and thoroughness with which they have carried out my design.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.

*Including Original Communications from Fellows and Others.**

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Placentation of Perameles.‡—Mr. J. P. Hill has discovered an allantoic placenta in *Perameles obesula* and *P. nasuta*, and gives a connected account of the successive stages.

I. The *changes in the uterine wall* are briefly the following:—The mucosa undergoes hypertrophy; the uterine glands increase in transverse diameter and in length; the interglandular connective tissue forms a loose network permeated by lymph; the vessels of the mucosa increase greatly in size and number; the whole epithelium becomes a vascular syncytium; maternal capillaries pass up between the syncytial lobules (formed of nests of nuclei), penetrate the syncytial protoplasm, and form a network on and just beneath its surface.

II. *Fixation of the embryo.* The embryo becomes attached to the maternal syncytium by means of the enlarged ectoderm cells over the discoidal area or true chorion with which the allantois fuses. In correlation with the close adherence of the chorionic ectoderm, the corresponding area of the uterine syncytium is markedly thicker than the remainder, and forms the allantoic placental area. In the allanto-chorionic mesenchyme, and in close relation to the inner surface of the chorionic ectoderm, run the allantoic capillaries.

Outside the discoidal allanto-chorionic area a somewhat annular zone of the yolk-sac wall is also brought into intimate relation with the maternal syncytium, and represents a yolk-sac placental formation, functional at a time when the allantoic placenta is being formed.

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

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, and Reproduction, and allied subjects. ‡ Quart. Journ. Micr. Sci., xl. (1897) pp. 385-446 (5 pls.).

The *formation of the functional allantoic placenta* is brought to pass through the gradual degeneration and resorption of the enlarged chorionic ectoderm cells over the placental area proper. The allantoic capillaries can now directly reach the vascular surface of the allantoic placental syncytium, with which they become intimately attached. The fœtal and maternal blood-streams are now separated only by their thin endothelial walls, and perhaps by a thin layer of syncytial protoplasm.

III. *Parturition.* There is no decidua at birth, but the vesicular portion of the allantois remains persistently attached to the placental syncytium, and is gradually absorbed *in situ* along with the latter by the maternal leucocytes.

The fœtus, while still connected with the placental area by the lengthened allantoic stalk, passes out, not by the lateral vaginal canals, but by breaking through a median track leading backwards from a posterior common portion of the two uteri.

Early Development of Amphioxus.*—Prof. E. W. MacBride has re-investigated this, and draws the following conclusions:—(1) The primitive gut or archenteron is formed in *Amphioxus* by a typical process of embolic invagination, the endoderm being at first not sharply marked off from the ectoderm. The blastopore is at first posterior, but subsequently becomes dorsal by the preponderant growth of the ventral lip.

(2) The mesoderm originates in *Amphioxus* as a series of true gut-pouches, viz. one anterior unpaired pouch and two pairs of lateral pouches. The first divides to form the two head-cavities; the anterior pair give rise to the first pair of myotomes, and, in addition, to two long canals extending back ventrally; the posterior pair, gradually separated from the gut, form the series of myotomes.

(3) Hatschek's nephridium is the persistent connection of the left of the pair of collar-pouches with the gut. (4) The metapleural "lymph-canals" found in the atrial folds are the persistent ventro-lateral extensions of the "collar-pouches."

He also concludes that all attempts to explain the formation of the nervous system of Vertebrates by the coalescence of the two halves of a nervous ring lying in the lips of a long slit-like blastopore must be given up; and that the theory of the descent of the Vertebrates from a form somewhat like *Balanoglossus* receives strong support from the early developmental history of *Amphioxus*.

Development of Atrial Chamber in Amphioxus.†—Prof. E. Ray Lankester makes some corrections on MacBride's paper in regard to the atrial chamber. Instead of confirming Kowalevsky's conclusions, as MacBride says, Lankester and Willey showed that there are no atrial folds. What Kowalevsky mistook for "atrial folds" are really the metapleura. These do not grow round and meet in the middle line, but a very small in-sinking is formed between them, and is covered in by a minute horizontal growth right and left (the subatrial ridges or folds), their union resulting in the formation of what is, at first, a very narrow "subatrial floor" lying between the two upstanding metapleura.

* Quart. Journ. Micr. Sci., xl. (1898) pp. 589–612 (3 pls.).
† Tom. cit., pp. 647–50.

Development of Epiphysis in Reptiles.*—Prof. E. Bugnion has studied this in *Iguana*, *Lacerta*, and *Coluber*, and finds that the epiphysis has *not* a separate origin from the parietal organ. The epiphysial diverticulum arises dorsally in front of the posterior commissure, and forms distally the parietal organ, which is gradually detached. The nerve destined for this organ is formed, not in the stem of the epiphysial diverticulum, but on a small swelling of the ganglionic wall in front of the latter. The so-called paraphysis is a simple epithelial structure in connection with the choroid membrane and its plexus.

Some Activities of Polar Bodies.†—Prof. E. A. Andrews remarks that the acceptance of the view that polar bodies are but imperfect ova incapable of fertilisation and without any *rôle* in development, has naturally tended to lessen interest in their fate. Yet their behaviour after extrusion shows some interesting phenomena. He has studied those of *Asterias*, *Cerebratulus*, the nudibranch *Tergipes*, the lamellibranchs *Nucula* and *Angulus*, and other forms. He finds that the polar bodies in these cases (representative of Echinoderms, Nemertines, and Molluscs) show marked activities, chiefly of an amœboid nature. In some cases the polar bodies behave like Heliozoa. They may also remain vitally connected with one another, and with the developing embryo for some time after extrusion. " How far these phenomena are normal, and how much may prove to be pathological, cannot be at present decided ; but, in any event, it has been shown the protoplasm of polar bodies has powers hitherto unsuspected." Perhaps the last word should rather read " undescribed," or " inadequately described."

Pronephros of Lamprey.‡—S. Hatta gives a preliminary account of his observations on the development of the pronephros in the lamprey. These lead to the following conclusions :—Both the pronephric tubules and the segmental ducts are purely organs of the lateral unsegmented portion of the mesoblast. The *Anlagen* of the tubules follow the same segmental arrangement as the mesoblast somites. The maximum number of pronephric tubules is six pairs, of which the first, second, and sixth degenerate one after the other. The persistent tubules are, therefore, the third, fourth, and fifth, of which the third pair is not so well developed as the next two. The first and second pairs originate in the region where the gill-slits are afterwards formed, and they disappear as the slits arise.

The facts closely agree with Price's observations on *Bdellostoma*, and there is strong reason to believe that the pronephros of Cyclostomata is homologous with Boveri's *Nierencanälchen* in the lancelet, and that the persistent tubules of the lamprey are homologous with those of Selachii, Teleostei, Amphibia, &c.

Egg-laying of Dog-fish.§—Herr Fr. Kopsch has studied the egg-laying of *Scyllium canicula* in the aquarium at Rovigno. The chief spawning time seems to be from the beginning of March to the end of

* Arch. Sci. Phys. Nat., cii. (1897) pp. 489–90.

† Ann. Mag. Nat. Hist., i. (7th series) 1898, pp. 109–116 (5 figs.). Johns Hopkins Univ. Circ., 1897, pp. 14–16.

‡ Annot. Zool. Japon., i. (1897) pp. 137–40.

§ Biol. Centralbl., xvii. (1897) pp. 885–93 (3 figs.).

May, but winter-spawning is also known. Two eggs are laid almost at the same time; the blunter end emerges first; the mother fish seems by her movements to secure the entangling of the tendrils of the egg-case. When the egg is laid the blastoderm is in a morula stage, and the disposition of the blastoderm disc has no constant relation to the main axes of the egg.

Between the temperatures 11° and 16° C. the stage reached is a function of time and temperature; thus if a stage x be reached in six days at 10° C., the same will be reached in four days at 15° C.

Formative Forces.*—Prof. Fr. Merkel discusses the forces which give shape to the animal body. He distinguishes the vegetative forces which sustain metabolism and growth from the formative forces which regulate structure. He supposes that both are resident throughout the cell and in every minute part. He refuses to accept the famous "Ignorabimus" of Du Bois Reymond, believing that Biology is really making some progress towards an understanding of the mysteries of growth and development.

b. Histology.

Intercellular Bridges in Muscle.†—Herr E. Hoehl has followed some others in pointing out that the intimate association of connective tissue and muscular tissue may give rise to a false appearance of intercellular bridges. In smooth muscle this seems particularly clear, though the existence of bridges is not denied. He also contends that the connective tissue sheath in the striped muscular tissue of the extremities and heart is in all probability identical with the sarcolemma.

Cell-Membranes.‡—M. Louis Querton has written an interesting paper on the mode of formation of cell-membranes. The most important part is that which deals with the formation of the chitinous cuticle in insects (*Tenebrio molitor*) and in Crustaceans (*Carcinus mænas*). There is nothing to warrant the conclusion that a peripheral plasmic layer is directly transformed into chitin. Vacuoles appear in the hypodermic or epidermic cells; these open on the surface, and disappear. There is evidently a process of cellular secretion.

Minute Structure of the Liver-Cell.§—Dr. G. Schlater finds that the liver-cell has an extremely complicated structure. The nucleus and the cell-substance form an inseparable unity, "a true organism." There are several different kinds of differentiated elements or cytoblasts which produce the intercytoblastic substance (the plasmic network + the linin-framework). The various cytoblasts, distinguishable by physico-chemical peculiarities, have a definite topographical distribution in the cell, like organs in fact, and even the intercytoblastic substance seems heterogeneous. It is different in the nucleus and in the cytoplasm; and the cytoblasts of the nucleus differ in nature and disposition from those outside. The real elemental parts of the cell are these said cytoblasts.

* Nachr. K. Ges. Göttingen, 1897, pp. 84–97.
† Anat. Anzeig., xiv. (1898) pp. 253–6 (3 figs.).
‡ Ann. Soc. Belg. Micr., xxii. (1897) pp. 61–74.
§ Anat. Anzeig., xiv. (1897) pp. 209–23 (11 figs.).

Influence of Cutting on Growth of Hair.* — Herr C. W. Bischoff has investigated this interesting question. In 1893, E. Remesow sought to show (on dog and rabbit) that cutting the hair induced stronger growth. He described various changes in the bulb; the bulb thickened, the cells became larger and more full of sap, a large number of mitoses occurred, and so on. Bischoff has followed the same methods, and tried various modifications, but without finding what Remesow described.

It is therefore probable, he says, that the cutting of the hair has *no* influence on its growth. It also follows that the hair is not capable of transmitting a stimulus of the kind discussed.

Regeneration of Descemet's Membrane.† — Prof. L. Ranvier asks whether there is in histogenesis anything analogous to the influence of the original crystal on a process of crystallisation. His observations on the regeneration of a partially destroyed Descemet's membrane (on the posterior surface of the cornea of the eye) lead him to answer the question in the affirmative. The old membrane has a histogenetic influence on the formation of the new one.

Nerve-Endings in Œsophagus and Stomach of Birds.‡ — N. Malischeff finds that the nerve-endings in the glands of these regions are free, and exhibit relations to the cells similar to those seen in the case of smooth muscle. Pericellular networks, as described by Dogiel, Fusari, Panasci, Korolkoff, were not seen, though an impregnation of the intercellular substance might produce a similar appearance.

Molecular Attraction in Vital Phenomena.§—Prof. A. L. Herrera thinks that molecular attractions play an important *rôle* in vital phenomena, e.g. in protoplasmic movements, inter-relations of nerve-cells, phagocytosis and chemotaxis, amœboid movements, arrangement of red blood-corpuscles in rouleaux, conjugation and reciprocal movements of nuclei.

c. General.

Text-Book of Zoology.‖—Our welcome to the new Text-book of Zoology by Professors T. Jeffery Parker and William A. Haswell is shadowed by the regret that Parker did not live to see the work appreciated. The work is clear in its method and exposition, full and explicit in its descriptions, and altogether such as an advanced student wishes. It is illustrated profusely and beautifully, and on the whole with freshness. The work rises at once to a first place among textbooks of Zoology.

Germinal Variation.¶ —Dr. A. E. Ortmann has made a critical study of the origin of variations—of those variations which, fixed by inheritance and preserved by natural selection, may give rise by separation to distinct species. He sums up in four propositions:—

(1) Every new deviation of an individual from the norm of the species

* Arch. Micr. Anat., li. (1898) pp. 691–703.
† Comptes Rendus, cxxvi. (1898) pp. 23–6.
‡ Bull. Soc. Imp. Nat. Moscou, 1897, pp. 278–89 (8 figs.).
§ Bull. Soc. Zool. France, xxii. (1897) pp. 235–6.
‖ 'A Text-Book of Zoology,' by T. Jeffery Parker and W. A. Haswell. Vol. i., xxxv. and 779 pp., figs. 1–663. Vol. ii., xx. and 683 pp., figs. 664–1173. 8vo, Macmillan & Co., London, 1897.
¶ Biol. Centralbl., xviii. (1898) pp. 139–57.

is to be referred to a reaction of the organism to external influences (bionomic conditions) to which the individual was exposed during its life-time.

(2) Similar parents produce similar offspring.

(3) If there are differences already present in the germs, the cause must be found in the parents; it is a case of inheritance. A spontaneous germinal variation, without a corresponding influence on the parents, is impossible.

(4) The possibility of the inheritance of acquired changes must be granted.

Relationship of Amphioxus and Balanoglossus.* — Mr. E. W. MacBride compares the threefold origin of the cœlom in *Amphioxus* with that in *Balanoglossus.* The trunk cœlom becomes divided into separate muscle segments, which are differentiated into a dorsal muscular and a ventral thin-walled portion. The "collar cœlom" undergoes a similar differentiation, but the two portions do not for a long time become constricted off from one another; and even when this occurs, the ventral part does not become confluent with the ventral part of the trunk cœlom. "The ventral part of the collar cœlom grows back externally to the trunk cœlom, forming two ventral lateral ridges, which reach some little distance behind the last gill-slit which is formed." These ridges are really the first rudiments of the atrial folds, and the contained cœlom gives rise to the ventral muscle of the atrial cavity. "Now in *Balanoglossus* the hinder end of the collar extends over and covers the first gill-slit, and the suggestion of Bateson that this represents the first beginning of the formation of an atrium like that of *Amphioxus* is borne out by the facts just narrated." Mr. MacBride also criticises very adversely Lwoff's contention that only certain cells of the gastrular invagination are truly endodermic.

A Japanese Amphioxus.† — H. Nakagawu describes a species of *Amphioxus* found in abundance at Amakusa, Kyushyu. Its "formula" as to segments does not agree with that of any of the nine species noted by E. A. Andrews.

Tailless Batrachians of Europe.‡—Mr. G. A. Boulenger has published through the Ray Society the first part of a description of the tailless Batrachians of Europe. There is a very interesting introduction, dealing with the classification, external characters, integument, dermal secretion, skeleton, viscera, habits, voice, pairing and oviposition, spermatozoa, eggs, development and metamorphosis, tadpoles, hybrids, and geographical distribution. The rest of the volume discusses the Discoglossidæ and Pelobatidæ. There are charming plates by Mr. P. J. Smit, and abundant excellent figures by Mr. J. Green. The second part of this valuable addition to zoological literature is to follow in a few months.

Habits and Life-History of Frog.§—H. Fischer-Sigwart has published his note-book of observations on *Rana fusca.* He discusses the

* Proc. Cambridge Phil. Soc., ix. (1897) pp. 309-13.

† Annot. Japon. Zool., i. (1897) pp. 125-32.

‡ Ray Society, 1897, part i., 210 pp., 10 pls., and 76 figs.

§ Vierteljahrschr. Nat. Ges. Zürich, xlii. (1898) pp. 238-316 (1 pl.).

spawning, development, diet, enemies, diseases, hibernation, &c., and gives some carefully compiled statistics.

Sense of Direction.*—G. Reynaud has made observations and experiments on pigeons, which lead him to the conclusion that the sense of direction from a distance is located in the semicircular canals, and has the effect of leading the animal to reverse the path over which it has been transported. More precise details as to the experiments are, however requisite.

Openings in the Wall of the Body-Cavity in Vertebrates.† — Mr. E. J. Bles finds that there is an interesting and compensating correlation in the adult Elasmobranchii, Ganoidei, Dipnoi, some Teleostei, Amphibia, certain Chelonia and Crocodilia, in the development of nephrostomes and of abdominal pores.

Only in some Elasmobranchs are both present; in most Elasmobranchs, and in all other groups, they are mutually exclusive. In the higher Teleostei, in *Hatteria*, and in some Crocodiles and Chelonians, both have been lost.

Anura hold an intermediate position in so far as the nephrostomes are present, but they are not connected with the renal system. The body-cavity communicates with the vascular system (1) by the nephrostomes and (2) through stomata. The latter alone form a communication between the body-cavity and the lymphatic system in the Saurii and Mammalia, which have neither abdominal pores nor nephrostomes.

If stomata were not present in those Teleostei and Saurii which have no abdominal pores or nephrostomes, these would form the only cases of a closed body-cavity.

The function of the abdominal pores, like that of the nephrostomes, is to void waste products from the body-cavity. In Pisces and the lower Amphibia the body-cavity is to a great extent excretory.

The evidence does not on the whole favour the view that the abdominal pores represent a pair of segmental tubes. They seem to be simple perforations, and are not necessarily homologous.

Suprarenal Bodies.‡—MM. B. Moore and Swale Vincent describe the colour-reactions of the chromogen in the medulla of mammalian suprarenal capsules, and show that a chromogen having the same chemical nature is present in the paired segmental suprarenal bodies of Elasmobranch fishes. This is an interesting chemical corroboration of the conclusion, otherwise arrived at, that the paired suprarenal bodies of Elasmobranchs correspond structurally and functionally with the medulla of the mammalian suprarenal capsules.

Suprarenal Capsules in Lophobranch Fishes.§—M. —. Huot makes a preliminary note on this subject which he has studied in young embryos of *Syngnathus Dumerilii*. He finds that the structures in question arise from two diverticula which appear as external buds on the posterior part of the Wolffian duct. The author does not as yet make any reference to the fact that the suprarenals of Teleosteans are in

* Comptes Rendus, cxxv. (1897) pp. 1191-4.
† Proc. Roy. Soc., lxii. (1898) pp. 232-47. ‡ Tom. cit., pp. 280-3.
§ Comptes Rendus, cxxvi. (1898) pp. 49-50.

all probability only partially homologous with those of Elasmobranchs or higher animals.

Air-bladder of Fishes.*—Dr. J. S. Haldane gives an account of what has been ascertained with regard to the conditions which determine the separation and absorption of gas in the swimming- or air-bladder. The belief which has long been current is that the chief function of the air-bladder is to enable its possessor, by compressing or relaxing its muscles, to increase or diminish its specific gravity, and thus to alter the depth at which it swims. Delaroche (1809) supposed that the muscles were in a state of tonic contraction which becomes more or less rigorous as the animal rises or goes down, so that the specific gravity is kept constant. But the careful investigations and experiments of Moreau † showed that the fish makes no use of its muscles in regulating the volume of its air-bladder. When the fish descends, the air in the bladder is compressed, and the specific gravity of the body increases, so that it tends to sink farther and farther; and, conversely, if the fish ascends the air expands, and if it goes too far it may be carried helplessly to the surface, unless it has a permeable air-duct. It thus behaves like the toy known as the "Cartesian Diver," and its position is at best one of unstable equilibrium which the smallest movement upwards or downwards could disturb. Compression of the air-bladder, even when it is very muscular, seems accidental and momentary, as by a sudden and violent movement. Moreau's further experiments show that the swimming-bladder may assist the fish in balancing itself at any depth, but that the action is a very slow one. Thus, he determined the specific gravity of a fish which had lived at the surface for some time, sank it in a cage to a greater depth, and tested it again at the same pressure as before. The fish was much lighter, because air had been gradually secreted into the bladder until its specific gravity corresponded with that of the water. Again, when an air-bladder was artificially emptied, the fish sank at once to the bottom, but in a few hours was able to swim about again. A float was attached to one fish and a sinker to another, with the result that the first could not leave the surface, the second could not leave the bottom; but a few hours later both were swimming about together, one having absorbed, the other having secreted sufficient gas to readjust matters. The absorption and secretion would therefore appear to be in some sense under voluntary control, and a fish will be able to live comfortably at any depth if the change be made gradually enough.

Early in the century Biot and others discovered that the gas in the swimming-bladder is not air, but a variable mixture of oxygen and nitrogen with about 1 or 2 per cent. of carbonic acid, and that the percentage of oxygen is higher the greater the depth at which the fish is caught. Moreau confirmed this, and showed that, if the bladder be artificially emptied, the gas secreted gradually into it is richer in oxygen than before, and much richer than air. Therefore, apparently, pure or nearly pure oxygen is secreted. In some fishes, however, such as *Coregonus Acronius*, the air-bladder is sometimes filled with pure nitrogen. The theory of diffusion of gases does not meet the case; for the

* Science Progress, vii. (1897) No. 6, pp. 120–30.
† 'Mémoires de Physiologie,' Paris, 1877.

oxygen tension of blood passing through the wall of the air-bladder is less than that of air, owing to the using up of oxygen for respiratory purposes. Hence the blood will absorb oxygen from the air-bladder, the percentage of nitrogen will be increased, and it too will be absorbed. Thus, on the diffusion theory, all the gas would disappear from the air-bladder, whereas it may even increase in quantity. Section of the sympathetic nerve-fibres to the walls of the air-bladder hastens the secretion of gas into the empty bladder; section of the vagus branch stops it entirely. It is not probable that the "retia mirabilia," discs of finely divided vessels in the walls of the swim-bladder, are directly connected with the secretion of gas, since they are under the epithelial lining. The epithelium itself is often differentiated into gland-like structures, as described by Coggi. These may be real air-glands, but they have never been fully investigated. It seems probable that molecules of gas are liberated from some form of combination within the cells lining the air-bladder, and that the process is continually going on. Some diffusion outwards must be constantly occurring, and when a fish is asphyxiated it quickly uses up the oxygen in the air-bladder.

If the gas be thus liberated from combination within the cells, Mr. Haldane concludes, we have in the animal kingdom a process analogous to the liberation of oxygen from the green parts of plants, and the fixation of free nitrogen by the parasitic organisms in Leguminosæ, and it would seem that life is not so essentially an oxidation process as is commonly supposed.

Hornet's Venom antagonistic to Viper's.*—M. C. Phisalix has made a number of experiments which go to show that the venom of hornets acts as a vaccine against the venom of vipers. The immunising substance is not destroyed by being heated at 120° C.; it is soluble in alcohol; it is neither an albuminoid nor an alkaloid; but its real nature remains obscure.

Tunicata.

South African Tunicata.†—Dr. C. Ph. Sluiter describes a collection of thirty-two Ascidiacea collected on Prof. M. Weber's South African expedition. In his introduction he discusses the vexed question of the classification of Ascidiacea, and gives his reasons for following this arrangement:—

A. Ascidiacea socialia (Clavelinidæ).
B. Ascidiacea merosomata (= Aplousobranchia Garstang excl. Clavelinidæ).
C. Ascidiacea holosomata.
  I. Phlebobranchiata (= Phlebobranchia Lahille and Garstang excl. Clavelinidæ).
  II. Stolidobranchiata (= Stolidobranchia Lahille and Garstang).

The collection of thirty-two species includes twenty-eight which are new.

* Comptes Rendus, cxxv. (1897) pp. 977–9.
† Zool. Jahrb. (Abth. Syst.), xi. (1897) pp. 1–64 (7 pls.).

INVERTEBRATA.

Potamoplankton.*—Dr. O. Zacharias discusses the plankton which he has demonstrated in many rivers. It consists of Protozoa, Rotifers, and Crustacea (lists of which are given), accompanied by many minute plants,—Phycochromaceæ, Chlorophyceæ, and Diatoms.

Earthworms and Moles.†—Prof. J. Ritzema Bos corroborates very circumstantially the often asserted, but often doubted, fact that moles store earthworms for winter and wound them so that they are unable to escape. About 300 were got from one mole's nest, all decapitated. Three to five segments had been bitten off. This prevents burrowing, and the cold weather probably prevents rapid regeneration.

Mollusca.

Abyssal Molluscs.‡—M. Arnould Locard points out that, besides the various littoral areas peopled by Molluscs, there is in the Atlantic, as in the Mediterranean, an abyssal area, inhabited by a "polybathic" Molluscan fauna, the members of which are able to live and develop at depths of 2000 m. or more. This fauna is rich in Gastropods, and also includes Scaphopods and many Lamellibranchs.

α. Cephalopoda.

Posterior Salivary Glands of Octopoda.§—Dr. R. Krause has investigated the structure and function of the posterior salivary glands of the Octopoda. He concludes, contrary to the opinion of most investigators, that these glands have a considerable functional significance. The name "pharyngeal mucous glands," proposed by Krukenberg, and accepted, among others, by Vogt and Jung, he regards as quite unsuitable, for these glands do not secrete mucus, at least not in appreciable quantities. On the other hand, their secretion is rich in albuminates, and has a powerful fibrinolytic effect. To many animals the secretion is a deadly poison, probably operating on the central nervous organs, and it is used by *Octopus* for killing the animals required for food. The glands show a singular kind of secreting mechanism, which is conditioned by the peculiarities of their blood-supply.

γ. Gastropoda.

Nerve-Cells of Gastropods.||—Mr. C. F. W. McClure finds that the nerve-cells of *Helix*, *Arion*, and *Limax* contain a large number of small bodies, which appear granular in character and are arranged in rows. Their staining affinities make it probable that they are essentially homologous with the chromophilous substance found in the nerve-cells of Vertebrates.

Fibrils were found in the axis-cylinder processes and cell-bodies of these nerve-cells. Their arrangement in the cell-body showed considerable diversity. In the majority, a concentric arrangement of fibrils

* Zool. Anzeig., xxi. (1898) pp. 41–8.
† Biol. Centralbl., xviii. (1898) pp. 63-4.
‡ Comptes Rendus, cxxvi. (1898) pp. 275–7.
§ SB. K. Preuss. Akad. Wiss. Berlin, 1897, pp. 1085-98.
|| Zool. Jahrb., xi. (1897) pp. 13–60 (2 pls).

and granular rows was marked. In other cells the fibrils wound about, like those figured by Flemming in the spinal ganglion-cells of Mammals. The arrangement of the small "chromophilous granules" in rows was found to be due to the fact that they are situated on and between the fibrils. In the nerve-cells of *Helix* the author found structures which undoubtedly correspond to the centrosomes and spheres commonly found in other cells.

Notes on Radulæ.*—Mr. F. C. Baker describes a number of radulæ which he has studied in preparing a report on the Molluscs of the Chicago area. He has also made some observations on the way in which the radula is used. In *Limnæa*, *Planorbis*, *Pleurocera*, *Campeloma*, &c. the motion of the tongue is precisely that of a cat lapping milk. Land snails, on the contrary, use the *jaw* for cutting a piece of leaf, &c., and the ribbon is pressed against the jaw and assists in cutting the lower part of the piece selected.

Structure of Prosobranchs.†—M. Alex. Amaudrut distinguishes three areas of growth in the anterior region of the Prosobranch body:—(*a*) Terminal elongation in front of the tentacles; (*b*) intercalary or post-tentacular elongation; and (*c*) dorsal intercalary elongation. These elongations may be isolated or combined. The object of this paper is to show their influence on the arrangement, form, and structure of the anterior organs, particularly in connection with the alimentary canal.

Arthropoda.

a. Insecta.

Wings of Insects.‡—MM. J. H. Comstock and J. G. Needham discuss the importance of a study of the homologies of the wing-veins, and describe their method. In this preliminary chapter they hardly advance beyond the sentence that "although there is no doubt that the courses of the principal wing-veins of primitive insects were determined by the position of the principal tracheæ of the wings, the wing-veins have been more or less modified to meet the needs of adult life; while at the same time the tracheæ of the immature wing, serving the purpose of respiration, and lying more or less free within the wing-sac, have not been forced to follow closely the changes in the cuticular thickenings of that sac."

Geographical Distribution of Dragon-flies.§—Mr. G. H. Carpenter has a learned essay on this subject. We cannot do better than quote from the last paragraph:—"The largest and most dominant sub-families, the Libellulinæ and Cœnagrionidæ, have the largest percentage of widely ranging genera. These groups, it will be remembered, are better represented in Tertiary than in Secondary rocks, and are clearly the most vigorous and flourishing branches of the order. The Æschinæ, a group which seems to have passed its zenith, and the Corduliinæ, show a larger proportion of forms peculiar to various regions. Lastly, in the Gomphinæ and the Agrioninæ, with an excessively large percentage of

* Journ. Cincinnati Soc. Nat. Hist., xix. (1897) pp. 81–92 (2 pls.).
† Comptes Rendus, cxxvi. (1898) pp. 259–62.
‡ Amer. Naturalist, xxxii. (1898) pp. 43–8 (3 figs.).
§ Proc. R. Dublin Soc., viii. (1897) pp. 439–68 (1 pl.).

genera of restricted range, we see the evidence of their geographical distribution strongly confirming the opinion of students of their structure, that they are the most primitive of the dragon-fly sub-families."

How Flowers attract Insects.*—Another contribution by Prof. F. Plateau to our knowledge of this subject treats of anemophilous flowers, and of such as have but little natural colouring; and he draws from his observations conclusions favourable to his view already expressed, that insects are but little attracted to flowers by the sense of sight, chiefly by that of smell.

In all the species of strictly anemophilous flowers observed, 17 in number, all of some green or brown tint, and not visited at all by insects in nature, it was sufficient to place on them fragrant artificial nectar in order to attract numbers of insects of different kinds, chiefly Diptera and Hymenoptera. The author enumerates moreover 91 species, belonging to a great variety of natural orders, which are entomophilous, but in which the flowers are inconspicuous, either bright green, very pale green, or brown.

In summing up his conclusions in the concluding part of his paper, Prof. Plateau recapitulates his reasons for regarding the sense of sight as only a secondary one in attracting insects to flowers. If the conspicuous parts of flowers are removed insects still continue to visit them, and they are at once attracted to flowers which they do not ordinarily visit if these are smeared with honey. Where a species varies in the colour of its flowers, they exhibit neither preference nor antipathy to one colour over another. Artificial flowers made of paper or calico, and very closely resembling real flowers, do not attract insects, while they do if made of leaves which have a vegetable scent. Inconspicuous flowers completely hidden by foliage are still abundantly visited by insects if scented.

Mimetic Attraction.†—Dr. F. A. Dixey has shown that the process of mimetic assimilation may start from a given form and proceed along *several* divergent paths. Thus from *Pieris phaloe* five divergent series of mimetic modifications could be traced, each passing through a graduated series of closely allied forms until it terminated in a *Pieris* or *Mylothrix*, bearing a more or less intimate relation with some protected form or forms of entirely different affinities. In these instances the model towards which the series tended was a member of a "Müllerian group"—an association of inedible species sharing a common notoriety of colouring. The ordinary Batesian mimicry between edible and inedible can exist only when the numbers of the mimic are insignificant compared with those of the model, whilst a Müllerian group gains in strength with every fresh accession. The attractive power in Batesian mimicry acts only from model towards mimic, whereas in Müllerian association the attraction is mutual and tends to produce reciprocal changes. This reciprocal mimetic attraction is probably the more important of the two. As a consequence of the keen struggle in the Neotropical fauna, scarcely any conspicuous form is completely isolated. If edible, it is generally

* Bull. Acad. R. Sci. Belgique, xxxiv. (1897) pp. 601-44, 847-80. Cf. this Journal, 1897, p. 121.

† Trans. Ent. Soc. London, 1897, pp. 317-31 (1 pl.).

a Batesian mimic; if nauseous, it tends to be drawn into the vortex of one of the great Müllerian groups.

Mimicry in Insects.*—Mr. R. Trimen, in his Presidential Address to the Entomological Society of London, discusses the evidence in relation to (*a*) persecution of insects by insectivorous foes; (*b*) possession of malodorous and distasteful juices by certain groups; (*c*) rejection or avoidance of the insects provided with offensive juices; and (*d*) loss occasioned to distasteful species by the attacks of young and inexperienced enemies. It is admittedly on the co-operation of these factors that the theory of mimicry depends.

Experiments as to Coloration of Butterflies.†—Dr. F. Urech used a thread to constrict the wings of *Vanessa urticæ* in the pupa state, and observed the results. Some parts of the wing were free from or very poor in scales. The coloration was changed, but unequally, and never so as to render the species unrecognisable. It seemed as if the colouring was more changed outside the area of constriction than within it. In what way the alteration of pressure results in a change of coloration remains obscure. We shall, however, doubtless hear more of this ingenious experiment.

Temperature and Modification.‡—Mr. F. A. Dixey gives a very useful summary of the important experimental researches made by Mr. Merrifield during the last ten years on the relation of temperature to modification in Lepidoptera. The changes induced were mainly of three kinds:—(1) general change, often striking, in the colouring, without material alteration in the markings; (2) change caused by the substitution of scales of a different colour, either singly and scattered, or so grouped as to cause a material change in pattern; (3) change in general appearance caused by imperfection in the development of the scales or of their pigment.

Experiments on Warning Colours.§—Mr. Frank Finn has made some interesting experiments with a Tree-shrew (*Tupaia ferruginea*), which showed that this animal has a very strong objection to the "protected" Danainæ and to *Papilio aristolochiæ*. It constantly refused them, the former absolutely, unlike the babblers previously experimented with, which generally showed their dislike of the Danainæ merely by preferring other forms. Further experiments with a bull-frog were not so satisfactory. The Amphibian appeared to object to *Danais chrysippus* more than to *D. eucharis*, yet not very seriously to either. But sufficient opportunity for choice was not given.

Myrmecophilous Coleoptera.‖—Maurice Pic gives a long list of myrmecophilous Coleoptera collected in Algiers, and describes *Oxysoma sefrensis* sp. n.

Crickets as Thermometers.¶—Mr. A. E. Dolbear finds that, while a single cricket chirps with no great regularity, when great numbers are

* Trans. Ent. Soc. London, 1897, pp. lxxiv.–xcvii.
† Zool. Anzeig., xx. (1897) pp. 487–501.
‡ Nature, lvii. (1897) pp. 184–8 (13 figs.).
§ Journ. Asiatic Soc. Bengal, lxvi. (1897) pp. 528–33.
‖ Bull. Soc. Zool. France, xxii. (1897) pp. 220–3.
¶ Amer. Naturalist, xxxi. (1897) pp. 970–1.

chirping together they keep time as if led by the wand of a conductor. The rate of chirp, he says, seems to be entirely determined by temperature; so much so that the temperature may be easily computed if the number of chirps is known. Thus at 60° F. the rate is 80 per minute, at 70° F. it is 120; this gives a change of four chirps for each degree. Below 50° F. the cricket has no energy to waste, and the rate is only 40 chirps per minute.

Chromatic Tetrads in Spermatogenesis of Grasshopper.*—Dr. E. V. Wilcox answers Dr. E. B. Wilson's criticism of his account of the spermatogenesis in *Calopterus*, and adheres to his previous conclusions. The doubling of the normal number of chromosomes in the prophases of the first maturation division is not due to a longitudinal splitting of the chromosomes. In the spireme of spermatocytes of the first order the chromosomes arise separately and independently, but afterwards become associated in pairs, and then by conjugation form tetrads, the components of which are all unlike.

Development of Heart in Agelastica Alni.†—Herr A. Petrunkewitsch describes the origin of the heart from a closure of the mesoderm on the dorsal median line of the embryo. Thus there is formed a canal, which Tichomiroff called gastro-vascular, with walls consisting externally of mesoderm, and internally (but only in part, i.e. ventrally) of endoderm. But it is perhaps enough to say that the author confirms what Tichomiroff described in *Bombyx mori* and *Sphinx ocellata*.

Apterygota of Kiew.‡—A. Scherbakow gives a list of the Collembola and Thysanura of the Kiew district, enumerating 67 species and 19 varieties. He describes a new genus *Mesira*, and three new species.

Lepidoptera injurious to Sugar-Cane.§—M. Edmond Bordage discusses *Diatræa striatalis* and *Sesamia nonagriodes* whose larvæ, known as "Borers," do injury to the sugar-cane in Reunion and Mauritius. The identity and synonymy of these two forms seems to have got strangely jumbled, and the note is intended to put matters straight.

Psyche Helix.‖—Herr I. Ingenitzsky has some notes on the life-history and habits of *Psyche* (*Epichnopteryx*) *helix* Sieb., whose larvæ, pupæ, and female imagines live in earth-like coiled tubes like snail-shells. It occurs very abundantly in Central Asia, sometimes damages even cultivated plants, and appears to be sometimes parthenogenetic. Its state in the different seasons is described.

β. Myriopoda.

Segmentation of Myriopod Body.¶—Dr. R. Heymons points out the close resemblance between the development of Chilopoda and Hexapoda. On the head-region of the *Scolopendra*-blastoderm the following segments are seen:—(1) Antennary, (2) intercalary, (3) mandibular, (4 and 5) two maxillary segments. Then follows, as in all Chilopods, a

* Anat. Anzeig., xiv. (1897) pp. 194–8.
† Zool. Anzeig., xxi. (1898) pp. 140–3 (3 figs.). ‡ Tom. cit., pp. 57–65 (9 figs.).
§ Comptes Rendus, cxxv. (1897) pp. 1109–12.
‖ Zool. Anzeig., xx. (1897) pp. 473–7 (1 fig.).
¶ SB. K. Preuss. Akad. Wiss., 1897, pp. 915–23 (2 figs.).

post-oral segment with the foot-jaws or maxillipedes. It is not improbable that the clypeus of Insects and Myriopods may be referable to the pre-oral head-lobes of Annelid-like ancestors.

The posterior maxillæ of Chilopoda and Hexapoda are not homologous with the most anterior pair of limbs in Diplopoda. The exact homologues are wanting in Diplopoda, the corresponding segment being more or less rudimentary and without appendages. This is seen clearly in *Julus* and *Glomeris*, and is probably true for *Polydesmus* and other forms.

The gnathochilarium of Diplopoda is to be interpreted as a fusion of the hypopharynx with a maxillary pair split in two halves.

δ. Arachnida.

Remarkable Case of Protective Resemblance.*—Dr. E. A. Goeldi describes a Brazilian species of *Cyclosa* which illustrates a remarkable protective resemblance. On the web there hangs a tube of detritus, apparently no random structure; the spider forms as it were part of this tube; lying horizontally it exactly fills up a gap; its dorsal and lateral markings correspond most deceptively with the irregular markings of the particles composing the tube of debris.

Development of Trombidion holosericeum.†—S. Jourdain describes the successive stages:—(1) The embryonic form within the egg-shell; (2) the hatched hexapod parasitic larva; (3) the sedentary nymph; and (4) the 8-limbed sexual adult.

Harvest-Mites.‡—P. Mégnin calls attention to the numerous species with red hexapod larvæ (*Rougets*), parasitic on insects and mammals—dogs, hares, wild rabbits, man, &c. He instances *Trombidion Gymnoterorum*, *T. holosericeum*, and *T. fuliginosum*, abundant in various localities.

Hydrachnida of Germany.§—Dr. R. Piersig has published another part of his magnificent monograph on the Hydrachnids of Germany.

Tardigrada from Spitsbergen.‖—Mr. D. J. Scourfield records *Macrobiotus hufelandii* C. Schultze, *M. tuberculatus* Plate, *Echiniscus arctomys* Ehrbg., and *E. spitsbergensis* sp. n., from mosses collected during the Conway expedition to Spitsbergen in 1896. Two further species were also seen, but were not specifically determined. The only previous record of a Water-bear (? *M. dujardini* Doy.) from the island was made by Dr. A. von Goes in 1862.

ε. Crustacea.

Reversal of Respiratory Current in Decapods.¶—Georges Bohn recently showed that the reversal of the direction of the current of water in the branchial chamber, which has long been known in *Corystes*, also occurs in *Carcinus mænas*, the common shore-crab. Garstang has shown

* Zool. Jahrb., x. (1897) pp. 563–8 (1 pl.).
† Comptes Rendus, cxxv. (1897) pp. 965–6. ‡ Tom. cit., p. 967.
§ Zoologica (Leuckart and Chun), Heft 22 (1897) Lief. 3, pp. 161–240 (8 pls.).
‖ Proc. Zool. Soc., 1897, pp. 790–1 (1 pl.).
¶ Comptes Rendus, cxxv. (1897) pp. 539–42; and Ann. Nat. Hist., i. 7th series (1898) pp. 20–3.

that in *Portumnus nasutus* the reversal also occurs. Bohn has now proved its occurrence in twenty-one species selected from various families. He discusses its advantages and disadvantages in connection with the parasitic Crustaceans often found in the branchial chamber.

Malayan Decapoda and Stomatopoda.*—Dr. J. G. de Man completes his report on a collection from Malacca, Borneo, Sumatra, and the Java Sea. He has dealt with 185 species, many of them new.

Some Rare Crustacea.†—Messrs. T. and A. Scott describe *Sunaristes paguri* Hesse, of which they have obtained several British specimens. The notes and drawings show the more important points of difference between this parasitic copepod and *Canuella*, and also the close relationship between these two and the genus *Longipedia* Claus. The authors have also notes on *Remigulus tridens* T. and A. Scott, which turns out to be synonymous with *Synatiphilus luteus* Canu and Cuénot; on *Diaptomus laciniatus* Lilljeborg from Loch Doon, Ayrshire (new to Britain); and on *Lathonura rectirostris* Lilljeborg from the same loch (new to Scotland.

Isopods of the 'Albatross' Expedition.‡—Herr H. J. Hansen reports on this collection. There were fifteen species—one terrestrial and well-known, fourteen marine and new. Of the marine species, eight are free-living, and one is parasitic on fishes; these nine are easily referred to well-established genera. The remaining five are new Bopyrinæ (four new genera), and are the more interesting since heretofore no Bopyrinæ have been found on truly deep-sea animals.

Synidotea.§—Dr. J. E. Benedict has made a useful revision of this genus of Isopods, which was instituted in 1878 by Harger to receive *Idotea bicuspida* Owen and *I. nodulosa* Kroyer, two species which now represent the two sections of the genus. The improved diagnosis reads:—Antennæ with an articulated flagellum. Epimeral sutures not evident above on the first four segments; on the last three the lines of demarcation are more or less distinct. Pleon apparently composed of two segments, united above but separated at the sides by short incisions. Operculum with a single apical plate. Palpus of maxillipeds three-jointed. Thirteen species are described and figured; seven being new.

Entomostraca of Plön.‖—Mr. D. J. Scourfield gives a list of 36 species of Cladocera, 10 of Ostracoda, and 18 of Copepoda, collected by him in the Grosser Plöner See and neighbouring pieces of water in July 1896. The list includes several rare and interesting species, e.g. *Ceriodaphnia setosa* Matile, *Alonopsis ? latissima* Kurz, *Candona stagnalis* Sars, *Heterocope appendiculata* Sars, *Canthocamptus vejdovskyi* Mrázek, &c., and shows that the Entomostracan fauna of the district immediately surrounding the Plön Fresh-water Biological Station is exceptionally rich.

* Zool. Jahrb. (Abth. Syst.), x. (1898) pp. 677–708 (11 pls.).
† Ann. Nat. Hist., xx. (1897) pp. 489–94 (2 pls.).
‡ Bull. Mus. Comp. Zool. Harvard, xxxi. (1897) pp. 95–129 (6 pls. and a map).
§ Proc. Acad. Nat. Sci. Philad., 1897, pp. 389–404 (13 figs.).
‖ Forschungsberichte Biol. Station Plön, v. (1897) p. 180 and table.

Non-marine Copepoda from Spitsbergen.*—Mr. D. J. Scourfield obtained, from mosses collected during the Conway expedition to Spitsbergen in 1896, a specimen of a Harpacticid, which, however, was damaged and could not be determined, and a few examples of *Cyclops bisetosus* Rehberg. Two of the latter exhibited peculiar abnormalities.

Eye of Corycæus.†—Dr. A. Steuer describes the structure of the eye in *Corycæus anglicus* Lubbock, confirming in general what has been observed in the allied *Sapphirina* and *Copilia*, but also furnishing more intimate details, especially in regard to the pigment-rod. His experiments led him to the conclusion that, in spite of its complexity of structure, the eye is functionally very imperfect, admitting of little more than perceptions of light and shade.

New Parasitic Copepods.‡—Surgeon P. W. Bassett-Smith has found a large number of new parasitic Copepods on fishes at Bombay. He erects a new genus *Helleria* for a member of the family Dichelesthina taken from the gills of *Cybium guttatum*, and describes thirteen new species of other genera.

North American Species of Diaptomus.§—Mr. F. W. Schacht gives a descriptive list of these, with diagnostic keys, and data as to distribution. Although the genus is the most cosmopolitan of its family, no species is known to be common to the mainlands of Europe and America, —a fact the more remarkable since almost the direct opposite is true of the companion genus *Cyclops*, of which only one or two species can be called peculiar to America.

Annulata.

Regeneration in Earthworms.||—Prof. E. Korschelt experimented with *Lumbricus rubellus*, *Allolobophora terrestris*, &c., and observed regenerative phenomena of much greater magnitude than Morgan and Hescheler saw. It seems that a small piece of 10–20 segments or so regenerates more successfully than a long piece. One piece of *L. rubellus*, consisting of 23 segments, regenerated 25 segments in front, and 62 behind. Pieces from the middle of the body are most regenerative; the process seems more difficult in the regions of head, gonads, clitellum, and tail. Yet no part can be said to be incapable of regeneration.

Origin of Setigerous Bulbs and Nephridia in Annelids.¶—M. Aug. Michel has studied this in the regeneration of *Nephthys* and *Allolobophora fœtida*, &c. In the caudal regeneration, the setigerous bulbs are *ectodermic*, the setigerous sacs *mesodermic*, and the nephridia *ectomesodermic*. Thus the results agree on the whole with those of the normal organogenesis, and favour the idea of parallelism between regenerative and embryonic processes.

* Proc. Zool. Soc., 1897, p. 792.
† Zool. Jahrb., xi. (1897) pp. 1–12 (1 pl. and 1 fig.).
‡ Ann. Mag. Nat. Hist., i. 7th series (1898) pp. 1–17 (7 pls.).
§ Bull. Illinois Lab. Nat. Hist., v. (1897) pp. 97–207 (15 pls.).
|| SB. Ges. Nat. Marburg, 1897, pp. 72–105. See Zool. Centralbl., v. (1898) pp. 50–2.
¶ Comptes Rendus, cxxvi. (1898) pp. 50–2.

Cirrophore of Polynoidæ.*—G. Darboux fils distinguishes on the dorsal cirrus of Polynoidæ the cirrophore and the cirrostyle. The cirrophore is a protrusion formed by an evagination of the whole musculo-cutaneous envelope. At the base of this there is a glandular pocket where the cirrostyle is inserted on the cirrophore by a delicate annular epidermic membrane. The delicacy of this membrane explains the caducous nature of the cirrostyles. Moreover, when the animal is irritated the pocket is filled with mucus which strains the line of insertion between cirrophore and cirrostyle. A simple figure would have made the paper more readily intelligible.

Irish Annelids.†—Prof. W. C. McIntosh gives an annotated list of collections from the Museum of Science and Art in Dublin, and from Prof. A. C. Haddon. Two new forms, *Harmothoë Fraser-Thomsoni* and *Sthenelais* sp. (imperfect) are recorded.

New British Echinuroid.‡—Prof. W. A. Herdman describes *Thalassema Lankesteri* sp. n., female specimens of which were dredged in fifty fathoms off the Isle of Man. The specific diagnosis runs:—Length about 20 cm.; proboscis nearly as long as trunk, and in most of its extent wider; tip of proboscis truncated and slightly indented; surface evenly tuberculated all over; colour apple-green on the trunk, paler on the proboscis; longitudinal musculature not divided into bundles; a single pair of anterior nephridia; nephrostomes spirally twisted; cloacal nephridia branched, with numerous ciliated funnels on the ends of the branches.

Herdman's new species agrees with *Hamingia* in having branched cloacal nephridia, while in all other respects it either agrees with or comes nearer *Thalassema*.

The green pigment has been examined by Prof. Sherrington, Dr. Noel Paton, and Miss Newbigin, with the result that the substance, which may be appropriately called *thalassemin*, is shown to be unrelated to hæmoglobin or chlorophyll, not a respiratory pigment, but on the whole nearer to bonellein than to any other known pigment.

Chætopterin.§—Prof. E. Ray Lankester gives an account of what is known in regard to this pigment, which he discovered in 1864 in the intestinal wall of *Chætopterus*. He describes its mode of occurrence and its optical properties. After discussing the colour and absorption spectra of bonellein, which is widely different from chætopterin, he records the measurements of the absorption spectra of both pigments recently made by Prof. Engelmann.

Nematohelminthes.

Vitality of Young Round-Worms.‖—Herr G. Fritsch made an osmic acid preparation of a mature female of *Anguillula aceti*, and sealed it up with asphalt. For fourteen days the embryos showed signs of life. This is another striking illustration of the extraordinarily small respiratory demands of these organisms.

* Comptes Rendus, cxxvi. (1898) pp. 257–9.
† Proc. R. Dublin Soc., viii. (1897) pp. 399–404.
‡ Quart. Journn. Micr. Sci., xl. (1897) pp. 367–84 (2 pls.).
§ Tom. cit., pp. 447–68 (4 pls.). ‖ Zool. Anzeig., xxi. (1898) pp. 110–2.

Terminal Organs of Excretory Canals in Ascarids.*—Prof. N. Nassonov discusses Hamann's description of these structures, and states his own observations. The terminal unicellular lymphatic gland is associated with a gigantic partially phagocytic cell of very complex structure.

Œsophageal Gland of Nematodes.†—L. A. Jägerskiöld describes (in *Strongylus armatus* and *Dochmius duodenalis*) a gland which lies along the dorsal surface of the œsophagus, and has a duct opening on the anterior margin of the mouth-cavity.

Platyhelminthes.

New Prorhynchid Turbellarian.‡—Prof. W. A. Haswell describes a remarkable Turbellarian found by Dr. Chilton in deep wells in Canterbury, New Zealand. It agrees with von Graff's *Prorhynchus* in having a ciliated groove, anterior mouth, and chitinous copulatory organ. But it differs in several important points. Such are the more complex pharynx, the bifurcate posterior vessel of the excretory system, the rod-like chitinous supports of the penis sheath, the laterally placed vitello-ovary, and the unpaired laterally placed testis. The disposition of the reproductive organs is probably unique. Also very remarkable is the mode of copulation, for there is strong evidence that the sperms of one individual are conveyed into the interior of the ovary of another by the penis piercing the body-wall and penetrating to the ovary. The structure of the penis and vesicula seminalis suggests a hypodermic syringe, with a compressible ball instead of a cylinder and piston.

In view, however, of the necessity for a more thorough knowledge of structure of the described species of *Prorhynchus*, Prof. Haswell thinks it best to regard this New Zealand form provisionally as a member of the genus, and proposes the name *P. putealis*.

New Parasites.§—Herr P. Mühling describes the following new species:—*Urogonimus Rosittensis* from the bursa Fabricii of *Turdus pilaris*; *Distomum exiguum* in the bile-duct of *Circus rufus*; *D. imitans* in the intestine of *Abramis brama*; *D. refertum* from the gall-bladder of *Cypselus apus*; *D. nematoides* from the intestine of *Tropidonotus natrix*; *D. simillimum* from the intestine of *Fuligula nyroca*; *D. spiculigerum* from the same; and *Monostomum alveatum* (named but not described by Mehlis) from *Fuligula marila*. He has also notes on some forms which, though not new, are but little known; on the "cysts" of *Echinostomum ferox* and *D. turgidum*; and on some parasites in unusual hosts, e.g. *Schistocephalus solidus* in the edible frog.

New Tapeworm in a Bird.‖—Mr. A. E. Shipley describes *Drepanidotænia hemignathi* sp. n. from the intestine of *Hemignathus procerus*, Sandwich Islands. The diagnosis reads:—Length 1–2·2 cm.; breadth, in the middle of the body, 2 mm. Head flattened and compressed, rostrum with a crown of ten hooks; each hook 18–23 μ in length, and with but a slight trace of the inner limb of the forked base. Neck short.

* Zool. Anzeig., xxi. (1898) pp. 48–50.
† Bihang. K. Svensk. Vet. Akad. Handl., xxiii. (1897) Afd. iv. No. 5, 26 pp. and 2 pls.
‡ Quart. Journ. Micr. Sci., xl. (1898) pp. 631–45 (1 pl.).
§ Zool. Anzeig., xxi. (1898) pp. 16–24.
‖ Quart. Journ. Micr. Sci., xl. (1898) pp. 613–21 (1 pl.).

The first segments are short, but they very soon (eighth or tenth) show traces of reproductive organs. Genital pore unilateral. The posterior limit of each segment is sharply defined, and forms an angle of about 45 degrees with the sides. Egg spherical, diameter about 40–50 μ. The three pairs of embryonic hooks measure about 20 μ each in length.

Incertæ Sedis.

New Genus of Enteropneusta.*—Dr. A. Willey describes *Spengelia porosa* g. et sp. n., from Lifu, Loyalty Islands:—"If it were not for the presence of vestigial roots in the collar nerve-cord, *Spengelia* (apart from its own peculiar features, e.g. dermal pits, splanchnic layer of *Punktsubstanz*, accessory genital pores not perforating the longitudinal musculature, &c.) might almost be defined as a *Glandiceps*, with synapticula between the branchial bars."

The genera of Enteropneusta fall naturally into three groups:—Group I., including *Ptychodera*, briefly characterised by the presence of an outer layer of circular muscles in the integument of the trunk, the occurrence of dorsal roots putting the fibrous layer of the collar nerve-cord in connection with the fibrous layer of the epidermis; and the presence of liver-saccules and of synapticula between the branchial bars.

Group II., including *Schizocardium*, *Glandiceps*, *Spengelia*, characterised by the presence of an inner layer of circular muscles (inside the longitudinal layer) and by the occurrence of a long vermiform process extending forwards from the anterior end of the notochord or proboscis cæcum.

Group III., including *Balanoglossus*, characterised by the absence of circular muscles in the integument of the trunk, and by the absence of synapticula.

Fertilisation in Myzostoma.†—Herr K. Kostanecki has investigated the maturation and fertilisation phenomena in *Myzostoma glabrum*. His main conclusion is a corroboration of Boveri's generalisation that the centrosomes of the first cleavage spindle arise from the sperm-centrosome. It was thought that *Myzostoma* was exceptional in this respect; but Kostanecki has shown that it is normal. There need be little hesitation, he says, in extending the generalisation to all Metazoa.

Rotifera.

Impregnation of the Ova of Hydatina Senta.‡—According to Dr. Sadone's observation, the spermatozoa of the male *Hydatina*, which are injected into the body-cavity of the female, reach the totally enclosed eggs by boring through the thin membrane of the ovary at a point where the mature ova are situated, a process which is not known in any other class of animals. The oval head of a spermatozoon was seen to attach itself to the membrane of the ovary, while the tail continued to make lashing movements in the body-cavity until the head was gradually forced through the membrane followed by the tail; the whole process taking eight to ten minutes. It is probable that this process is the same in other Rotifers.

* Quart. Journ. Micr. Sci., xl. (1898) pp. 623–30 (1 pl.).
† Arch. Mikr. Anat., li. (1898) pp. 461–80 (2 pls.).
‡ Zool. Anzeig., xx. (1897) pp. 515–7.

Echinoderma.

Function of Pyloric Cæca in Starfish.*—Ellen A. Stone finds that the pyloric cæca of *Asterias vulgaris* have a definite pancreatic function. Their abundant secretion contains three ferments :—

(1) A proteolytic ferment, comparable to trypsin, which acts best in a slightly alkaline medium, to good advantage in a neutral solution, but scarcely at all in an acid medium ; converting proteids into diffusible peptones, and breaking down some of these even further into amido-acids, such as leucin and tyrosin.

(2) A diastatic ferment, acting rapidly upon starch, converting it through the dextrins into maltose.

(3) A fat-splitting ferment, comparable to that of the pancreas, which breaks fats into their fatty acids and glycerin. But this is surely not quite so new as the authoress indicates (p. 1040) ; since even in such an elementary text-book as Thomson's 'Outlines of Zoology,' 2nd edition (p. 232), we read "these glands secrete tryptic, peptic, and diastatic ferments."

Development of Phyllophorus urna.†—Prof. H. Ludwig makes a preliminary communication in regard to the development of this Mediterranean Holothuroid. He confirms Kowalevsky's observation that the young are found within the body-cavity of the mother, but he has not yet succeeded in finding the earliest stages. It is doubtful whether the development normally occurs in the body-cavity, or in the ovarian tubes which might be readily ruptured. One of the interesting features of the young stages is their abundant equipment with calcareous bodies, of which there is hardly a trace in the adults.

Notes on Dendrochirota.‡—Hjalmar Östergren describes some of the differences among Dendrochirota ;—(*a*) as regards the disposition of the coils of the gut and the associated mesentery, (*b*) as regards the respiratory trees. He also describes some new species,—*Cucumaria longicauda*, *Thyone anomala*, &c.

Sphærothuria bitentaculata in Japanese Seas.§—Prof. K. Mitsukuri found this interesting Holothurian, looking externally like some simple Ascidian, at about 350 fathoms in the Sagami seas. Both specimens were caught by a long fishing line, and found attached to the jelly-mass which *Bdellostoma* secretes. Agassiz described its occurrence near the Galapagos Islands, and the discovery of this rare species at two places separated by the entire width of the Pacific is, to say the least, very interesting, and goes once more to establish the comparative uniformity of the deep-sea fauna. The discovery of the animals at intermediate localities would not now be surprising.

Protein Crystalloids in Nuclei of Amœbocytes.‖—Dr. Th. List describes the occurrence of crystalloid aggregates of a proteid nature within the nuclei of the wandering amœboid cells of *Sphærechinus*

* Amer. Naturalist, xxxi. (1897) pp. 1035–41.
† Zool. Anzeig., xxi. (1898) pp. 95–9. ‡ Tom. cit., pp. 102–10 (3 figs.).
§ Annot. Zool. Japon., i. (1897) p. 149.
‖ Anat. Anzeig., xiv. (1897) pp. 185–91 (4 figs.).

granularis. They are products of the nuclear substance, and possibly become pigment-granules.

Cœlentera.

American Fresh-water Jelly-fish.*—Mr. E. Potts has observed the budding and separation of free-swimming Medusæ from *Microhydra ryderi.* The jelly-fish was about 1/32 in. in diameter, of a somewhat prolate dome-shape, with a quadrate manubrium, four radial canals, and eight tentacles. The author found *Microhydra ryderi* among colonies of Bryozoa, on stones collected from the rocky bed of Tacony Creek, a rapidly flowing mill-stream near Philadelphia, Pennsylvania, a small affluent of the river Delaware, but far above tide-level. He observed the Medusoids in a tank in August. Details are promised.

Notes on Cubomedusæ.† — Mr. F. S. Conant found in Kingston Harbour, Jamaica, two very abundant Cubomedusæ—*Charybdea xaymacana* sp. n. and *Tripedalia cystophora* sp. n.—the latter requiring a new family Tripedalidæ between Charybdeidæ and Chirodropidæ, the two families hitherto recognised. After a description of the two new species and some notes on their unusual occurrence in shallow water, this preliminary communication contains an account of the eye and the otolithic sac. The occurrence of a free unsuspended otolith in a ciliated sac is probably unique among Medusæ. The mature eggs of *Tripedalia* pass from the ovaries into the stomach-pouches, and there develop up to the stage of free-swimming planulæ. The young are set free from the parent as ciliated planulæ, with posterior pigment-spots: they swim about on the surface for a day or two; they gradually lose their forward motion and rotate on their own axis in one spot. At this point they settle down, the pigment-spots migrate into the interior, tentacles are budded out, and in this condition they lived in the aquaria for three weeks without further development. Search for scyphistomas in the region where the jelly-fish were found was fruitless.

Irish Hydroids.‡—Mr. J. E. Duerden gives a list of the Hydroids of the Irish Coast, including 101 species,—35 Athecata, and 66 Thecata. His examinations made an addition of about 23 species to the Irish Hydroids, including two new species, and one new to Britain.

Distribution of Millepora.§—Prof. S. J. Hickson notes the absence of evidence that *Millepora* existed further back in history than what may be called geologically recent times, and the consequent difficulty of accounting for its present wide distribution in the West Indies, Red Sea, Indian Ocean, and the Pacific.

Tubularia indivisa.‖—Gösta Grönberg describes the structure of the hydranth-head and the stalk of *Tubularia indivisa*, amplifying, and in some particulars correcting Allman's description. The "pendulous lobes" of the endoderm described by Allman are probably the "tæniolæ." A specific peculiarity is found in minute endodermic canals in the oral

* Amer. Naturalist, 1897, pp. 1032–5.

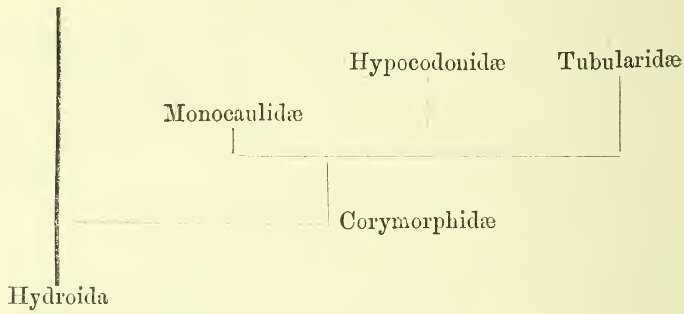
† Johns Hopkins Univ. Circ., 1897, pp. 8–10 (2 figs.); Ann. Nat. Hist., i. 7th series, 1898, pp. 31–40 (2 figs.).

‡ Proc. R. Dublin Soc., viii. (1897) pp. 405–20.

§ Zool. Anzeig., xxi. (1898) pp. 70–1.

‖ Zool. Jahrb., xi. (1897) pp. 61–76 (2 pls.).

region passing obliquely outwards and downwards from the gastro-vascular cavity, and equal in number to the proximal tentacles. No external pores were seen, but the canals probably correspond to those in *Amalthæa vardoensis* described by Loman. The canals in the stalk, described by Wright and Allman, are separated by true septa, but these are not regarded as of any phylogenetic importance. In regard to the oogenesis, the author differs from Doflein; the ovum does not arise from a syncytium of equivalent cells in which the best nucleus—primum inter pares—becomes the germinal vesicle; the ovarian cells are previously differentiated into ova and nutritive cells. The relationships of the Tubularidæ are thus indicated:—



Recent Progress in the Study of Graptolites.*—Dr. R. Ruedemann gives a useful synopsis of recent work in which he has himself had an important share. "Whatever the relations of the graptolites may be, it certainly is necessary for the understanding of the life-history of the individuals of the colonies to compare the graptolites with some class of living animals, and there is undoubtedly no other class available but the order of Campanulariæ. It also should not be forgotten that the virgula which always has been considered as constituting one of the principal differences between graptolites and campanularians, has been proved to be comparable to the hydrocaulus of the first theca of the Campanulariæ." "It is highly probable that many graptolites were indeed pseudo-planktonic, while some may even have gone further and have become free-floating or planktonic, and others are known to have been sessile at the bottom."

Porifera.

Spongillids of Lago di Garda.†—Sig. A. Garbini has found four Spongillidæ in this locality—*Euspongilla lacustris* Liebk., *Ephydatia fluviatilis* Liebk., *Ephydatia robusta* Potts, and *Carterius tubisperma* Potts. The particular interest of this note is that the two last-named species are new to Europe.

* Amer. Nauralist, xxxii. (1898) pp. 1–16 (28 figs.).
† Zool. Anzeig., xx. (1897) pp. 477–8.

Protozoa.

Text-Book on the Protozoa.* —MM. Y. Delage and E. Hérouard have published a large work on the Cell and the Protozoa. It combines a detailed description of types with a systematic account of the genera, and with a discussion of protoplasm and the cell as a sort of background. Four classes of Protozoa are distinguished:—Rhizopodia, Sporozoaria, Flagellia, and Infusoria. The book is adorned with great abundance of illustrations, many of which are coloured.

Argentine Protozoa.†—The fourth part of the late Prof. J. Frenzel's studies of Argentine Protozoa contains descriptions of many new Rhizopods. Four forms—*Gringa filiformis, Abœnia angulata, Eickenia rotunda, Microhydrella tentaculata*—represent new genera. There is also a general discussion of the classification and geographical distribution of fresh-water Rhizopods. More than half the European species are known outside Europe; and, although much has still to be done in the way of description and recording, the majority may be already called cosmopolitan. The talented author lost his life through an accident on the Müggelsee.

Studies on Amœbæ.‡—S. Prowazek observed a small amœba in an aquarium with very concentrated sea-water, and saw a peculiar behaviour of the contractile vacuole. In its diastole it was protruded on the periphery of the ectoplasm, and almost constricted off; in its systole it emptied itself *inwards*. As the process seemed to be normal, the observer suggests that the fluid in the vacuole was aerated or oxidised by the exposure, and that the process was really respiratory. In another note he describes the transformation of a small organism from a flagellate to an amœboid phase.

Fresh-water Rhizopods from Spitsbergen.§—Mr. D. J. Scourfield has found, in mosses collected during the Conway expedition to Spitsbergen in 1896, about twenty-one species of Rhizopods. None of these appear to be new to science, but they are nearly all new to the known fauna of Spitsbergen, as the only information about these animals previously published was a record of three species by Ehrenberg in 1874. The commonest form Mr. Scourfield found to be *Difflugia constricta* Ehrbg., but *Euglypha ciliata* Ehrbg. and *Trinema enchelys* Ehrbg. were also very abundant. The genera *Arcella*, *Clathrulina*, and *Gromia*, on the other hand, were each represented by only a single specimen.

Two new Protozoa.‖—Dr. R. Lauterborn, continuing his faunistic studies on the Upper Rhine, describes *Chromulina mucicola* sp. n., a flagellate Infusorian, living in large groups surrounded by a gelatinous secretion; and the ciliated Infusorian *Trichorhynchus Erlangeri* sp. n., which, besides being interesting in itself, is noteworthy in connection

* 'Traité de Zoologie concrète. Tome i. La cellule et les Protozoaires,' Paris, 1897, 8vo, xxx. and 584 pp., 870 figs.

† Bibl. Zoologica (Leuckart and Chun). Heft 12, Lief. 4 (1897) pp. 115–66 (4 pls.).

‡ Biol. Centralbl., xvii. (1897) pp. 878–85.

§ Proc. Zool. Soc., 1897, pp. 786–89.

‖ Zool. Anzeig., xxi. (1898) pp. 145–9 (2 figs.).

with distribution, since the only other known species is *Tr. tuamotuensis* from the South Sea Islands. The generic name will have to be changed, since *Trichorhynchus* was previously given by Schneider to a Gregarine; the new name *Mycterothrix* is proposed.

Protozoa of Pontine Marshes.*—Dr. G. Lindner describes some of the forms he observed in water from the malarial marshes—numerous Flagellata, the ciliate *Colpoda cucullus*, and a few amœboid forms.

New Cœlomic Gregarine.†—Maurice Caullery and Felix Mesnil describe an addition to the not very long list of cœlomic Monocystidea. They call it *Gonospora longissima*; it occurred in the general cavity of *Dodecaceria concharum* Œrst., one of the Cirratulid Annelids. It is remarkable (for a Gregarine) in exhibiting a phase of asporulate or endogenous multiplication, comparable to that in Coccidia.

* Biol. Centralbl., xvii. (1897) pp. 865–78 (3 figs.).
† Comptes Rendus, cxxvi. (1898) pp. 262–4.

BOTANY.

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

a. Anatomy.

(1) Cell-structure and Protoplasm.

Centrosomes in Plants.*—Reviewing the present state of our knowledge on this subject, M. L. Guignard insists on the improbability that these bodies, present in animals and in the lower divisions of the vegetable kingdom, should be absent from the higher plants. In animal cells the centrosome is regarded as the most important part of the centrosphere; it is a refringent corpuscle, often exceedingly minute. The centrosphere itself is composed of a substance which may be differentiated into two zones—the internal one hyaline, the external granular. In cells in a state of repose it is formed of the substance which some authors term archoplasm or kinoplasm, to distinguish it from nutritive protoplasm or trophoplasm. In this state there is sometimes one, sometimes there are two centrosomes, sometimes a considerable number lying side by side, constituting what may be called a *micro-centre*.

The author then proceeds to point out the variation in the structure and form of the centrosome in different families of Thallophytes:—round in the Fucaceæ, rod-shaped in the Sphacelariaceæ.† In these groups it appears never to be surrounded by a sharply differentiated sphere, while this is the case in certain Muscineæ. From observations made on nuclear division in the pollen-mother-cell of Angiosperms (*Nymphæa*, *Nuphar*, *Limodorum*), the author concludes that the formation of multipolar spindles, whether normal or accidental, is not a valid argument against the existence of dynamic centres in the division of the nucleus. There exist in the cytoplasm, at a certain moment, bodies distinct from ordinary granulations. It is probable that the higher plants are provided with differentiated kinetic elements the function of which is the same as that of the analogous bodies in animals and in the lower plants.

Movement of Protoplasm in Cœnocytic Hyphæ.‡—Mr. J. C. Arthur finds the streaming of protoplasm to be a universal phenomenon in the hyphæ of all Mucoraceæ examined,—*Mucor Mucedo*, *M. racemosus*, *Rhizopus nigricans*, *R. elegans*, *Phycomyces nitens*, *Sporidinia Aspergillus*, *Thamnidium elegans*, *Pilobolus crystallinus*. In this streaming movement it would appear that all the contents—cytoplasm, microsomes, food-bodies, nuclei, vacuoles—participate. There is sometimes an evident ectoplastic layer lining the cell-wall which does not take part in the movement; but this is often so thin that it is no longer visible. All kinds of granules are borne along in the current. The vacuoles, however large, are also swept along; and, at the right stage of growth for movement, the protoplasm is usually highly vacuolated. The movement is usually fitful. It does not take place in all the hyphæ of an individual plant at the same time, but occurs in some of the main filaments

* Comptes Rendus, cxxv. (1897) pp. 1148–53; Bot. Gazette, xxv. (1898) pp. 158–64.
† Cf. this Journal, 1897, pp. 107, 108.
‡ Ann. of Bot., xi. (1897) pp. 491–507 (4 figs.).

and in some of the branches leading from them. It continues for a time and then ceases without apparent reason. The rate of movement varies greatly, and is quicker than the rotation of *Nitella* or the circulation of *Tradescantia*; 3·3 mm. per minute was measured.

The author does not find, in the phenomena observed, any support for the theory of an autonomy of the vacuoles or of a special vacuolar membrane, advocated by De Vries and others. Return currents were occasionally seen, always occupying the periphery of the hyphal cavity; they never carry vacuoles. He considers the origin of the movement to be rather in osmotic absorption and exudation of water than in the vitality of the protoplasm itself.

Relations of Chloroplastid and Cytoplasm.*—Dr. A. J. Ewart contests the adequacy of the bacterium method employed by Kny and Kolkwitz to detect the assimilating energy of chlorophyll-grains. He states that the inhibition of the power of assimilation in chlorophyll-bodies contained in a living cell, which may persist for a time after the injurious agency has been removed, is due to a pathological condition which may be induced in the chloroplastids of many plants by the prolonged operation of almost any injurious agency of sufficient intensity to depress the functional activity of the chlorophyllous cells to the lowest possible ebb consistent with the preservation of vitality. From this pathological condition recovery may or may not be possible.

Histology of the Cell-wall.†—Mr. W. Gardiner has pursued his investigations on this subject, especially in relation to the threads of protoplasm which pass from cell to cell. He has been able to demonstrate, in a large number of cases, the presence of threads of undoubtedly protoplasmic nature, often of exquisite delicacy, which pass in large numbers through the walls of adjacent cells, not only where they are thinned by the presence of pits, but elsewhere also. He thinks there can be little doubt that such connecting threads occur universally in the cells of all the tissues of all plants. From this arises the fundamental conception that the plant-body must be regarded as a connected whole. It goes far, also, to explain the transmission of impulses and of nutrient material from one part of the vegetable organism to another.

In the case of pitted tissue, the author finds the pit-closing membrane to be invariably traversed by what he terms "pit-threads." But the threads are by no means confined to the pits; they often perforate the walls of the cells themselves, when he calls them "wall-threads." When pit-threads and wall-threads coexist in one and the same cell, the former are stouter and more readily stainable than the latter. The pit-threads are necessarily arranged in groups, and in each group the threads are arranged in bundles. The threads appear to be present *ab initio*; it would seem that in a given cell the whole system of connecting threads arises at an early stage, and that no subsequent development occurs. The theory of a system of open pits connected with one another is altogether discarded by the author.

The following is a list of the tissues in which the author has at present detected these connecting threads:—Cotyledons of *Tropæolum*

* Bot. Centralbl., lxxii. (1897) pp. 288–96. Cf. this Journal, *ante*, p. 101.
† Proc. Roy. Soc., lxii. (1897) pp. 100–12 (8 figs.). For Technique, see p. 240.

majus; endosperm of *Lilium Martagon*, *Fritillaria imperialis*, and *Hordeum vulgare*; root of *Ranunculus asiaticus*; leaf-stalk of *Tamus communis*, *Viscum album*, *Marattia elegans*, *Aucuba japonica*, *Prunus Laurocerasus*, *Nerium Oleander*, *Lilium Martagon*, *L. candidum*, *Salisburia adiantifolia*, *Asplenium rutæfolium*; flower-stalk of *Taraxacum dens-leonis*; pulvinus of *Mimosa sensitiva*, *Robinia Pseudacacia*; tendril of *Cucurbita Pepo*.

Tensile Strength of Cell-walls.*—From experiments made on various vegetable fibres, Mr. H. N. Dixon concludes that the tensile strength of cell-walls is very much more than sufficient to resist the osmotic pressure of the cell-sap, which frequently ranges between 20 and 30 atmospheres. In the cases experimented on there was a coefficient of safety varying between 14 and 25. The tenacity of cellulose is stated to be greater than 50,000 grs. per sq. mm.

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

Proteolytic Enzymes of Nepenthes.†—Prof. S. H. Vines has made a careful examination of the fluid secreted by the pitchers in several species of *Nepenthes*, especially *N. Mastersiana*, and has determined that its digestive powers are due to the action of a true proteolytic enzyme in the presence of an acid, and not to the presence of bacteria. He states that the liquid will digest fibrin in the presence of 1 per cent. hydrocyanic acid, and that it is possible to prepare active glycerin-extract from the pitcher-tissue. The enzyme is clearly allied to the peptic group, and is apparently tryptic in its action. The proteid-product of digestion appears to be not peptone, but deutero-albumose. One peculiarity of the enzyme is its great stability; it is antiseptic, and resists decomposition.

"Encapsuling" of Starch-grains.—Prof. L. Macchiati ‡ gives additional reasons for doubting Buscalioni's statement with regard to the "encapsuling" of starch-grains in the integument of the seed of *Vicia narbonensis*.

In reply Dr. L. Buscalioni § adduces the opinion of various distinguished Italian botanists in favour of his view.

Sorghin and Sorghorubin.‖—Sig. N. Passerini has extracted from the red-spotted leaf-sheaths of *Sorghum vulgare* and *saccharatum*, and of *Zea Mays*, a pigment which he terms *sorghin*, which is, however, a product of transformation of the natural pigment *sorghorubin*. The red colour of the spots is due, in the first place, to this pigment, and not directly to bacteria, as has been stated.

(3) Structure of Tissues.

Development of the Growing Point in the Stem of Monocotyledons.¶—From the study of a number of species belonging to several different orders of Monocotyledons, M. J. Baranetzky states that a very characteristic feature is the presence in the growing point of one or

* Ann. of Bot, xi. (1897) pp. 585–8.
† Tom. cit., pp. 563–84.
‡ Bull. Soc. Bot. Ital., 1897, pp. 268–71. Cf. this Journal, 1897, p. 514.
§ Tom. cit., pp. 303–10. Malpighia, xi. (1898) pp. 469–90.
‖ Tom. cit., pp. 195–7.
¶ Ann. Sci. Nat. (Bot.), iii. (1897) pp. 311–65 (3 pls.).

even of two well differentiated generative zones. The permanent tissues of the stem of Monocotyledons are rarely formed in the primitive meristem; in their formation a part is usually taken by the secondary meristem produced by one or both of the cambial zones. The order of formation of the bundles is sometimes strictly centrifugal, but more often they make their appearance in the stem in centripetal sequence; or mixed types are formed by a combination of the two. No primary cortex, consisting of a layer of tissue distinct from the embryonic condition, exists in the stem of Monocotyledons. When the leaves have a sheathing character, the cortex of the stem is, in its origin, simply a prolongation of the tissue of the foliar sheaths.

Anatomy of the Aquatic Gentianaceæ.* — M. E. Perrot gives a general account of the peculiarities of structure of the genera *Menyanthes*, *Nephrophyllidium*, *Villarsia*, *Limnanthemum*, and *Liparophyllum*, making up the tribe Menyanthoideæ of Gentianaceæ. The vascular bundles are collateral, without internal phloem; the secondary xylem is absent, or but feebly developed; in the latter case it is composed of scalariform vessels; sclerites occur in nearly all of the species; the mesophyll is bifacial; the stomates are formed simply by the division of an epidermal cell; the mechanical tissue is scanty; there is but little starch, except in the endoderm; crystals of calcium oxalate do not occur.

Sieve-Tissue outside the Phloem and Vascular Tissue outside the Xylem.†—In certain species of Gentianaceæ belonging to the genera *Gentiana* and *Swertia*, M. E. Perrot finds, in the root, sieve-fascicles within the xylem, resulting from the segmentation of one or more cells of the secondary xylem-parenchyme. In the stem there are always sieve-fascicles in the pith, especially in its periphery, but sometimes throughout its whole extent. Some species have sieve-islands within the xylem; others possess in the pith, in addition to the sieve-fascicles, cribro-vascular bundles, the vessels of which are simply tracheæ. In the leaf are perimedullary sieve-fascicles proceeding from the stem, and strongly developed in the periderm of the bundles of the veins.

Effect of Æcidium elatinum on Abies balsamea.‡ — Mr. A. P. Anderson has studied the anatomical changes which are the result of the "witch-broom" produced on the balsam pine by the attacks of *Æcidium elatinum*. There are fewer stomates on the diseased leaves, but their distribution is normal. The hypodermal strengthening cells are more irregular in form and size; they are often found in nests and groups. Transfusion-tissue is nearly always present, often in from one to three small areas on the dorsal side of the phloem. The diseased buds are covered with a greater number of bud-scales, which are smaller than the normal; they are covered by resin in the winter, and are fringed with marginal hairs. Resin canals are fewer in the diseased scales, but are always present in the wood of the tumour, and nearly always in the wood of older diseased branches above the tumour; resin vesicles begin to form even in diseased shoots of the first and second year. Epidermal

* Bull. Soc. Bot. France, xliv. (1897) pp. 340–51 (1 pl.). Cf. this Journal, 1897, p. 405.

† Comptes Rendus, cxxv. (1897) pp. 1115–8; Journ. de Bot. (Morot), xi. (1897) pp. 374–90 (1 pl. and 6 figs.). ‡ Bot. Gazette, xxiv. (1897) pp. 309–44 (2 pls.).

hairs are rarely present on the diseased shoots; when present they are usually one-celled.

(4) Structure of Organs.

Green Hemi-Parasites.—From a detailed study under cultivation of several species of *Euphrasia*, *Odontites*, and *Orthantha*, Herr E. Heinricher * comes to the following general conclusions as to the parasitism of these genera of Rhinantheæ. The seeds of *Odontites Odontites* (and probably those of all chlorophyllous parasitic Rhinantheæ) are capable of germinating independently of any chemical irritation resulting from a nutrient root or from a second living seed, or from living tissue. The haustoria of *Odontites Odontites* (and probably those of all parasitic Rhinantheæ) are the result of the chemical irritation exercised by a nutrient object on the root of the parasite. The parasitism develops in a different way in different genera and species. In the case of all the species examined (*Odontites Odontites*, *Euphrasia stricta*, *Orthantha lutea*) single individuals may produce flowers and fruits, when thickly sown, without any host-plant. Under these conditions haustoria are always formed, but in the presence of a different nutrient plant the individuals attain three or four times as strong a development. In the case of *Odontites Odontites*, single individuals sown separately were brought to the flowering stage under conditions which excluded the possibility of parasitic or saprophytic nutriment. This species is characterised by a relatively strong development of root-hairs. It reached the flowering stage when grown on two distinct dicotyledonous host-plants, *Vicia sativa* and *Trifolium pratense*, a large number of haustoria being formed; *Euphrasia stricta* also formed haustoria on the roots of *Vicia sativa*. An injurious influence of the parasite on the host-plant could be distinctly detected. The seeds of all the green parasitic Rhinantheæ appear not to germinate before the following spring, the spring being the usual time for their germinating. The seeds of both *Odontites* and *Euphrasia* retain their power of germinating for two or even three years, but the period of their actual germination varies greatly.

In the course of his observations, Heinricher criticises unfavourably some of the statements of von Wettstein, especially with regard to the parasitism of *Euphrasia* on dicotyledonous plants, and to the retention by the seeds of their power of germination. To these criticisms von Wettstein replies; † and in another paper ‡ details further experiments with regard to *Euphrasia*, which lead to the same conclusion, viz. that although parasitism is necessary for their full development, individuals may produce flower and fruit without parasitism, though their development is then always feeble.

To the former of these papers Heinricher again replies §

Polymorphism of the Branches of an Inflorescence.‖—According to M. H. Ricome, in a radially branched inflorescence such as that of the Umbelliferæ, *Sambucus*, *Viburnum*, *Sedum Fabaria*, &c., the different branches do not present the same anatomical structure. Those branches

* Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxi. (1897) pp. 77–124 (1 pl.).
† Tom. cit., pp. 197–206. ‡ Oesterr. Bot. Zeitschr., xlvii. (1897) pp. 319–24.
§ Tom. cit., pp. 442–3. ‖ Comptes Rendus, cxxv. (1897) pp. 1046–8.

which have a more or less nearly vertical position have a normal symmetry of structure, from which there is a deviation in those which are placed at various angles, the supporting, the assimilating, and even the vascular tissues having a bilateral structure, and the branches being flattened dorsiventrally.

Buds and Stipules.*—The structure and position of the leaf-buds and stipules is described in a very large number of additional instances by Sir John Lubbock, the observations confirming his previous conclusion that the most usual purpose of stipules is to protect the leaves while in the bud, sometimes their own leaf, but, as a rule, the younger one. In some cases they themselves perform the function of leaves, replacing them entirely in a few cases (*Lathyrus Aphaca*). In others they serve to hold water; in some they develop into spines; in some into tendrils; in others they become glandular. The outer scales which protect the winter-buds may be classed under seven heads, viz.:—(1) Pedestals of last year's leaves (*Pyrus Aria*); (2) modified bases of leaves (maple, horse-chestnut); (3) leaf-blades (*Viburnum Lantana*); (4) modified leaves (*Viburnum Opulus*, willows); (5) stipules (poplar, oak, beech); (6) connate pairs of stipules belonging to the same leaf (elm, *Castanea*); (7) connate pairs of stipules belonging to different leaves (hop, *Gardenia*, and other Rubiaceæ).

Disguises in Bud Arrangement.†—Mr. G. H. Shull has attempted to trace to deviations from a general law some of the more striking variations from the normal arrangements of organs in the bud. He concludes that most cases of branch and flower arrangement may be explained by the law that a bud, real or potential, occurs in the axil of every leaf, and terminates every axis. If a bud is removed from the axil of a leaf by adnation or by development into a branch, a secondary axillary bud may form in the axil of the leaf; and if that is also removed, a tertiary axillary bud may be formed. Bud pressures explain reduction of bracts and their failure to appear, as well as many modifications in the normal order of anthesis.

Fibrovascular Bundles of Leaves.‡—M. A. Chatin discusses the number and symmetry of the fibrovascular bundles of the appendicular organs as an indication of perfection of organisation. Among Corollifloræ the number of bundles that enter into the composition of the petiole is very rarely more than one. The exceptions are chiefly non-chlorophyllous parasites or plants with very large leaves. The Apocynaceæ, Jasminaceæ, Gesneraceæ, and Labiatifloræ are especially noteworthy for the constancy of the unital structure. When the bundles are numerous, they are arranged either in a single circle, or in two or more circles, or are scattered through the thickness of the petiole. Among the perigynous Gamopetalæ the unital type of bundles in the petiole is not nearly so universal. They may be divided into two groups,—one, represented by the Rubiaceæ and Caprifoliaceæ, with only one; the other, comprising the Compositæ and allied orders, with numerous petiolar bundles.

* Journ. Linn. Soc., xxxiii. (1897) pp. 202–69 (4 pls. and 133 figs.). Cf. this Journal, 1895, p. 653.

† Bot. Gazette, xxiv. (1897) pp. 427 32 (2 figs.).

‡ Comptes Rendus, cxxv. (1897) pp. 343-50, 415–20, 479–84, 997–1004. Cf. this Journal, 1897, p. 306.

As respects the group of perigynous Dialypetalæ, M. Chatin finds, at all events in the two largest orders, the Leguminosæ and the Rosaceæ, a very general difference between the woody and the herbaceous species; the former having, as a rule, only one, while the latter have several vascular bundles in the petiole.

The hypogynous Dialypetalæ are divided into 6 classes, according to the number of vascular bundles in the petiole, whether 1, 3, 5, 7, 9–11, or a larger number, some natural orders having representatives in nearly all the classes; but the complete union of the vascular bundles into one, a sign of the highest development, is much less common than in the Corolliforæ or the perigynous Dialypetalæ. Climbing plants, as a rule, have a large number of vascular bundles in the petiole.

Peltate Leaves.*—M. C. de Candolle distinguishes two kinds of peltate leaves, "epipeltate" and "hypopeltate." In the former the lamina is, in the growing state, intercalated between the petiole and the upper region of the stem; while in the latter it is the outer or lower face of the growing point of the future leaf which produces the base of the lamina, and the petiole is thus intercalated between the lamina and the upper region of the stem. M. de Candolle believes that the formation of the hypopeltate leaves can always be traced to a law of compensation, in virtue of which a great development of the upper portion of the growing point excludes the possibility of a secondary increase at the base of the lamina.

Leaves of Ficus.†—Prof. M. Moebius describes the structure of the leaves of various species of *Ficus*, especially in relation to the thickness of the epiderm, the cystoliths, and the pits; each species has a characteristic structure on these points. The epiderm of the upper is always thicker than that of the under surface, either from the cells being larger, or from their being arranged in a larger number of rows. The cystolith-cells are modified trichomes. They are of two kinds: either modified specially enlarged or ordinary epidermal cells. The presence of pits is not connected with the external nature of the leaf; they are derived from trichomic structures. *Ficus australis* has mucilage-cells, but the nature of the cell-contents has not been accurately ascertained.

Defences of Plants.‡—M. A. Gilkinet gives a succinct account of the various modes of defence exercised by plants against herbivorous and other enemies:—The production of spines, especially on young plants and young organs; the formation of alkaloids, glucosides, oxalic acid, essences, and other poisonous or unpalatable substances; the exudation of viscid secretions; myrmecophily, &c.

Bulb of Erythronium.§—Dr. A. P. Winter describes the structure and biology of the bulb of the dog's-tooth violet, *Erythronium dens-canis*. The flower-stalk obtains its nourishment from a fleshy "nutrient leaf" by which it is surrounded; the lower part of the flower-stalk swells up into the rudiment of next year's bulb. The plants are of two kinds;—annual,

* Bull. Trav. Soc. Bot. Genève, 1897. See Bull. Soc. Bot. France, xliv. (1897) Rev. Bibl., p. 378.
† Ber. Senckenberg. Naturf. Gesell., 1897, pp. 117–38 (2 pls.).
‡ Bull. Acad. R. Sci. Belgique, 1897, pp. 1120–38.
§ Oesterr. Bot. Zeitschr., xlvii. (1897) pp. 331–5.

with a single radical long-stalked foliage-leaf; and biennial, with two opposite leaves above the level of the soil.

Root of Anemone.*—M. E. de Janczewski classifies the roots of the different species of *Anemone* under 5 groups, viz.:—(1) The primary root is thick and perennial, serving as a storehouse for food-material (*A. rivularis, Pulsatilla*); (2) the primary root and the adventitious roots are altogether alike, and attain a medium thickness, while the rootlets are very slender (*A. Knowltonia*); (3) the primary root, adventitious roots, and rootlets are altogether alike and are all moderately slender (*A. sylvestris, japonica, virginiana, multifida, pennsylvanica*); (4) all the roots are very slender (*A. Hepatica, nemorosa, ranunculoides, trifolia, flaccida, baikalensis*); (5) all the roots are filiform and fugitive, the only living organ during the repose of vegetation being a tuberous rhizome (*A. appenina, coronaria, hortensis*).

Root of Hydrocharis.†—M. G. Chauveaud has made a detailed study of the root of the frog's bit, *Hydrocharis morsus-ranæ*, and notes the peculiarity, not hitherto recorded in any plant, that, of the internal or medullary sieve-tubes which form part of the central cylinder, one usually occupies the axis of the root. The successive appearance of bundles in the central stele is a further peculiarity as contrasted with the simultaneous formation of the primary sieve-tubes in the roots of other Monocotyledons. The vascular system of the root is, in fact, greatly reduced, the primary vessels having disappeared, and being replaced by supernumerary vessels. This is accompanied by an unusual development of root-hairs for the root of an aquatic plant.

β. Physiology.

(1) Reproduction and Embryology.

Behaviour of the Nuclei in the Development of the Embryo-sac and in Impregnation.‡—Mr. D. M. Mottier gives details of further observations on this point, chiefly in the cases of species of *Lilium* and of *Helleborus fœtidus*. These establish beyond doubt that neither in the pollen-cells nor in the rudiment of the embryo-sac are there any centrospheres. In both cases the spindle-fibres are entirely of cytoplasmic origin. In the first process of division the lower nucleus (the one in the chalaza end) is larger, and its chromatin-thread is much longer and more coiled than the upper nucleus (the one in the micropylar end of the embryo-sac). The second nuclear division in the embryo-sac follows immediately on the first, without the daughter-nuclei having entered into a complete state of rest. Between the second and third nuclear divisions there is, on the other hand, a considerable interval.

In the formation of the egg-apparatus, the planes in which the divisions of the two upper nuclei take place may be either parallel or somewhat oblique, or even at right angles to one another. The cytoplasm which surrounds the polar nucleus is not limited by a membrane. The

* Rev. Gén. de Bot. (Bonnier), ix. (1897) pp. 337–54 (2 pls.).

† Tom. cit., pp. 306–12 (5 figs.).

‡ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxi. (1897) pp. 125–58 (2 pls.). Cf. this Journal, *ante*, p. 91.

oosphere is somewhat larger than the nuclei of the synergids, and often contains three or four nucleoles of different sizes.

The author then compares in detail the vegetative and the heterotype modes of cell-division. The structure of the resting nucleus is in both cases the same. The differences relate to the distribution of the chromosomes, and to the connection between them and the spindle-fibres.

Embryo of Gramineæ and Cyperaceæ.*—In the structure and development of the embryo in these two natural orders, M. P. Van Tieghem finds additional reasons for a wide separation between them in a natural system of classification.

In the Gramineæ, belonging to the Inseminatæ, the fruit consists of embryo, endosperm, and a pericarp closely concrete with the latter; there is no true seed. The embryo lies laterally and below in the endosperm, which completely surrounds it; but at the point where the embryo comes very near the pericarp, the nutrient tissue forms only a very thin sheath. The embryo is straight, and consists of an endogenous radicle, and a plumule which bears the scutellum, usually an epiblast, the closed germinal sheath known as the coleoptile or pileole, an open green sheath on the other side of the scutellum, and the first green leaf above the pileole. The stem may lengthen between the scutellum and the germinal sheath, the plumule being then elevated on a stalk—the epicotyl or pedicle. Grasses with a sessile plumule are comparatively few—*Triticum*, *Hordeum*, *Secale*, &c.; those with a stalked plumule are again divided into the Plagiodesmæ and the Prenodesmæ, dependent on the structure and course of the vascular bundle.

The fruit of the Cyperaceæ contains a true triangular seed, in the axis of which is the embryo, surrounded by a layer of endosperm, which is here very thick in the neighbourhood of the embryo. The embryo is straight or curved. It consists of an exogenous radicle, a plumule, a club-shaped foliar organ which remains enclosed in the seed, and a closed sheath, which often opens at a later period. The anatomy of the leaves and the structure and arrangement of the vascular bundles differ greatly from those in grasses. The sheath and the club-shaped leaf must be regarded as the two halves of one and the same organ, viz. the single cotyledon, and the bud enclosed in the germinal sheath is the plumule.

Van Tieghem points out the very great separation from one another which these differences in structure indicate. The Cyperaceæ must retain their place among the Monocotyledones; while the Gramineæ occupy a transitional position between the Monocotyledones and the Dicotyledones; and the author proposes to erect them into a new class, the ANISOCOTYLEDONES. They were originally Dicotyledones, in which one of the two cotyledons has gradually aborted, but still remains in some cases in a rudimentary condition, the epiblast. This organ is never present in the Cyperaceæ.

Homology of the Embryo of Grasses.†—Herr L. Celakovsky discusses the various theories that have been advanced respecting the homology of the different parts of the embryo of grasses, and sums up

* Ann. Sci. Nat. Bot., iii. (1897) pp. 259–309. Cf. this Journal, 1897, p. 313.
† Bot. Ztg., lv. (1897) 1te Abt., pp. 141–74 (1 pl.).

in favour of Van Tieghem's that the scutellum and the coleoptile (the first leaf-sheath) represent two different portions—the lamina and the ligule—of a single cotyledon, the epiblast being an outgrowth on the margin of the scutellum. Hanstein has established that the coleoptile arises at the base of the terminal scutellum, and can therefore not be an independent foliar organ. The interval which frequently occurs in the ripe seed between the plumule which is invested by the coleoptile and the insertion of the scutellum is not an internode, but an elongated leaf-node, and the author proposes for it the term *mesocotyl*. In all Monocotyledons, therefore, with the exception of the Dioscoreaceæ and the Commelynaceæ, the single cotyledon is terminal to the embryo.

The development of the embryo in Monocotyledons takes place in three different ways:—In the simplest, the lamina is the direct terminal prolongation of the sheath, the cotyledon assuming more or less the function of a sucking organ. In the second mode, the lamina is not terminal to the sheath, but lateral. In the third (grasses) the lamina and sheath have completely lost their connection, and are separated by a distinct mesocotyl. In the third and fourth modes the cotyledon is completely modified into a sucking organ, and no longer has assimilating functions.

The course of the vascular bundles confirms the view of a connection between coleoptile and scutellum. The ligule represents an axillary sheathing double stipule, the lamina being transformed into the scutellum and the ligule into the coleoptile. On a mature leaf of *Oryza sativa* the author detected a structure corresponding to the epiblast.

Germination of Pollen-grains.* — Prof. G. Arcangeli has observed the length of time before germination commences in the case of the pollen-grains of a number of plants belonging to different natural orders. The nutritive medium employed was a solution of saccharose of 5, 10, or 20 per cent., and the commencement of germination was regarded to be the first appearance of the protuberance caused by the germinating pollen-tube. The average period before germinating was from 20 to 30 minutes; the pollen-grains of *Canna indica* required a whole hour.

Pollination by Bats.† — Dr. P. Knuth gives another instance, observed by Mr. J. H. Hart in Trinidad, of the pollination of flowers by a bat, viz. of *Eperna falcata* by *Glossonycteris Geoffroyi*. He also calls attention to the fact that a similar phenomenon had been observed in 1892 by Herr W. Burck in Java, viz. in the visits of *Pteropus edulis* to a species of *Freycinetia*.

Pollination of Compositæ, Campanulaceæ, and Lobeliaceæ.‡— Prof. R. Gérard points out the similarity in the mode of pollination in these nearly allied orders. The flowers are, as a rule (when hermaphrodite) proterandrous. The hairs on the style do not, as is generally stated, perform the function of collecting the pollen for the purpose of self-pollination, but assist rather in its dissemination for cross-pollina-

* Bull. Soc. Bot. Ital., 1897, pp. 262–6.
† Bot. Centralbl., lxxii. (1897) pp. 353–4. Cf. this Journal, 1897, p. 309.
‡ 'Sur la pollination chez les Composées, Campanulacées, et Lobeliacées,' Lyon, 1897, 11 pp. See Bull. Soc. Bot. France, xliv. (1897) Rev. Bibl., p. 408.

tion. The stigmas are developed only after the hairs on the style, which have collected the pollen, have withered and fallen.

Flowering of Arum pictum.* — Prof. G. Arcangeli has noted the elevation of temperature which takes place within the spathes during the flowering of this species; the maximum elevation observed being 8·1° C., at 9.30 A.M. The insects which find their way into the spathe and assist in the transport of the pollen to the female flowers are very numerous, by far the greater number being Diptera. In one case, out of 149 insects captured, 120 belonged to one species of Diptera, *Limosina simplicimana*; in another case, out of 200, 191 were Diptera, the remainder being Coleoptera and Hymenoptera. The author altogether disbelieves the alleged carnivorous habit of this or of other species of *Arum*, such a phenomenon being, in fact, inconsistent with the part played by the insects in pollination.

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

Conduction of Organic Food-Materials in Plants.† — Observations made by Dr. F. Czapek on leaf-stalks lead to the following conclusions. The carbohydrates find their way from the leaf to the stem through the leptome-bundles, and not through the parenchyme of the petiole. The conducting tissues of the leptome-bundles are exclusively the sieve-tubes and the cambiform cells; the leptome-parenchyme and the medullary rays serve no other function than that of storing-up of food-materials. In addition to starch, sucroses are a widely distributed content of the sieve-tubes. Protoplasm-threads and the streaming of protoplasm are not essential factors in the transport of formative materials through the leptome; the most active factor in the process is the absorption and excretion of the transported substances through living protoplasm. The independent life of detached portions of a plant, and their development into new individuals, are, in general, the results of a sensitive reaction, caused by the cessation of the interchange of formative substance with the mother-plant.

Effects of Tropical Insolation.‡—Dr. A. J. Ewart gives the result of a large number of observations on exposure to the direct rays of the sun in the case of plants grown at Buitenzorg. He finds that, if prolonged, the insolation may markedly affect, or temporarily inhibit, the functional activity of the assimilating parts. If the stoppage is temporary, it is generally accompanied by but little change in colour; but if permanent, the chlorophyll-grains may become completely bleached. The leaves are protected against the injurious effects of excessive exposure by the presence of a red pigment and by active or passive paraheliotropic movements. The active movements are best shown in the motile leaves of the Leguminosæ, the pulvini being the motile and irritable perceptive organs. The red pigment acts mainly and primarily as a protective shield against the more refrangible green and blue solar rays. It has also a feeble heat-absorbing power, which

* Bull. Soc. Bot. Ital., 1897, pp. 293–300.
† SB. K. Akad. Wiss. Wien, cvi. (1897) pp. 117–70.
‡ Ann. of Bot., xi. (1897) pp. 439–80 and 585. Cf. this Journal, 1897, p. 311.

may, in a few cases, possibly be of considerable, or even of primary, importance.

Correlation of Growth under the Influence of Injuries.*—From experiments, made chiefly on seedlings and on *Phycomyces*, Mr. C. O. Townsend draws the following general conclusions:—A single irritation produced by cutting or splitting the shoots or roots, or removing the leaf-tips of seedlings, tends to produce a change in the rate of growth of the injured and of the uninjured parts. If the injury is slight, signs of an acceleration in the rate of growth will be apparent in from 6 to 24 hours, and will continue for from one to several days. If the injury be severe, the acceleration will be preceded by a period of retardation of longer or shorter duration, depending upon the severity of the injury and upon the condition of the plant injured. The growth of the stem of older plants is accelerated by the removal of a number of the roots or leaves, but is not affected by a slight injury to the root. The roots of older plants, as well as of seedlings, are more independent than are the stems and shoots. The change in the rate of growth of higher plants under the influence of a single irritation begins gradually, reaching its maximum in from 12 to 96 hours, and gradually diminishes until the normal rate is resumed. The total variation in the growth of higher plants due to the influence of a single irritation, is from zero to 70 per cent. of the normal growth for the same period. The growth of sporangiophores of *Phycomyces* is suddenly and strongly retarded by cutting either the mycele or another sporangiophore on the same plant. The growth does not entirely cease, and gradually recovers its normal rate in from 30 to 60 minutes. The influence of an irritation due to cutting or other injury is capable of acting through a distance of several hundred millimetres.

Hygroscopic Function of Stomates.†—By the method described on p. 134, Prof. F. Darwin has arrived at the following conclusions with regard to the action of stomates. When leaves have stomates on the under surface only (hypo-stomatal), there is a low degree of transpiration for that surface. On the under surface of floating leaves (*Nymphæa*) there is active transpiration when exposed to the air. In a terrestrial leaf with stomates on both surfaces, those on the upper surface are more sensitive to external conditions, and are frequently shut when those on the lower surface are open. The typical stomate closes either wholly or partially in darkness, the process being a gradual one; the nocturnal closure is a periodic phenomenon. When a leaf is removed from the plant, the stomates close, owing to the diminished turgescence of the guard-cells. The opening of stomates must be due to the loss of turgor in the other elements of the leaf, especially of the ordinary epidermal cells, the final closure being due to the withering of the guard-cells.

Influence of Electric Currents on the Lower Organisms.‡—According to Dr. R. Heller, a continuous electric current exercises a prejudicial effect on filaments of *Cladophora* and *Spirogyra*, ultimately killing them. On the diatoms the effect was but slight, as was also the case with *Oscillatoria*. *Mucor stolonifer* displayed strong powers of

* Ann. of Bot., xi. (1897) pp. 509-32.
† Proc. Cambridge Phil. Soc., ix. (1897) pp. 303-8.
‡ Oesterr. Bot. Zeitschr., xlvii. (1897) pp. 326-31, 358-61 (1 fig.).

resistance to the electric current, spores not being killed in the course of an hour; while *Bacillus subtilis* and *vulgaris* showed a much greater sensitiveness. It is, however, not proved that this is universally the case with bacteria.

Relation of Nutrient Salts to Turgor.*—Mr. E. B. Copeland has experimented on the effect on the growth of plants of various solutions of mineral salts; the plants employed being *Phaseolus vulgaris*, *Pisum sativum*, *Sinapis alba*, *Polygonum Fagopyrum*, *Zea Mays*. He finds that potassium presented to the roots of plants causes the cells of both root and stem to exhibit a higher turgor than they can do when it is replaced by sodium. Potassium is therefore a factor, direct or indirect, in the turgor of the plant; and there is no experimental ground for attaching this significance to any other constituent of the mineral food. From the analysis of the sap the author further concludes that the influence of potassium on the turgor of the plant is direct.

Influence of Low Temperatures on the Germinative Power of Seeds.†—Mr. H. T. Brown and Mr. F. Escombe have subjected a number of air-dried seeds (containing from 10 to 12 per cent. of natural moisture), belonging to different natural orders—Gramineæ, Cucurbitaceæ, Leguminosæ, Geraniaceæ, Compositæ, Umbelliferæ, Convolvulaceæ, Liliaceæ—for 110 consecutive hours to a temperature of from $-183°$ to $-192°$ C., subsequently thawing them very slowly. Their germinative power showed no appreciable deterioration; the resulting plants grew to full maturity, and were healthy. Of the seeds some contained endosperm, others did not; the reserve-material consisted in some cases of starch, in others of oil or mucilage.

Periodicity of Root-Pressure.‡—From the facts recorded on this subject, Mr. M. B. Thomas concludes that the measure of the root-pressure is the osmotic activity of the root-hairs, due to the presence in them of organic acids and other substances which show a great affinity for water. The root-pressure does not seem to have any relation to the previous periodicities of the vital activities of the plant. The author believes the periodicity of root-pressure to be inherent in the plant, and to have been acquired either by previous adaptation to environment or as the result of the action of some constant or periodic changes in the plant.

Aeration of the Trunks of Trees.§—As the result of a series of experiments on a large number of different kinds of forest-trees, M. H. Devaux finds that the permeation of the air into the interior of the stem is effected mainly through the agency of the lenticels, which are for the most part open, even in the main trunk. He finds, moreover, that the crustaceous lichens which frequently cover the trunks of trees do not sensibly prevent the access of air to the lenticels or impede the exchange of gases which takes place through them.

* Bot. Gazette, xxiv. (1897) pp. 399–416.
† Proc. Roy. Soc., lxii. (1897) pp. 160–5. Nature, lxii. (1897) pp. 138–9, 150. Cf. this Journal, *ante*, p. 102.
‡ Proc. Indiana Acad. Sci., 1896, pp. 143–7.
§ Comptes Rendus, cxxv. (1897) pp. 979–82.

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

Emptying of the Contents of Reserve-Receptacles.*—Herr K. Puriewitsch has investigated this subject in detail, especially in relation to the endosperm of grasses. In a long series of experiments he found the consumption of the food-materials to take place in all cases without the introduction of any enzyme from outside. The author considers it as proved that the endosperm of grasses and other plants is a living organ in which each individual cell has the power of forming diastase independently of the embryo and scutellum. The same conclusion was arrived at with respect to cotyledons, bulbs, roots, and rhizomes, whenever the conditions are such that the resulting products of dissolution can be carried away.

The emptying of the reserve-receptacles is promoted by a rise of temperature. In the case of objects which do not contain chlorophyll, light appears to produce no effect. The products of the processes which take place are chiefly carbohydrates; but the exact composition was difficult to determine owing to the very small quantities produced.

Digestion of the Endosperm of the Date.†—M. Leclerc du Sablon confirms, in the case of the date, the accepted statement that the endosperm does not itself produce any diastase capable of digesting its food-materials; and moreover, that the diastase supplied by the cotyledon which attacks the cellulose does not penetrate into the endosperm. Its action is confined to those portions where the endosperm and the cotyledon are in contact; it is only the diastase which gives rise to the production of fatty acids that passes from the cotyledon into the endosperm, and commences the digestion of its oily substances. The reserve food-material of the endosperm is contained entirely in the very thick cell-walls composed of cellulose; in the interior of the cells is a small quantity of oil and of aleurone mixed with protoplasm.

Oleaginous Reserve-Substances of the Walnut.‡—M. Leclerc du Sablon finds the general course of digestion of the oil to be the same in the walnut as in other oily seeds. It displays also a similar increase in acidity during germination. Glucose, the assimilable form of carbohydrate, is always found in the seed when in a state of activity, but is wanting in the dormant condition. The quantity of saccharose, on the other hand, is continually increasing; it forms a reserve-material in the ripe seed; during germination it is digested and transformed into glucose. It is, in fact, an intermediate substance between oily matters and glucose.

Enzyme of Barley.§—Herr F. Reinitzer does not find in germinating barley the cytase stated to occur there by Browne and Morris. The diastase of germinating barley has the power of easily dissolving hydrolytic hemi-celluloses, which are abundantly distributed in plants. But there are numerous hemi-celluloses which are not attacked by diastase. Seeds in which these are stored up as reserve-substances probably produce in germinating a peculiar enzyme which may be called cytase.

* Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxi. (1897) pp. 1–76.

† Rev. Gén. de Bot. (Bonnier), ix. (1897) pp. 395–8. ‡ Tom. cit., pp. 313–7.

§ Hoppe-Seyler's Zeitschr. f. Phys. Chemie, xxiii. (1897) pp. 175–208. See Oesterr. Bot. Zeitschr., xlvii. (1897) p. 303.

Alleged Alcoholic Enzyme in Yeast.—From a series of experiments made on a variety of English yeasts, Prof. J. R. Green * has been unable to obtain any evidence of the presence in them of a substance capable of setting up alcoholic fermentation in a solution of cane-sugar, as alleged by Buchner.

Herr A. Stavenhagen † has come very much to the same conclusion.

Unorganised Ferments in Milk.‡—Messrs. S. M. Babcock and H. L. Russell have found that milk, kept in contact with an excess of chemical substances that destroy the metabolic activity of micro-organisms but do not suspend entirely the action of unorganised ferments, will undergo a series of chemical changes, similar to those that occur in the normal ripening of cheese, and the authors conclude from the experiments they have made that the enzymes present in milk—i.e. used in the manufacture of cheese, and undoubtedly inherent in the milk itself—are very important factors in the breaking down of the casein in the normal ripening of cheese. In any case, it must be admitted that the transformation of the casein in this process is not entirely due to the action of micro-organisms, but is shared in a large degree by the action of these ferments whose presence and effect have heretofore not been recognised.

γ. General.

Phylogeny and Taxonomy of Angiosperms.§—Prof. C. E. Bessey discusses at length the probable genetic connection of the main divisions of Angiosperms. He believes that the angiospermous phylum parted very early into two sub-classes, the Monocotyledons and the Dicotyledons; this separation taking place while the flower-strobilus (pistil) was still apocarpous, and before any of the carpellary leaves had undergone much, if any, modification. These modifications have been chiefly in two directions, viz. a fusion and a suppression of parts, which the author terms respectively *symphysis* and *aphanisis*. That the Dicotyledons represent a higher type of structure than the Monocotyledons is indicated by the difference in the constitution of the vascular bundles, and by the structure of the stem and root. The author then explains in detail his views respecting the descent and genetic connection of the various groups of Monocotyledons and Dicotyledons.

Resistance of Plants to Desiccation.‖—As the results of a further series of experiments on this subject, Dr. A. J. Ewart states that the assertion often made, that seeds, spores, and mosses can withstand complete desiccation without their vitality being destroyed, is incorrect. In no case can anything of a vital nature be deprived of all water without its vitality being destroyed. The minimum percentage of water which is sufficient to maintain vitality was found to be from two to three per cent. of the dried weight of the object. Dry protoplasm (i.e. protoplasm with the minimum amount of water necessary to maintain vitality) is perfectly dormant; it can neither respire nor assimilate; can neither add to its substance nor diminish it.

* Ann. of Bot., xi. (1897) pp. 555–62. Cf. this Journal, 1897, p. 414.

† Ber. Deutsch. Chem. Gesell., xxx. (1897) pp. 2422–33. See Journ. Chem. Soc., 1898, Abstr., p. 88. ‡ Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 615–20.

§ Bot. Gazette, xxiv. (1897) pp. 145–78 (3 figs.).

‖ Trans. Liverpool Biol. Soc., xi. (1897) pp. 151–9. Cf. this Journal, 1897, p. 219.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Hybrid Fern.*—Prof. J. B. Farmer describes the structure of a hybrid obtained between *Polypodium aureum* and *P. vulgare elegantissimum*. In its general habit of growth and in the scaly rachis, the hybrid has a closer resemblance to the former; in the general appearance of the frond a closer resemblance to the latter species. Attempts to germinate the spores were unsuccessful.

Spencerites, a new Fossil Genus of Lycopodiaceæ.†—From Lower Coal Measures near Halifax, Dr. D. H. Scott has obtained some Lycopodiaceous cones, from which he establishes the new genus *Spencerites*, separated from *Lepidostrobus* mainly on account of the very different mode of insertion of the sporanges, a character which is accompanied by differences in the form of the sporophylls, the structure of the sporangial walls and of the spores, and in the whole habit of the strobilus.

Muscineæ.

Development of the Archegone of the Muscineæ.‡—M. L. A. Gayet has examined the structure and the development of the archegone in the various orders of Muscineæ, and has arrived at the following general conclusions:—The archegone of the Hepaticæ develops not only by intercalary, but also by terminal growth. In the Musci this terminal growth contributes greatly to the elongation of the female organ. The terminal or "lid-cell" does not give rise to neck-canal-cells, either in the Hepaticæ or in the Musci; the neck-canal-cells have all the same origin, always proceeding from an initial detached from the mother-cell of the oosphere.

The mode of development of the archegone in the Anthoceroteæ differs so widely from that of other Muscineæ that the author proposes to erect them into a family co-ordinate with the Hepaticæ and Musci, and intermediate between the latter and the Pteridophyta. It has four canal-cells which may be compared to the single canal-cell of *Pteris* with four nuclei. The archegone opens simply by separation of the terminal cells, not by their destruction and rupture.

In *Sphærocarpus* the archegone has five rows of neck-cells, but is sessile, indicating an intermediate position between the Jungermannieæ and the Riccieæ; two ventral canal-cells were sometimes observed. In the Marchantiaceæ the number of canal-cells is eight. In exceptional cases the ventral canal-cell may be impregnated instead of the oosphere. The Andreæaceæ present no variation from other families of Musci in the development of the archegone, notwithstanding the difference in the dehiscence of the capsule.

New Genera of Musci.—In addition to a large number of new species, Herr C. Müller describes the following five new genera of

* Ann. of Bot., xi. (1897) pp. 533–44 (2 pls.).
† Phil. Trans. R.S., clxxxix. (1897) pp. 83–106 (4 pls.).
‡ Ann. Sci. Nat. (Bot.), iii. (1897) pp. 161–258 (7 pls.).

Mosses: — (1) *Teichodontium.** Caulis leptodontioides; folia vaginata canaliculato-subulata, angustinervia, e cellulis basi longis angustis in membranam luteam conflatis, superne rotundis viridibus crassiusculis areolata; theca majuscula, ovalis, macrostoma, pedunculata, operculo brevirostri; peristomium duplex; externum membrana papillosa, e dentibus dense approximatis et dense trabeculatis medio abruptis composita, internum dentes 16 simplices, lineari-lanceolati, dilute flavi glaberrimi, homogenei. From Bolivia.

(2) *Ulea.*† Cespites weissiacei; folia weissiacea, e basi laxe reticulata, latiuscule lanceolata, obtusata v. obtuse brevissime acuminata, nervo crasso carinato ante apicem evanido, e cellulis parvis rotundatis superne areolata; theca in pedicello tenui medio erecta parva ovalis, evacuata cylindracea truncata ochracea, operculo breviter oblique subulato annulo latiusculo revolubili, peristomium simplex; dentes externi octo distantes, breves, late lanceolati, e dentibus binis articulatis conjugati, pallide ochracei, intra orificium siccitate inclinantes; calyptra minuta dimidiata, operculum solum detegens glaberrima.

(3) *Venturiella*, belonging to the Erpodiaceæ.‡ Peristomium simplex; dentes externi 16, per paria approximata, refuscentes, lanceolati-acuminati interdum apice bifidi et irregulariter articulati, ob papillas obscuri; calyptra *Erpodii*, longitudinaliter plicata, mitriformis, nuda; sporæ majusculæ, virides; reticulatio folii laxa, pellucida, hookerioides; folium in subulam basi reticulatam ubique hyalinam protractum. From China.

(4) *Triquetrella*, belonging to the Zygodonteæ.§ Caulis tristichaceo-foliosus; folia dense imbricata, madore subrecurva; peristomii simplicis dentes 16, externi breves, filiformes, simplices, homogeneo-hyalini, nec transversim striati nec trabeculati, interdum paulisper fissiles, cornei, solitarii v. aggregati. From Eastern Tropical Africa.

(5) *Thysanomitriopsis.*‖ Habitus *Campylopodis capitoflori* alicujus, sed foliis piliferis, i.e. surculus fertilis coma ditissime fructifera terminatus; capsulæ breviter pedicillatæ, minutæ, cylindricæ, perangulatæ, leves; calyptra dimidiata, basi fimbriata; peristomii dentes 16, conum sistentes, piliformes, indistincte articulati, stricti, pallidi, *Pilopogonis*; inflorescentia dioica. From New Zealand.

Algæ.

Antherozoids of Dictyota and Taonia.¶ — Mr. J. Ll. Williams gives further details respecting the motile antherozooids of *Dictyota dichotoma* and *Taonia atomaria*. In the former species each antherid is divided into a large number of small cells, the contents of each cell forming a single antherozoid. Each has a small round globule situate either at the centre or near the periphery; they do not appear to be eye-spots. The antherozoids escape by the dissolution of the walls of the antherids. Their motility continues only for a short time (usually about ten minutes); and under unfavourable conditions they are com-

* Nuov. Giorn. Bot. Ital., 1897, p. 119.
† Hedwigia, xxxvi. (1897) pp. 84–144.
‡ Nuov. Giorn. Bot. Ital., 1897, pp. 245–76.
§ Oester. Bot. Zeitschr., xlvii. (1897) pp. 420–1.
‖ Hedwigia, xxxvi. (1897) p. 363.
¶ Ann. of Bot., xi. (1897) pp. 545–53 (1 pl.). Cf. this Journal, 1897, p. 563.

pletely passive. Each antherozoid has only a single very long flagellum, which may be six times as long as the diameter of the head, and is often spiral. The greater part of the head is hyaline, one side being occupied by a thin layer of denser protoplasm; and the cilium arises from about the centre of this denser protoplasm. In *Taonia atomaria* similar phenomena were observed.

Tilopterideæ.*—Mr. G. Brebner reviews the genera of this small order of Phæosporeæ, and considers that the genus *Scaphospora* Kjellm. must be entirely suppressed, *S. speciosa* being but a stage of *Haplospora globosa*. *Choristocarpus* does not properly belong to the *Tilopterideæ*, which are thus limited to the two genera, *Tilopteris* and *Haplospora*, and to only two well-established species, *T. Mertensii* and *H. globosa*, with two other doubtful ones, *H. arctica* and *H. Kingii*. In *Haplospora* five different conditions have been found with regard to the reproductive organs, viz. sporo-hermaphrodite, hermaphrodite, sporo-antheridic, sporo-oogonic, and non-sexual.

Structure of Codium.†—Mr. H. H. Dixon finds, in many of the branches of the cœnocyte of *Codium tomentosum*, a stout axial strand which stains violet with Delafield's hæmatoxylin. It is thin and more delicate in the narrow intervening parts of the cœnocyte, and thickens gradually as it passes into the enlarged terminations which form the surface of the plant. These processes have a club-shaped head, and are often tubular. They are composed of some form of cellulose.

Fungi.

Fungus-Parasites of Cereals.‡—Prof. J. Eriksson gives a *resumé* of the facts at present known respecting the diseases of cereals in Sweden produced by Fungi. He states that there are, at most, ten species or specialised forms which attack corn-crops; a list is given of the species of cereals and of other grasses infested by them. Only one species, *Puccinia simplex*, is confined to a single host-plant, the barley. The appearance of the various kinds of rust depends, in the first place, on a pathological substance (*Krankheitsstoff*) present in the host-plant, sometimes inherited from the mother-plant, and maintaining a latent life as mycoplasm; secondly, on infection from neighbouring diseased plants. The intensity of the disease depends, firstly, on the energy by which external conditions are able to develop the mycoplasm-stage of the parasite into the visible mycele-stage; and, secondly, on fresh infection from without.

Two new Kinds of Red Yeast.§—M. K. Yabe obtained two new species of yeast from the soil of rice-fields and from rice-straw. Both resemble *S. rosaceus* in not forming ascospores.

S. japonicus. The cells are elliptic, but approach a more globular form when nourished with meat extract. Size, in Pasteur's solution,

* Proc. Bristol Nat. Soc., viii. (1897) pp. 176–87 (1 pl.).

† Ann. of Bot., xi. (1897) pp. 588–90 (2 figs.).

‡ Bot. Centralbl., lxxii. (1897) pp. 321–5, 354–62. Bot. Gazette, xxv. (1898) pp. 26–38.

§ Bull. Coll. Agric. Imp. Univ. Tokyo, 1897, iii. pp. 233–6. See Journ. Chem. Soc., 1897, Chem. Abst., p. 578.

$6 \times 3\ \mu$; in meat extract, $9 \cdot 2 \times 5 \cdot 1\ \mu$ to $10 \cdot 3 \times 6 \cdot 1\ \mu$. It grows well on potato, and acquires a brilliant red tint. It does not produce alcohol from glucose or cane-sugar, and its development is retarded by 3 per cent. alcohol, and altogether stopped by 7 per cent. A temperature of 45° for 15 minutes destroys the cells.

S. keiskeanus. Globular cells, $5 \cdot 1\ \mu$–$9\ \mu$ in diameter. It forms a faintly pink deposit in Pasteur's solution, but the colour, probably owing to free oxygen, is brighter on potato. A moderate growth is obtained in starch culture or on sugar-gelatin, but the cells remain colourless, whilst those on the surface gradually acquire a pink tint. The cells are killed by heating for 15 minutes at 50°, but not at 46°. Development is retarded by 5 per cent., and stopped by 7 per cent. of alcohol.

Behaviour of Yeast at a High Temperature.*—According to M. T. Nakamura yeast is not destroyed by exposure for $1\frac{1}{2}$ hours at 46°, or for 2 hours at 48°, but is completely destroyed at 52° in 20 minutes. Exposure to 50° destroyed the yeast in 30 minutes, but not in 29 minutes. The results of other observers who found that yeast is destroyed at 40° are attributed to the fact that, after being heated, the fermentation produced in Pasteur's solution is retarded for several days.

Experiments were made for the purpose of ascertaining the effect of different compounds in enabling yeast to resist the action of heat (50° for 30 minutes). With distilled water, cane-sugar (10 per cent), sodium sulphate (1–10 per cent.), and sodium diphosphate (1–10 per cent.), there was no fermentation. With sodium chloride (1–10 per cent.) there was fermentation only after heating in 3 per cent. solution. With sodium nitrite (1–10 per cent.) there was fermentation only in the case of the 2 per cent. solution ; with meat extract there was normal fermentation. Only the last three solutions had therefore the effect of increasing the resistance towards heat.

Peculiar Movement of Intracellular Particles in Yeast-Cells.†—Dr. W. St. C. Symmers describes certain peculiar motile bodies which he first observed as far back as 1893 in a yeast. The particles and their movements were rendered visible when a culture was treated with a 4 or 5 times diluted solution of gentian-violet. Under these circumstances certain yeast-cells were observed to contain a multitude of minute point-like bodies in a state of extremely active movement. After a while the particles decrease in number and increase in size from coalescence; the increased size is associated with retarded movement. The process is continued until all the particles have fused into a single mass, almost filling the cell, and having only a sluggish movement. When the movement ceases, the pigment rapidly overspreads the cell and precludes farther observation of its contents.

Since 1893 the author has observed the phenomenon in the following yeasts: — *Saccharomyces anomalus*; *ellipsoideus*; *membranifaciens*; *Pastorianus* i. and ii.; *exiguus*; *litogenes* (Sanfelice); a red yeast; and in others the exact identity of which is not established.

* Bull. Coll. Agric. Imp. Univ. Tokyo, 1897, iii. pp. 227–30. See Journ. Chem. Soc., 1897, Chem. Abst., p. 577.

† Trans. Brit. Inst. Preventive Med., 1st series, 1897, pp. 33–9 (3 figs.).

Phalline, a Poisonous Product from Fungi.*—Prof. Kobert gives the name *phalline* to the poisonous substance present in *Amanita phalloides*. It is a toxalbumen, and, even in very minute quantities, causes dissolution of the red corpuscles of the blood, followed by the liberation of certain ferments. It occurs also in other species of the same genus, viz. in *Amanita virescens*, *viridis*, *citrina*, *virosa*, *mappa*, *recutita*, and *porphyria*.

Sterigmates and Spores of Agaricus campestris.†—Different statements having been made by different writers as to the number of sterigmates and spores ordinarily borne on each basid of the common mushroom, Mr. E. C. Horrell has re-investigated the subject, with the result that, in the overwhelming majority of cases, the number is two, three being comparatively very rare, and four still rarer.

Morphology of Blastomycetes.‡—Dr. O. Casagrandi finds that the investing membrane of Blastomycetes is not single, but is composed of two or more layers, present not only in the old but also in young yeast-cells.

In its chemical nature this membrane is allied to pectose, but is not identical with the intercellular substance of the Papilionaceæ.

It does not give the cellulose reaction with iodine, either applied directly or after treatment with acid or alkali. It is soluble in chromic acid and in strong sulphuric acid. It is insoluble in Schweizer's reagent, with or without previous treatment with hydrochloric or acetic acid alcohol. It is not easily stained with carmin or anilin solutions, but methylen-blue and Hanstein's anilin are exceptions if used hot and after previous treatment with 4 to 6 per cent. hydrochloric acid alcohol, or 2 per cent. acetic acid. Not infrequently it stains with carbol-fuchsin or carbol-safranin.

The cell-granules of Blastomycetes are considered by the author to be formed of protoplasmic vesicles, which in their early stages are filled with a solid fatty substance. When the cells get older, or if acted on by chemical reagents, the fatty substance is fluid. The granules exhibit reactions indicative on the one hand of fatty principles, on the other of proteid and nuclear substances.

Of the presence of a nucleus the author is assured. In cells actually budding the nucleus presents certain forms which may possibly serve to explain the different opinions of observers as to the fission being mitotic or amitotic. This question is reserved for a future communication.

Myxomycetes.

Pseudocommis Vitis, as a Cause of Disease in Plants.—M. E. Roze § has determined experimentally that this myxomycetous parasite is the cause of the anthracnose or *brunissure* of the vine. Infection was obtained from the brown spots produced by the parasite on the leaves of the cherry.

The same author ‖ finds the same organism accompanying *Aspergillus glaucus*, as a frequent cause of disease in the sweet chestnut and other

* Lehrb. d. Intoxicationen, 1897, p. 457. See Trans. Brit. Mycol. Soc., 1896, 97 p. 27.
† Journ. Linn. Soc., xxxiii. (1897) pp. 168–71 (1 pl.).
‡ Centralbl. Bakt. u. Par., 2te Abt., 1897, pp. 563–75, 634–9, 718–21.
§ Comptes Rendus, cxxv. (1897) pp. 453–5.
‖ Tom. cit., pp. 982–3.

Amentiferæ. He states, moreover,* that in both the dry and moist gangrene of the potato—both known under the name of *pourriture*—one of the main elements is the same parasite.

Protophyta.

α. Schizophyceæ.

Biology of Nostoc.† — M. R. Bouilhac states the following as the conditions of growth of *Nostoc punctiforme* in a solution containing mineral salts and microbes which have the power of fixing nitrogen. Growth will proceed in sufficient light; but when the light is insufficient growth ceases, unless glucose or some other organic substance is present in the solution. Green colouring matter is produced under the influence of strong light, which does not become yellow in the dark, like the chlorophyll of higher plants.

Nostoc punctiforme.‡—In addition to the two ordinary modes of propagation of the heterocyst Nostocaceæ, by cysts and by hormogones, M. L. Sauvageau finds, in *Nostoc punctiforme*, a third mode, viz. by isolated cells distinct from the cysts, which the author terms *cocci*, forming a brown pellicle on the surface of the water. The cocci vary in their longer diameter from 3 to 7 μ; they multiply by dividing into two equal halves, and these again divide into two, thus forming a colony of four cells enclosed in a common membrane; or the division may continue until as many as twenty cells are enclosed in a common jelly.

β. Schizomycetes.

Central Body of the Bacteriaceæ.§—MM. J. Kunstler and P. Busquet are of opinion that the central body of bacteria which has an areolar or reticulate structure, and is enveloped in a special membrane, is not to be regarded as a morphological entity. It merely represents the subtegumentary mass of the body, having chromophilous properties more marked than those of the tegumentary layer. It is in this central body that those red granules are found which the authors had discussed in a previous communication. By some, these red granules were supposed to be of a nuclear nature, a view which would lend support to the notion that the central body should be regarded as a nucleus. The authors, however, give reasons for their belief that the characteristics of the red grains were purely physical phenomena.

Ferment of Cellulose.‖—M. V. Omélianski, who, some two years ago, isolated a ferment of pure cellulose, now gives further characters of this microbe. When young it is a straight very thin rodlet (0·3–0·5 μ by 4–8 μ); it elongates with age (10–15 μ), and then acquires a unipolar swelling, which eventually becomes a spore, 1·5 μ in diameter. These spores will stand heating up to 90°, but are killed at once at 100°. The bacillus is never blued by iodine. It grows not at all or badly on the ordinary media. The author used paper, cotton, or an amorphous precipitate of cellulose immersed in a mineral solution and protected from the action of air. The mineral solution contained

* Comptes Rendus, cxxv. (1897) pp. 1118–20. † Tom. cit., pp. 880–2.
‡ Ann. Sci. Nat. (Bot.), iii. (1897) pp. 367–78 (1 pl.).
§ Comptes Rendus, cxxv. (1897) pp. 1112–5. ‖ Tom. cit., pp. 970–3.

sulphate of ammonia, to which pepton (0·1 per cent.) or asparagin (0·5 per cent.) was added. The results of fermenting 5 grm. of paper for three months showed the presence of carbonic acid and hydrogen, of volatile acids, chiefly acetic and butyric, and faint traces of valerianic acid. The presence of one of the higher alcohols was also determined, but not in quantity sufficient for analysis. The fermentation excited by this bacillus belongs to the class of butyric fermentations.

Later,* the author showed that the products of cellulose fermentation are fatty acids, carbonic acid, and hydrogen. The amount of fatty acid produced is relatively large, being 70 per cent. of the total product, the remainder, 30 per cent., being gas.

Bacteriosis of Carnations.†—Mr. A. F. Woods confirms in all essential particulars the description of the disease affecting carnations. This observer, however, does not agree as to the cause; for infection experiments with bacteria failed to reproduce the disease; and from the fact that neither fungi nor bacteria were found in connection with the earlier stages of the malady, he was led to look for other agencies. These he found in aphides and thrips, by which the young leaves are punctured.

Tetanus Bacillus in a Case of Dementia paralytica.‡—Drs. G. Montesano and Maria Montessori describe a case of dementia in which atrophy of the frontal lobes, &c., was found. During life the spinal canal was tapped and some cerebro-spinal fluid drawn off. A guinea-pig injected with 2 ccm. of the fluid died with the phenomena of tetanus. Cerebro-spinal fluid was afterwards again withdrawn on two occasions, and *B. tetani* demonstrated in all three samples. In addition to *B. tetani*, *B. olivaceus* and *Streptococcus* were found.

Action of Pseudo-tuberculous Serum on the Bacillus of Pseudo-Tuberculosis.§—Dr. Ledoux-Lebard has observed numerous spontaneous cases of pseudo-tuberculosis in the guinea-pig. The animals emaciate and die with disseminated tubercles. In the liver the deposit is in the miliary form; in the spleen the size is variable, some of the tuberculous masses being of the size of peas and filled with caseous pus. Cultivations from the blood and viscera on gelose showed in 24 hours the difference between pseudo-tuberculosis and the tuberculosis of Koch. The colonies consist of an ovoid motile bacillus, which is easily stainable with aqueous solutions of anilin dyes, does not stain by Gram's method, and when inoculated kills the animal more quickly than does the bacillus of Koch. In the rabbit pseudo-tuberculosis is much rarer; the animal is more resistant, and even gets well after subcutaneous inoculation. When rabbit serum is tested after the manner of typhoid serum and typhoid bacilli, the pseudo-tubercle bacilli agglutinate and lose their motility; yet, though the serum excites the agglutination phenomenon, it does not prevent the growth of the culture. But it modifies the development; for, instead of becoming free and wandering about the medium, the bacilli, under the inhibiting effect of the serum, grow into filaments and form a network. In order to produce this effect, the proportion of serum must

* Tom. cit., pp. 1131–3.

† Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 722–7 (3 figs.). Cf. this Journal, 1896, p. 555.

‡ Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 663–7.

§ Ann. Inst. Pasteur, xi. (1897) pp. 909–15 (6 figs.).

be equal to that which gives a well-marked agglutinating reaction in an undiluted bouillon culture.

Growth of the Tubercle Bacillus at a Low Temperature.* — Mr. F. J. Reid states that a broth culture of the tubercle bacillus a month old was filtered through a sterilised Birkefeld filter. The filtrate having been ascertained to be sterile, was then sown with a trace of *B tuberculosis* and incubated at 18°–20°. The bacillus developed well. The growth had not the usual flocculent appearance, but was granular. Microscopically the organism was unchanged.

Action of Rennet on Pasteurised Milk.†—M. Ed. de Freudenreich, who has made experiments as to the action of rennet, finds that milk which has not been heated too long at 68° coagulates perfectly well under the action of rennet. Heated longer, or when the temperature exceeds 70°, the property of coagulation is in a measure lost. Hence in practice it would be possible to pasteurise milk destined for cheese-making, provided that after the pasteurisation the bacteria necessary for the maturation of the cheese were added.

Fermentation of Fresh Grass.‡—Herr O. Emmerling fermented freshly cut grass for four weeks, and found at the end of that time that the hay produced possessed a somewhat pleasant ethereal odour, and at the same time a pungent odour, which was found to be due to quinone. Among the organisms isolated were small quantities of moulds, chiefly species of *Mucor*; and besides hay bacteria, granulobacter, and coccus species, *Bacillus mycoides* was found. It has been shown that the latter organism is capable of fermenting glucose, yielding inactive lactic acid, and that it is also capable of hydrolysing cane-sugar, maltose, and glycogen. No other lactic acid bacterium could be isolated.

Streptothrix Form of the Swine Erysipelas Bacillus.§—Prof. Th. Kitt records an instance of the bacillus of swine erysipelas assuming the streptothrix form when cultivated on a medium composed of blood-serum and bouillon. This observation recalls those made on the bacillus of tubercle by Coppen Jones and others. The author's remarks are confirmed by four photographs, three of which exhibit very strikingly the streptothrix appearance.

Bacterium found in Hooping Cough.‖ — Drs. E. Czaplewski and R. Hensel describe a bacterium which they have detected in the expectoration of numerous cases of hooping cough. The microbe is a bacillus with rounded ends. It is extremely small and has some resemblance to the bacillus of influenza. It is non-motile and is easily stained, especially at the ends. This polar staining suggests the name, Polar bacterium. The bacilli have no special distribution, are usually scattered about irregularly, are mostly free, but occasionally are found within cells. The polar bacillus grows on the usual media, but its cultivation does not seem particularly easy. The optimum temperature was found to be 37°; and though it grows best with free access of air, the organism

* Nature, Jan. 6, 1898, p. 221. † Ann. de Micrographie, ix. (1897) pp. 345–60.
‡ Ber. Deutsch. Chem. Gesell., xxx. (1897) pp. 1869–70. See Journ. Chem. Soc., lxxi. and lxxii. (1897) Chem. Abst., p. 579.
§ Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 726–32 (1 pl.).
‖ Tom. cit., pp. 641–63, 721–6 (1 pl.).

is a potential anaerobe. The addition of glycerin to the medium seems to exert a favourable effect. Gelatin is not liquefied. Attempts to reproduce the disease in animals failed. During the investigation one of the authors caught a "cold and cough," and found the microbe in the discharge.

Bacilli and Pseudo-Bacilli of Diphtheria.*—Drs. R. T. Hewlett and Edith Knight thus sum up the results of their investigations into the relations of the pseudo-diphtheria bacillus and the Klebs-Loeffler bacillus.

(1) At least two forms have been described under the term pseudo-diphtheria bacillus: (*a*) one in morphology a K.-L. bacillus but non-virulent (Roux, Yersin, &c.), and (*b*) another, shorter, plumper, and more regular in form, and staining more uniformly than the K.-L. bacillus (Loeffler, von Hoffmann, &c.).

(2) The term pseudo-diphtheria bacillus should be reserved for the latter form.

(3) This pseudo-bacillus differs from K.-L. bacillus in morphology and staining, by producing an alkaline and not an acid reaction, by giving a visible growth on alkaline potato, by not growing anaerobically, and by being non-virulent.

(4) The pseudo-bacillus may occur in healthy throats, and in certain mild forms of angina.

(5) The pseudo-bacillus sometimes seems to replace the diphtheria bacillus towards convalescence.

(6) Pseudoforms may occur in cultures of the bacillus.

(7) K.-L. or diphtheritic forms nearly always occur some time or other in cultures of the pseudo-bacillus.

(8) In a number of cultures it is possible to obtain a series of organisms which form a connecting link between the K.-L. and the pseudo-bacillus.

(9) By careful heating it has apparently been possible to convert a typical virulent K.-L. into a typical non-virulent pseudo-bacillus.

(10) By cultivation and incubation and passage through an animal, a pseudo has apparently been converted into a K.-L. bacillus.

The authors therefore consider the pseudo is sometimes a modified K.-L. bacillus.

Bacilli of Beri-Beri.†—M. G. Nepveju describes three forms of bacilli which he has found in diseased tissues sent from Senegal. The largest are most frequent in the kidneys; here they measure 6–10 μ in length by 0·3–0·4 μ in breadth. They are straight or slightly curved, with rounded ends. The rodlet is marked by alternations of light and dark spaces. The best method of demonstrating this long form is to mordant the sections in a bath of ammonia-alum and sesqui-oxide of iron (0·1 per cent.), overstain with Roux's blue, and then decolorise strongly. The dark spaces are coloured blue, the rest of the cell, including the thin marginal contour, being pale rose.

In the medium sized form the bacilli are from 3–4 μ long, by 0·3 μ broad. These are found in large numbers in the blood-vessels of the

* Trans. Brit. Inst. Preventive Med., 1st series, 1897, pp. 7–32 (1 pl.).
† Comptes Rendus, cxxvi. (1898) pp. 236–7.

kidney. They are best stained with fuchsin and methylen-blue. The third form is extremely small, and they are met with in considerable numbers in the blood. They are barely as thick as the tubercle bacillus, and their length is about double their breadth. They have the appearance of a small oblong, and they impart to the red corpuscles on the surface of which they are scattered a milled appearance. The author regards the first two kinds as being of the same nature, and analogous to the bacilli of fowl cholera and of rabbit septicæmia.

The last two forms were found in the blood of all the viscera. Whether the first form is derived from the third form seems doubtful.

Streptococcus Sanguinis Canis.*—Dr. R. L. Pitfield found in the blood of dogs a coccus which is actively motile, usually single, but occasionally in pairs. On agar or on bouillon it forms long chains, and examined in hanging drops, these chains can be seen to move about slowly. The coccus is easily stained, and is not decolorised by Gram's method. Flagella could not be stained, but were seen occasionally. The organism grows well on the normal media, and does not liquefy gelatin. The growth is white. The streptococcus was found in healthy and diseased animals; and while harmless to dogs, only causing a local abscess which healed rapidly, it was found to be pathogenic to rabbits and guinea-pigs.

Ripening of Emmenthal Cheese.†—M. Ed. de Freudenreich finds that the microbic agents which effect the ripening of Emmenthal cheese are chiefly the lactic ferments. These organisms exist in ripening cheese in enormous numbers, while other bacterial species such as *Tyrothrix* are comparatively rare. The legitimate conclusion from this is that cheese-ripening is due to lactic acid bacteria, and that there is reason to hope that the art of cheese-making may be facilitated by the use of artificial cultures in the same way that bacteria are used for ripening cream.

In the ripening of soft cheeses, however, *Oidium lactis* and yeasts appear to act in concert with the lactic ferments, for they certainly play some part in the ripening of these cheeses.

Black Discoloration of Cheese and Cheese-Poisoning.‡ — The note of C. Besana on a sample of Parmesan cheese covered with black spots and smelling of garlic allows Herr G. Marpmann to indicate the causes of these conditions. The black spots are due to the presence of ferrophilous bacteria which form sulphides. The bacteria are motionless rodlets 2–3 μ long and 0·8–1·0 μ broad. The ends are rounded, and the cells are distinguished by black polar chromatophores and grey granules; many cells are black throughout. The pigment is produced only when the media contain iron, and the presence of iron and sulphides is easily demonstrable by the ordinary chemical tests.

The garlicky odour is common to decomposing organic matter which contains phosphates, and is due to the presence of phosphuretted hydrogen. The presence of this compound can be demonstrated, and distinguished from sulphuretted hydrogen by the reaction to test-papers

* Micr. Bulletin, xiv. (1897) p. 44.
† Ann. de Micrographie, ix. (1897) pp. 385–409.
‡ Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 21–6.

moistened with silver nitrate and lead acetate solutions. The former is stained by the phosphuretted hydrogen, the latter by the sulphur compound.

Bacillus Pestis.*—Dr. R. T. Hewlett was able to study the general characters of the plague bacillus from a case which occurred recently in London. Some of the original material was inoculated in a guinea-pig, the animal dying on the seventh day. The spleen and lymphatic glands were much enlarged, and in them were found enormous numbers of a short thick ovoid bacillus with rounded ends, and generally in pairs, the average size being $2 \cdot 3\ \mu$ by $1 \cdot 7\ \mu$. In young cultures the bacilli are extremely short, almost coccoid in fact; in older cultures, rod, thread, and involution forms are frequent. In broth chains are formed. On gelatin and agar the growth is cream-coloured; gelatin is not liquefied; there is no growth on potato, and milk is not coagulated. There is production of indol, and with neutral litmus-sugar-agar a well-marked acid reaction after two days' growth.

Cultures retain their vitality for at least a month. Guinea-pigs die in from three to seven days; if in three days, the enlargement and nodulation of the spleen may not be marked. Mice die in two to three days, and rats in about a week.

The organism is met with in all parts of the body, the chief tissue changes being cloudy swelling, hyperæmia, and minute hæmorrhages.

Bacillus X Sternberg, and Bacillus icteroides Sanarelli.†—Recently Sternberg made an attempt to show that these two bacilli had certain points in common, and claimed that they were identical. This view is hotly disputed by Prof. J. Sanarelli, who is unable to find any ground for assuming that these microbes are identical. He states that he is well acquainted with Sternberg's report, and has not met with a single bacillus amid the numerous microbic flora described in the report which has any resemblance to *B. icteroides*.

Tubercle Bacilli in Butter.‡—The prevalence of tubercle bacilli in market butter has, says Mr. H. L. Russell, been made the subject of special investigation by numerous workers. Groening § found that a large percentage of samples of butter produced in guinea-pigs pathological lesions similar to tuberculosis. Smear-preparations showed the presence of bacilli with staining reaction similar to that of the tubercle bacillus.

Obermüller ‖ found tubercle bacilli in every sample (14) examined. Lydia Rabinowitsch ¶ examined thirty samples in Berlin and fifty in Philadelphia. In 28 per cent. she found an organism which macroscopically and microscopically closely resembled the genuine tubercle bacillus. Cultures, however, showed slight but distinct differences. The butter bacillus is mildly pathogenic to guinea-pigs, but not to other animals. Culturally and in its reaction to tuberculin it is readily distinguishable from *Bacillus tuberculosis*.

* Trans. Brit. Inst. Preventive Med., 1st series, 1897, pp. 136-41 (2 pls.).
† Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 668-74.
‡ Bot. Gazette, xxiv. (1897) p. 442.
§ Centralbl. f. Vet. Viehmarkt. u. Schlacht., 1897, Nos. 14, 15.
‖ Hyg. Rund., 1897, No. 14.
¶ Zeitschr. f. Hyg., 1897.

Bacillus enteritidis sporogenes var.*—Dr. F. W. Andrewes describes a variety of the bacillus isolated by Klein from cases of epidemic diarrhœa. It is a long straight bacillus, often forming long-jointed threads; it varies in length from 4 to 30 μ, and is about $0 \cdot 8$ μ thick. Spontaneous movements were not observed, and flagella were not demonstrable. It probably forms spores, since the organism was in all cases obtained from material which had been heated to 80° C. for 10 minutes. It is a strict and essential anaerobe. In grape-sugar-gelatin gas is formed and the medium slowly liquefied. Milk is coagulated, and a strongly acid reaction produced.

Subcutaneous inoculation of guinea-pigs produces in some cases intense spreading hæmorrhagic œdema and necrosis, and death in 24 hours. In other cases it is not pathogenic.

Microbes of Vaccinia and Variola.†—Dr. E. Klein has cultivated from small-pox crusts the following organisms:—(1) *Streptococcus erysipelatis*, (2) *Bacillus* or *Leptothrix epidermidis*, (3) *Bacillus xerosis variolæ*, (4) *Bacillus albus variolæ*. Particular notice is called only to this last, which morphologically belongs to the group of diphtheria and pseudodiphtheria bacilli. On agar it forms pure white colonies. The bacilli are from $0 \cdot 8$–1 μ in length, the thickness of the rods being about one-third or one-fourth of the length. The ends are rounded; the bacilli are grouped together by a homogeneous interstitial substance. After two or three days' growth on agar the bacilli look knobbed, and some are markedly thicker than the rest. This thickening is due to the sheath which, owing to some change, stains more deeply. In broth cultures knobs, clubs, and segmented forms appear. These apparently are not involution forms, but more probably are to be regarded in the light of spores, inasmuch as these deeply-staining thick forms behave like spores on staining with hot fuchsin, followed by alcohol and methyl-blue. Subcutaneous injection of agar cultures into guinea-pigs produced no effect.

The results from inoculating calves with this bacillus were not very satisfactory, though they gave sufficient encouragement to warrant further study; in only one calf was there anything approaching a condition of antagonism to subsequent vaccination.

Lectures on Bacteria.‡—Dr. A. Fischer has recently published a text-book on Bacteriology, in which the matter is put forward in a concise and comprehensive manner. Considered as an introduction to Bacteriology, the work will be found useful, not only to the botanist, but also to the medical man and brewer. The author is well known for his researches on plasmolysis, flagella, and cell-contents, and these investigations receive full attention in the work.

* Twenty-sixth Ann. Rep. Local Govt. Board, 1896–7, Appendix 4 B, pp. 255–62.

† Twenty-sixth Annual Rep. Local Govt. Board, 1896–7, Appendix B, No. 6, pp. 267–86 (21 figs.).

‡ Jena, 1897, 29 illustrations. See Hedwigia, xxvi. (1897) Rep., p. 111.

MICROSCOPY.

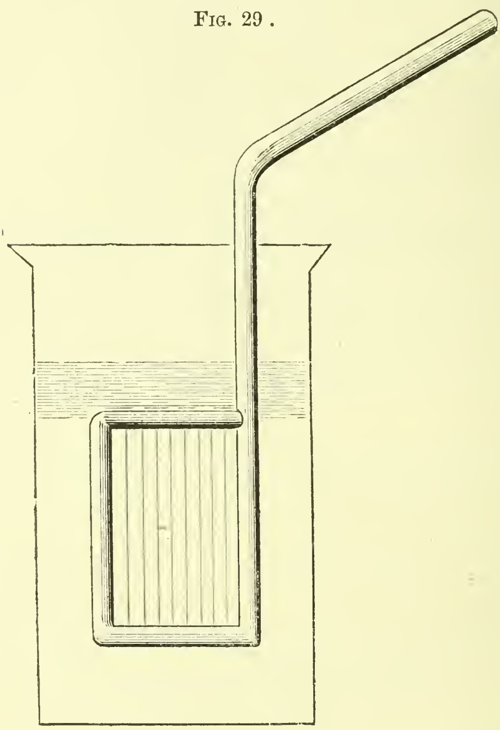
[An abstract of Dr. Clifford Mercer's important paper on "Aperture," referred to in the President's Annual Address, is unavoidably postponed to the next number.—Editor, Journ. R.M.S.]

A. Instruments, Accessories, &c.*

(3) Illuminating and other Apparatus.

Spider-Lines.†—Mr. F. L. O. Wadsworth reports very favourably on his experience of quartz-fibres instead of silk or spider threads in the

Fig. 29.



cross lines of optical instruments. The transparency of the quartz-fibres is removed by silvering them by any of the ordinary methods. The difficulties arising from the hygroscopicity and semi-translucency of both

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

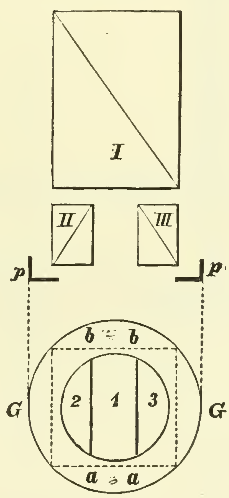
† The Microscope, December 1897, p. 157.

silk and spider threads are thus overcome, and the quartz, while equalling these other materials in fineness, surpasses them in strength. Mr. Wadsworth asserts that anybody, after a little practice, can easily make the fibres, the only essential apparatus being an oxyhydrogen blow-pipe which must be fed by compressed oxygen and fairly pure hydrogen (coal gas is unsatisfactory). He has found no method for "shooting" the fibres superior to the bow and arrow method first used by Prof. Boys. Previous to immersion in the silvering solution, the fibres should be chemically cleaned by successive immersions in (1) strong nitric acid; (2) distilled water; (3) strong caustic potash; (4) distilled water. He finds it convenient to mount a dozen fibres in a glass rod frame, fastening them with fused shellac which resists both hot acid and hot alkali. The frame can then be laid aside and the fibres removed for use when required.

Novelties in Polarisation Apparatus.*—W. Wicke classifies saccharimeters into:—(1) Apparatus for circular polarisation requiring under all circumstances homogeneous illumination—usually sodium light; and (2) apparatus with wedge compensation and linear scales which can be used with white light.

(1) This includes the old forms of:—Mitscherlich, Wild, Halb-

Fig. 30.



schatten-Laurent, and Lippich. The best is that of Lippich, which excels in accuracy and certainty; its advantage depending upon a tripartition of the field of view.

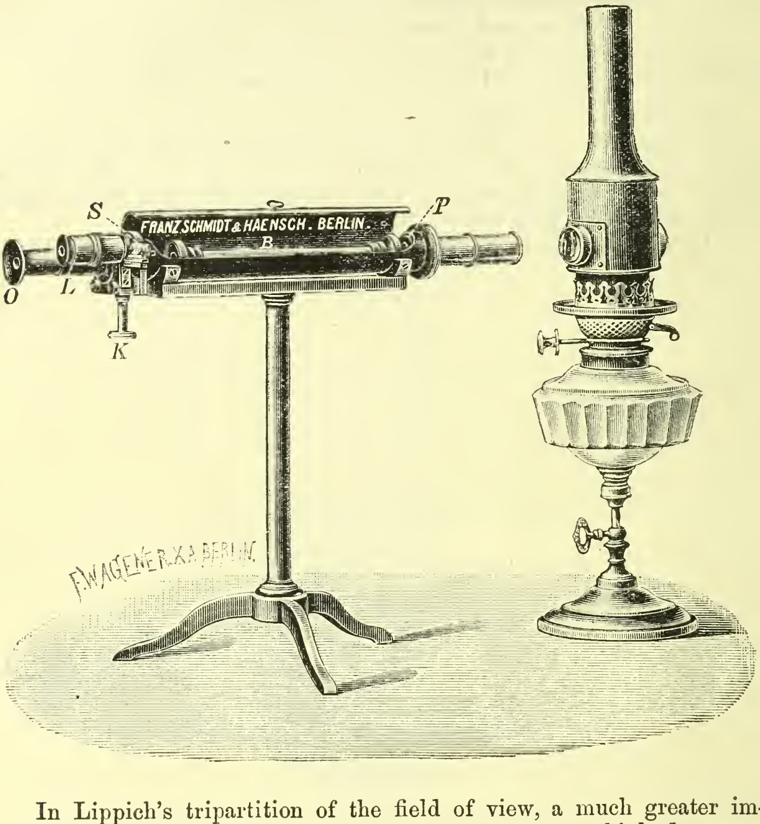
(2) This includes Soleil's saccharimeter depending on a now antiquated colour system, with the improvements by Ventzke and by Scheibler, as well as applications of the half shadow (*Halbschatten*) system. Soleil, although still much used, is unsatisfactory, both in

* Berichte der Deut. Pharm. Gesells., 1898, pp. 7–15 (7 figs.).

cases of colour-blindness and on account of the variation in colour sensation.

Fig. 31 shows the external form of the simple half-shadow apparatus with wedge compensation, as specially constructed for urine analysis; and fig. 32 shows the method of arranging the lenses. The advantages of Laurent's half-shadow are larger dimensions, greater delicacy of reading, and better mechanical arrangement.

FIG. 31.



In Lippich's tripartition of the field of view, a much greater improvement of the half-shadow results, securing a very high degree of accuracy. Whilst in the simple Lippich polariser only one sharp-edged so-called half-prism is placed before the large nicol, and the field of view bisected, in the tripartition system two of these sharp-angled half-prisms are employed, as shown in fig. 30. The effect of this application is to produce as great an improvement in the wedge compensation as in the circular apparatus.

With the Landolt-Lippich apparatus the investigation of substances in strongly heated or cooled media is possible (fig. 33). For such purposes a metal box with asbestos casing and an inner observation tube gilded inside (fig. 34) are used. Nickel scales take the place of ivory, as they are found not to bulge with changes of temperature. A mirror

Fig. 32.

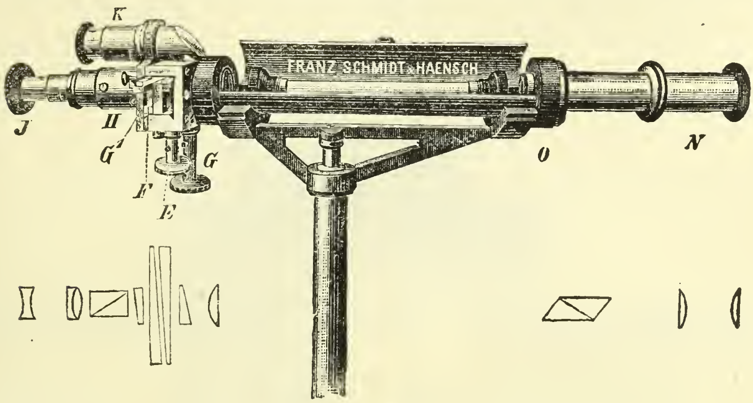
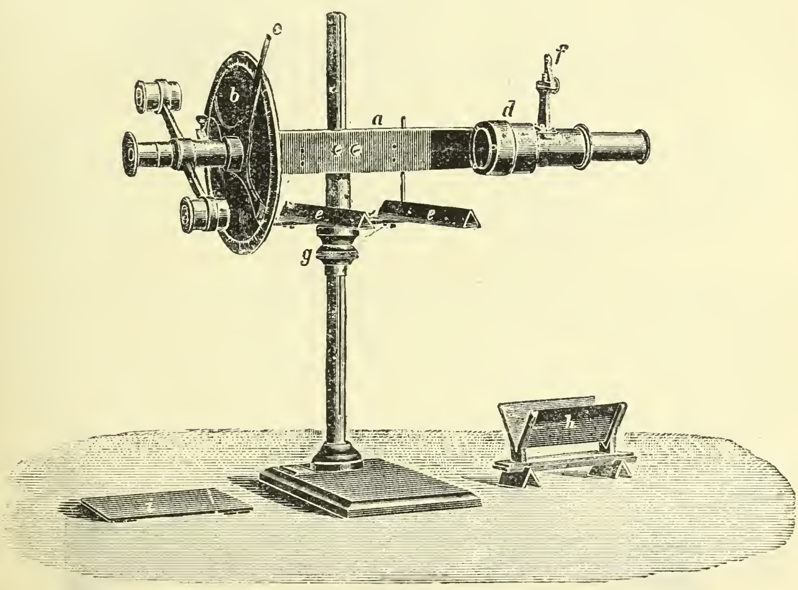


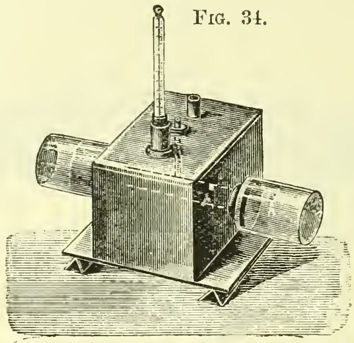
Fig. 33.



S adjusted by a ball-and-socket joint K allows the light from the lamp to be reflected from a mirror L on to the nickel scale B (fig. 35).

The lamp has also been much improved. For circular apparatus a grooved platinum ring has been substituted for the platinum net, formerly used for the sea-salt; this gives a very bright uniform yellow flame. For white light the improvements include two and threefold

Fig. 34.



flat burners on the cylinder. Elcctric and incandescent lamps have also been used with good cffect.

Fig. 35.

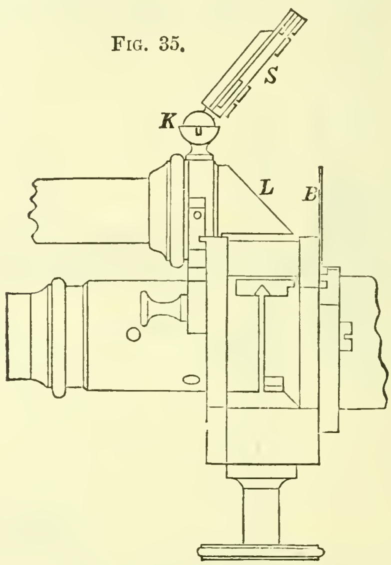
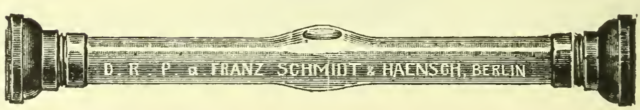


Fig. 36.



To avoid optical activity in the liquid, the observation tube is enlarged in its centre and filled so as to permit the enclosure of an air-bubble, which, when the tube is *in situ*, does not interfere with observa-ion (fig. 36).

(6) Miscellaneous.

Laboratory Dish.*—Prof. W. M. L. Coplin describes the dish used in his laboratory in the manipulation of paraffin sections. As the illustration (fig. 37) shows, the vessel is made of glass; it has the following measurements: $3\frac{1}{2}$ in. high, 1 in. square at bottom, $1\frac{3}{8}$ in. square three

Fig. 37.

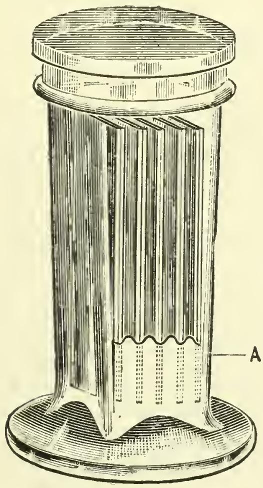
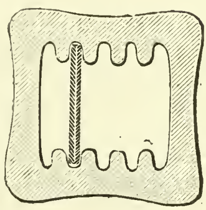


Fig. 38.



inches from bottom, $1\frac{3}{4}$ in. in diameter at top, which is round and covered with an air-tight cover; the base is nearly $2\frac{1}{2}$ in. in diameter. The inside is ridged on two opposite sides (fig. 38), so that five grooves are formed in which eight slides may be packed, three pairs back to back and one at each end.

Micro-Sclerometer for Determining the Hardness of Minerals.†—Mr. T. A. Jaggar, jun. (Camb. Mass.) describes an instrument which appears to give a new and valuable method of determining the hardness of minerals, whether simple, compound, amorphous, or crystalline. The quality which it is proposed to measure is the resistance offered by a body to the removal of particles of its substance by a defined diamond point moving in contact with it under uniform conditions. The instrument is applied to the Microscope, so that it may be used for either thin sections or crystal faces. The adjustments of the instrument are such that any of the variable elements in the process of abrasion may be made functional while the others are maintained constant. The principle is as follows:—A diamond point of constant dimensions is rotated on an oriented mineral section under uniform rate of rotation, and uniform weight to a uniform depth. The number of rotations of the point, a measure of the duration of the abrasion, varies as the resistance of the

* Journ. New York Micr. Soc., xiii. (1897) pp. 87–9 (2 figs.).
† Amer. Journ. Sci., Dec. 1897, pp. 399–412 (1 pl. and 2 figs.).

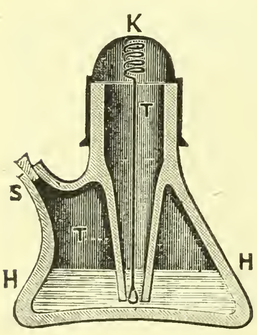
mineral to abrasion by diamond: this is the property measured. The instrument (plates III. and IV.) consists of the following parts:—

1. A standard and apparatus for adjusting to Microscope.
   (i) foot adjustments; (ii) rotating adjustments; (iii) lifting adjustments; (iv) fixing adjustments.
2. A balance beam and its yoke.
3. A rotary diamond in its end.
4. Apparatus for rotating uniformly.
5. Apparatus for recording rotations.
6. Apparatus for locking and releasing.
7. Apparatus for recording depth.

The instrument admits of measurements with any of the four variables,—rate, weight, depth, duration. The last has been found most practical, because it gives the highest values, and hence admits of the most delicate gradation.

Weights (e.g. 10 grm.) are placed on the pans *w* (plate IV.), and a micrometer scale at *m*; D is the diamond, which has to be carefully selected, and has a perfect point. The plate *m* is rotary on a horizontally pivoted ring, so that it may be turned in any azimuth. This device is so adjusted that the micrometer scale is visible in the field of the Microscope at the point exactly 10 mm. from the axis of rotation of the diamond point; this is one-sixth of the distance from the diamond axis to the beam pivots *a*, hence any downward movement at the diamond point is magnified by one-sixth at the micrometer. The reading is therefore seven-sixths of the actual depth bored. If now it be rotated until the micrometer scale stands at right angles to the beam, and be then tipped gently, an inclination may be found where, under a high power, only one line of the micrometer scale is in focus at a time, and a downward focus of precisely ·01 mm. is necessary to bring the next lower line on the slope into focus. Conversely, if we focus on the lower line and allow the diamond to bore its way down ·01 mm., the next higher line of the micrometer glass will come into sharp focus only when that depth is reached. We thus have here an extremely sensitive measure of depth.

Fig. 39.



The author gives a preliminary series of tests with the minerals of the Molis scale to show the efficacy of the method. The improvement of certain details is under consideration. The instrument seems to be applicable to the determination of the amount of double refraction, and to the measurement of the thickness of mineral thin sections.

Immersion-Oil Bottle.* — Dr. W. Gebhardt describes a new form of bottle for holding cedar oil for immersion purposes. As the illustration (fig. 39) shows, the bottle is much like a small Erlenmayer's ask with a side tube S and a fairly broad neck T, the latter being

* Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 348–50 (1 fig.).

prolonged downwards to near the bottom of the bottle, and being narrowed so as to form an elongated funnel. The neck T is closed by a metal cap K, from inside of which passes a wire ending in a loop. The loop picks up just the necessary quantity of oil, provided that the bottle be not filled too much. Owing to its broad base the bottle is very steady, and if S be closed with a cork there is no fear of any overflow, as the bottle then acts as a siphon. For travelling, the metal cap must be replaced by a cork.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Alkalised Serum as a Culture Medium for Diphtheria Bacilli.†—Dr. L. Cobbett prepares alkalised ox-serum in the following way. To every 100 ccm. of the serum 2 grm. of glucose and 1·75 ccm. of a 10 per cent. solution of NaHO are added. The mixture is then put into tubes and sterilised in an autoclave at a higher pressure than usual. This is effected by closing the exit tap of the autoclave before the air which it contains has been expelled, and thus the pressure of the heated air is added to that of the steam. The medium is of a rich brown hue, and should be perfectly transparent by transmitted light. On it the colonies are discrete, flat, grey, or almost colourless, and after several days' growth their margins usually became indented and radially fissured.

Alkalised horse-serum, from which more rapid results are obtained, is prepared as follows. To every 100 ccm. of serum 2 grm. of glucose and from 1·25 to 1·2 ccm. of a 10 per cent. solution of NaHO are added. The mixture is then poured into tubes and Petri's dishes, and sterilised at a temperature of 90° C. on 2 successive days in a chamber surrounded by a jacket containing boiling water. Thus prepared the medium is bright, transparent, and almost as light in colour as gelatin. Colonies may be seen on it after from 6 to 8 hours' incubation; the colonies are, however, not so radially striated (daisy-shaped) as with ox-serum.

The impression method of examining the growth is recommended, as thereby a large number of colonies can be examined at once.

Preserving Living Pure Cultivations of Water Bacteria.‡—Mr. J. Lunt finds that water bacteria can be preserved in sterilised tap water for considerable periods without impairment of vitality or of their characteristic and specific features. This simple method has the following advantages. (1) It obviates the necessity of frequently transplanting cultures to fresh media; such cultures remain in good condition for periods during which they would have died on the ordinary media. (2) The cultures are preserved in their natural habitat, and, when resown, grow vigorously. (3) The method serves also to differentiate those organisms which may properly be classed together as water bacteria from those outside the water group.

The experiments were made with *B. fluorescens liquefaciens*; *fluores-*

* 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, 1898, i. pp. 362-3.

‡ Trans. Brit. Inst. Preventive Med., 1st series, 1897, pp. 152-63.

cens fuscus sp. n.; *violaceus*; *nubilus*; *iridescens*; *prodigiosus*; *giganticus* sp. n.; *coli communis*.

Actinomycotic Form of the Tubercle Bacillus.*—Herr P. L. Friedrich injected rabbits with 0·2–6·5 ccm. of a suspension of young tubercle culture in salt solution. The injection was made into the left ventricle. The animals died in 24 to 86 days with tuberculous deposits in kidneys, iris, lungs, and brain. By special methods the author succeeded in staining preparations from kidneys, lungs, and iris which showed appearances very similar to those characteristic of actinomycosis. Paraffin sections were first treated for one minute with Böhmer's hæmatoxylin, washed in water, and then with Victoria blue. They were next heated over a flame until vapour arose, and afterwards decolorised with hydrochloric acid alcohol. After having been washed with water they were treated for one minute with 4 per cent. aqueous solution of eosin, and then washed again. Next they were transferred to alkaline methylen-blue for 30 seconds; then washed with alcohol until no more eosin was given up, and after this immersed for 5 minutes in water slightly acidulated with acetic acid. They were then immersed successively in water, alcohol, xylol, and balsam. The tubercle bacilli are deep blue, the clubs red, and the rest of the tissue blue-violet.

The formula for the Victoria blue solution is,—Alcohol 90 per cent. 30 ccm., anilin 1 ccm., H_2O 70 ccm., saturated alcoholic solution of Victoria blue 10 ccm.

For the hydrochloric acid alcohol,—Alcohol 70 per cent. 70 ccm., H_2O 30 ccm., HCl 1 ccm.

For the alkaline methylen-blue solution,—Saturated solution of lithium carbonate 5 ccm., H_2O 50 ccm., alcohol 90 per cent. 20 ccm., saturated alcoholic solution of methylen-blue 2·5 ccm.

(2) Preparing Objects.

Detection of Protoplasmic Threads in Cell-Walls.†—The following are the principal points in the method of preparing, staining, and mounting sections of vegetable tissue employed by Mr. W. Gardiner to obtain the results described on p. 206.

The method depends upon the use of two principal reagents, viz. the osmic-acid-uranium-nitrate mixture of Kolossow as a fixative, and safranin as a dye. Thymol water is used as a preservative. In material such as that of young endosperms (e.g. *Tamus communis*), no swelling is required, and the tissue, cut into small pieces, may be both killed and fixed at one and the same time by Kolossow's reagent, and then preserved in thymol water. Where only slight swelling is necessary, treatment with water may precede that of Kolossow's reagent. In certain classes of tissue, where the walls are swollen with comparative ease—such as the ordinary vegetative tissue of *Phaseolus vulgaris*, *Tamus communis*, *Nerium Oleander*, *Salisburia adiantifolia*, &c.—small pieces are killed and swollen in an aqueous solution of picric acid, and then fixed in Kolossow's reagent. Finally, where the tissues are more resistant—e. g. in *Robinia Pseudacacia*, *Prunus Laurocerasus*, *Aucuba japonica*—treat-

* Deutsch. Med. Wochenschr., 1897, p. 653. See Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 413–5.
† Proc. Roy. Soc., lxii. (1897) pp. 102–4.

ment with picric acid may be followed by more severe swelling by means of zinc chloride or sulphuric acid.

With regard to staining, it is possible, in certain special cases, to stain the connecting protoplasmic threads either with safranin alone, or by introducing safranin by means of a somewhat intricate substitution method, the sequence being Hofmann's blue (or soluble water-blue), methylen-blue, safranin. The safranin may then be succeeded by gentian-violet or by eosin; with gentian-violet Gram's method is the best. In all cases the staining is practically limited to the protoplasmic threads.

But with ordinary tissues this method is not applicable; since the whole of the wall becomes deeply stained, and the threads are no longer visible. To avoid this, the method was adopted of staining and washing out, using for the purpose orange G or acid fuchsin. With ordinary tissue the staining appears to be more easily accomplished than with the thick mucilaginous walls of endosperm-cells. Excellent results may be obtained by staining at once with safranin and washing out with orange G. This may be followed by staining with gentian-violet, succeeded by treatment with acid fuchsin, or the sequence of staining may be safranin, gentian-violet, acid fuchsin. Substitutions in which safranin, gentian-violet, and eosin are included give good results.

Use of Permanganate in Microtechnique.*—M. M. Tswett finds potassium permanganate a useful reagent for causing swelling of the protoplasmic structures, and thus assisting in the observation of the structure of the chromatophores. The same reagent may also be employed as a macerating substance; beautiful preparations were thus obtained of the sieve-tubes of *Vitis*.

Preparation of Pigments for Depicting Microscopical Preparations.†—Herr W. Baklanoff rubs up anilin pigments in a mortar with strong gum arabic solution until the mixture is of the consistency of paste. Glycerin in the proportion of 1 drop to 1 ccm. of the mixture is then added. The paste is then incubated at 37–38° until hard. In this way pigment-masses are made which, when used for depicting microscopical preparations, reproduce the original colours very faithfully. Pigments made in this way form masses which are compact, homogeneous, and do not run or soak through the paper. Hæmatoxylin may be prepared in a similar way.

Visibility and Appearance of Unstained Centrosomes.‡—Prof. E. Ballowitz maintains that centrosomes are more easily examined and clearly seen in the unstained condition when merely fixed with Flemming's solution than when treated with sublimate and specific stains.

Clearing Vegetable Sections.§—Mr. W. Kirkby recommends the following procedure for treating sections of vegetable tisssue, as it leaves the sections in a condition suitable for mounting in liquid, gelatinous, or resinous media:—Place the sections in a fresh clear solution of chlorinated lime until they are quite bleached (2–5 minutes). Warm gently in a test-tube for a few seconds, then quickly replace the solu-

* Bull. Lab. Bot. Univ. Genève, i. (1897) pp. 13–5.
† Zeitschr. f wiss. Mikr., xiv. (1897) pp. 366–8.
‡ Tom. cit., pp. 355–9. § The Microscope, v. (1897) pp. 151-2.

tion with distilled water, boiling for 2–3 minutes; repeat the last treatment thrice. Wash with 1 per cent. solution of acetic acid, and finally with distilled water. The sections are then quite ready for staining. The author advises alkaline glycerin as a mounting medium, the mixture recommended being composed of glycerin 2 oz., distilled water $1\frac{1}{2}$ oz., solution of potash (B.P.) 1/2 oz.

Preparing Central Nervous System.*—Mr. H. J. Berkeley, when studying the lesions produced by the action of certain poisons on the cortical nerve-cell, adopted the following method of preparing and examining the brains. The cerebra are hardened in Müller's fluid until the tissue is of sufficient consistency to admit of fairly thin sections (about two weeks at room temperature). Pieces not more than 3 mm. thick are then immersed in a mixture of 3 per cent. solution bichromate of potash 100 parts, and 1 per cent. osmic acid 30 parts, for 2 or 3 days. On removal, the pieces are mopped up on blotting-paper, washed for a few moments in weak silver nitrate, and then transferred to a solution composed of 2 drops of 10 per cent. phospho-molybdic acid to 60 ccm. of 1 per cent. silver nitrate solution.

This last solution must be prepared the moment before placing the brain tissue in it, and the pieces remain therein for 2 or 3 days; if longer, a few drops of nitrate of silver solution must be added to prevent precipitation. Light does not affect the process unfavourably, though it is better to keep the jars covered up. In winter the solution should be kept at a uniform temperature of about 25° C. By this procedure the individual details of the component parts of the neuron are finer than in Golgi sections; each element stands out clearly and distinctly; the axons and their collaterals are clear, and not too numerously tinged; and the gemmulæ on the protoplasmic processes are fully and equally impregnated, and appear in their proper relations to the parent dendrite.

Apparatus for Rapidly Fixing and Hardening Tissues.†—Prof. R. Thoma describes a simple apparatus made of tin-plate for rapidly hardening pieces of tissue, provided that their structure is not too fragile or delicate. It consists of an overshot wheel, the interior of which has six compartments for preparation glasses. The latter are fixed tightly by means of cotton-wool packing. The wheel is driven by water from a dropping apparatus capable of holding 10 litres of water. The author mentions a dropper of his devising which can be fitted on to the ordinary water-tap.

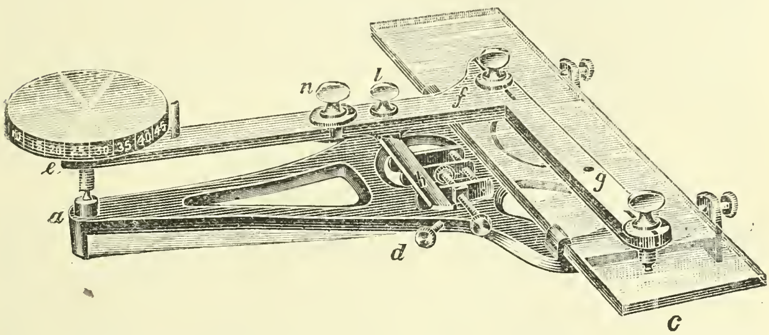
(3) Cutting, including Imbedding and Microtomes.

New Microtome.‡—The instrument invented by Dr. S. Yankawer consists of two parts, a stand and a movable right-angled piece. The stand is a triangular piece of metal across the base of which an oblong piece of glass is fixed. At the apex of the triangle is *a*, a small elevation with an excavation 1/8 in. in diameter and 1/8 in. deep. The bottom of the hole is on a level with that of the glass plate. One arm of the sliding piece *e*, *f*, *g*, is $7\frac{1}{2}$ in. long, the other $12\frac{1}{2}$ in. long.

* Johns Hopkins Hospital Rep., vi. (1897) pp. 1–108 (15 pls.).
† Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 333–4.
‡ The Microscope, v. (1897) pp. 145–8 (2 figs.).

The angle and both ends are perforated for capped interchangeable screws, each having ten turns to the inch, one of these being the micrometer screw. The blade, fig. 40, *h*, is fastened to the long arm by the screw *l*, so that its edge is parallel to the short arm *fg*. The sliding piece moves along the glass plate, carrying the knife over the specimen to be cut, and the knife is lowered by turning the micrometer screw. The

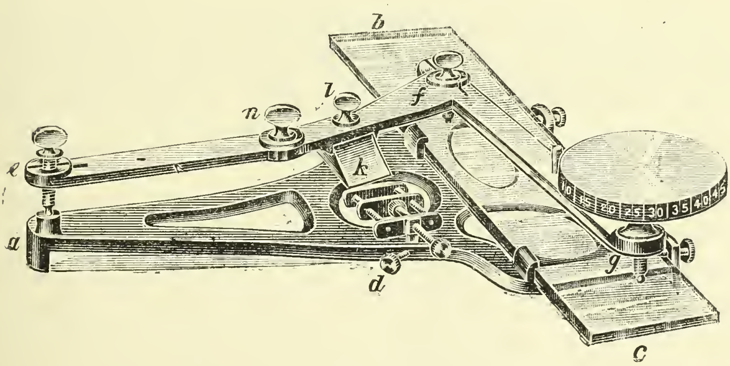
Fig. 40.



thickness of section is obtained as follows: as one turn of the micrometer screw lowers the long arm 1/10 in., and as the distance between knife and short arm is one-fifth the length of *ef*, the knife is lowered 1/50 in. for a complete revolution. Hence one division of the micrometer screw represents 1/5000 in.

By bending the long arm at the joint *n* the knife can be placed in position to cut specimens from 1/2 in. upwards. As the knife always

Fig. 41.



moves in a plane parallel to that of the glass plate, the sections are of even thickness and are not wedge-shaped.

For cutting frozen specimens or specimens imbedded in paraffin, the edge of the knife must be placed perpendicular to the direction of the motion. For this purpose a small blade, fig. 41, *k*, is used, and the position of the screws arranged as in fig. 41. From what has been said, it will be gathered that the microtome is well adapted for celloidin sections, which may be cut as thin as 10 micromillimetres.

Groot's Improved Lever Microtome.*—M. J. G. de Groot states that the advantages of his recently improved microtome are that the instrument is very strong; the knife cannot wobble, and may be fixed at any angle. Movement is imparted by the oscillation of a lever. The paraffin block slides easily and smoothly under the knife; it is easy to fix or unfix the object. The thickness of the section is easily regulated. The size of the section may amount to 4–5 cm. square. Celloidin sections are also easily cut by this machine; it is only necessary to immerse the block in paraffin so that it can be fixed to the object-holder in the usual way.

(4) Staining and Injecting.

Chrome-silver Impregnation of Formalin-hardened Brain.†—Dr. J. S. Bolton has obtained excellent results from brains hardened in formalin for periods of 5 weeks to 12 months according to the size. Pieces of cortex 1/8 in. thick with a base of about 1/4 in. are then immersed in 1 per cent. ammonium bichromate for a few hours to five days. The pieces are then rinsed in distilled water and placed in a bath of 1 per cent. silver nitrate for 16 – 24 hours or even longer. The pieces are next hardened by immersion in 60 per cent. alcohol for a few hours, and having been mopped up with blotting paper, imbedded without soaking in paraffin. The sections are placed successively in methylated spirit, absolute alcohol, chloroform and xylol, and mounted in xylol balsam without cover-slip.

The author also states that for some time he has passed the Golgi sections into water and developed and fixed them by the method of Kallius, afterwards treating them as above and mounting under a cover-slip.

Staining Flagella of Bacteria with Orcein.‡—Prof. Bowhill stains flagella in the following way. Two stock solutions are required, one a saturated alcoholic solution of orcein (the solution improves by keeping for about 10 days); (2) a 20 per cent. solution of tannin. When required for use the foregoing are mixed in the following way:—15 ccm. of orcein solution, 10 ccm. of tannin solution, and 30 ccm. H_2O, and then filtered.

Young agar cultures are recommended as affording the best results. The film is prepared in the usual way from a suspension in distilled water, and the cover-glass dropped film side downwards on the orcein solution in a watch-glass. The fluid is then gently warmed, and the preparation allowed to float for 10–15 minutes. The cover-glass is then washed and examined in water. If satisfactory, it is dried and mounted in balsam. The bacteria are stained a bluish-purple colour, the flagella being of a somewhat paler hue. A list of nineteen bacteria stained by this method is given, among them being *Sp. choleræ asiaticæ*, *B. typhi abdominalis*, and *B. coli communis*.

* Ann. Soc. Belge de Microscopie, xxii. (1897) pp. 77–80 (1 fig.).
† Lancet, 1898, i. pp. 218–9. ‡ S.A. Hygienischen Rundschau 1898, No. 3.

Staining Blood of Oviparous Vertebrata.*—Dr. E. Giglio-Tos recommends the following method for staining blood-films. The film should be dried quickly in the flame and immediately stained. The stain recommended is a saturated aqueous solution of methylen-blue B.X. One or two drops are placed on the film and left there for one minute. The preparation is then washed with distilled water, afterwards covered with a cover-glass, and luted with olive oil. In this way the preparation will keep for four or five days, and the results for observation are excellent. Attempts to make permanent preparations by means of glycerin and resin were failures.

Permanent Stain for Starch.†—Prof. G. Lagerheim describes the following method for imparting a permanent brown stain to starch-grains. The material is first fixed with alcohol, and should it contain chlorophyll, must be left in the spirit until colourless. Eau de Javelle may be advantageously substituted for alcohol, as that fluid rapidly destroys the protoplasm of the cells, leaving the starch-grains intact. The specimen, having been washed, is placed still wet on a slide, and then treated with an iodine solution of the following composition,—water 15 grm., potassium iodide 1·5 grm., iodine 0·5 grm. One drop or so of this solution usually suffices to stain the starch-grains blue. The preparation is next washed with distilled water until the cell-membranes and the plasma have lost their iodine staining, and is thereupon treated with one or more drops of a solution of nitrate of silver (? strength). The silver iodide precipitated in the starch-grains is now reduced by a developer of the following composition,—distilled water 100 grm., sodium sulphite 10 grm., hydrochinon 2 grm. To one cubic centimetre of the developer is added a drop of 10 per cent. solution of potassium carbonate; and the preparation is treated with a few drops of this freshly made solution immediately after it has been washed with distilled water. The preparation now gradually becomes brown, and is mounted in glycerin.

A brown staining of the starch-grains is also obtainable by treating the preparations, after the iodo-potassic iodide solution, with 1 per cent. solution of palladium chloride for a few minutes, and then carefully washing with water.

Injection Mass.‡—Herr O. Fränkl uses a mass for injecting the kidney of frogs which was prepared of the following ingredients and in the following manner. Ten to fifteen plates of white gelatin were soaked in water for 24 hours; the superfluous fluid was then poured off, and the mass boiled with an equal bulk of glycerin, and then, after the addition of 4–5 ccm. of sublimate water (concd.), was filtered. The mass, stained with 1–20 Berlin blue or 1–20 carmin, is injected warm. It keeps well if a thymol crystal be added.

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

Method of Preserving Algæ.§—Mr. C. Thorn recommends the following method of preserving algæ for demonstration purposes without shrinking. Fix in Flemming's weaker formula (10 ccm. 1 per cent. osmic

* Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 359–65. † Tom. cit., pp. 350–2.
‡ Zeitschr. f. wiss. Zoologie, 1897, p. 63. See Zeitschr. f. angew. Mikr., iii. (1897) p. 265. § Bot. Gazette, xxiv. (1897) p. 373.

acid, 10 ccm. 1 per cent. acetic acid, 25 ccm. 1 per cent. chromic acid, 55 ccm. distilled water). Next drop 10 per cent. glycerin directly into the fixative, each drop being allowed to diffuse before adding more. Continue adding drop by drop until enough glycerin has been put in to cover the specimens when evaporated. The fixative and water should now be allowed to evaporate in a watch-glass where a large surface is exposed. The specimens may now be handled with a needle or knife, and arranged on the slide under a dissecting Microscope. A drop of pure glycerin or of glycerin-jelly makes a very satisfactory mount. Glycerin-jelly has to be used very carefully, but it is the more satisfactory when it can be used with success. The method was found especially useful for demonstrating swarm-spores and the formation of zygosperms.

Media for the Study of Diatoms.*—Dr. H. van Heurck, in an excellent description of the media used for mounting diatoms, divides these media into resinous and chemical. Of the first, three are discussed, viz. Canada balsam, now but little used, storax, and liquid amber. Storax should be purified by dissolving in chloroform and then filtering it. Liquid amber is prepared by heating the raw material in a water-bath together with equal parts of benzin and absolute alcohol. The solution is filtered and evaporated down until the mass becomes slightly brittle at about 10°. The mass is then redissolved in the same solvents. The chemical media are monobromide of naphthalin, iodide of methyl, and Smith's arsenical fluid. As monobromide of naphthalin dissolves most resinous bodies, the preparation must be closed with strong liquid glue. Its refractive index is 1·658, and hence its visibility is 22. This latter is calculated by taking the difference between the index of the silica of the diatoms, 1·43, and the refractive index of the medium.

Iodide of methyl has a refractive index of 1·743, and therefore a visibility of 31. If saturated with sulphur its index is raised to 1·787.

Prof. H. L. Smith's arsenical medium has an index of 2·4, and consists of realgar dissolved in bromide of arsenic. This medium is prepared by melting together in a retort 1 part of sulphur and 1·7 parts of arsenious acid, and raising the temperature until the product distils. The realgar thus obtained is, together with some tribromide of arsenic, also obtained by distillation, heated in a test-tube, the resulting liquid being of a syrupy consistence and of a greenish-yellow hue. The diatoms, fixed to the cover-glass, are covered with a drop of the medium and then placed on the slide. The slide is then heated over a spirit-lamp until the bromide of arsenic is volatilised. When the gas bubbles cease to be given off, the heating is stopped and the preparation allowed to cool slowly. During the heating the colour of the medium is red, but as the slide cools it becomes yellow.

This method is subject to two grave objections: the medium rapidly deteriorates even in sealed tubes, and two-thirds of the preparations spoil without any obvious reason. The best way to preserve the preparations is to make them when the air is dry and the weather sunny. The slides and cover-glasses should be warm when the medium is applied. The manipulation should be quick and the cover-glass ringed round at once. The slides should be kept in a dry place.

* Zeitschr. f. angew. Mikr., iii. (1898) pp. 285–97.

Limpid Colourless Solution of Copal.*—Dissolve 1 part of gum camphor in 12 parts of sulphuric ether, and to the solution add 4 parts of gum copal. Allow to stand until the copal is thoroughly softened, then add 4 parts of absolute alcohol and 1/4 of a part of rectified turpentine oil, and shake well. Set aside for a few days, agitating occasionally the while; in about a week the liquid will have separated into two layers, the upper being a limpid colourless solution of copal. Decant or siphon off the upper layer, and then treat the residue with more alcohol and oil of turpentine to obtain another limpid layer, and so on. If the solution be too thin it can be easily thickened by evaporation. The liquid can be made to dry more slowly by the addition of a small amount of Canada balsam.

(6) Miscellaneous.

Sources of Error in the Plankton Method.†—Mr. C. A. Kofoid has determined that the ordinary method of collecting plankton by drawing a net made of silk bolting cloth vertically through the water is subject to error, owing to the leakage of organisms through the openings in the silk. The leakage has hitherto been minimised or ignored, and the author has made experiments to ascertain the amount of the escape. The leakage has been tested by means of the Sedgwick-Rafter sand-filter; by hard pressed filter-paper; by the centrifuge; and by the Berkefeld filter.

It was found that in a general way the order given is that of increasing efficiency. The silk retains from 5 per cent. to less than 0·1 per cent. of the total number of the organisms present (excluding bacteria), as contrasted with the catch of the Berkefeld filter. Examination of the sand filtrate showed that 40 per cent. to 65 per cent. of the organisms present were captured, while the filter-paper method yielded 75 per cent. to 85 per cent. of the planktons. By the aid of the centrifuge 98 per cent. were sometimes captured. The Berkefeld filter method was found to be very satisfactory as far as the catch was concerned, but subject to a serious drawback, viz. the presence in considerable amount of infusorial earth, owing to the softness of the filter.

Method of Demonstrating Assimilation.‡—Prof. F. Darwin has adopted the following modification of Farmer's method for demonstrating assimilation in green leaves. A leaf of *Elodea canadensis* is mounted in water, and the preparation sealed by carefully ringing it with "wax-mixture" (15 parts resin, 50 parts vaseline, 35 parts bees-wax). The preparation is then placed in the dark, and the observer waits until the available oxygen has been absorbed and the circulation has come to rest, which takes place in from 3 to 6 hours. It is easy to show that the cessation of circulation is due to want of oxygen, by lifting the cover-glass with a needle and adding a drop of fresh water, when the protoplasm will begin to stream in a few minutes.

Logarithmic Plotting of Biological Data.§—Mr. D. J. Scourfield suggests that for plotting certain classes of data, such as those connected

* National Druggist, xxvii. (1897) p. 371.
† Science, vi. (1897) pp. 829–32.
‡ Proc. Cambridge Phil. Soc., ix. (1898) pp. 338–40.
§ Journ. Quekett Micr. Club, vi. (1897) pp. 419–23 (1 pl.).

with the development of the lower animals and plants, the variation in the number of plankton organisms, &c., biologists should use sectional paper ruled logarithmically, or should use the ordinary sectional paper as if the distances at which the lines are drawn represented the logarithms of numbers, and not the numbers themselves. For most purposes it is sufficient if the paper be ruled or taken logarithmically in one direction only, the ruling in the other direction proceeding arithmetically as usual.

Logarithmic plotting has two great advantages over the ordinary method, viz.:—(1) it allows of the graphic representation of an enormous range in the numbers dealt with; and (2) it shows the same proportionate changes by lines having the same angle of slope, which implies that similarly shaped curves denote the same relative course of events. Some data relating to six species of diatoms, a rotifer, and two species of Entomostraca, taken from Apstein's 'Das Süsswasserplankton' are plotted on the plate accompanying the paper in illustration of the method.

Aitken's Dust-Counter.*—Dr. A. Macfadyen and Mr. J. Lunt describe the apparatus devised by Dr. Aitken for counting particles of dust in samples of air. The dust particles are rendered visible by supersaturating the air with vapour, whereby each particle becomes a centre of condensation. The essential parts of the apparatus are a metal box, in the top of which is a pair of biconvex lenses, and in the bottom a micrometer-plate etched into squares. The box is lined with bibulous paper moistened with water. The bottom of the box has a couple of perforations, one on each side of the micrometer-scale. Into one is fitted an air-pump, and into the other a tube supplied with three taps, which regulate the quantity and quality of the air allowed to pass into the box. The cooling of the vapour is effected by the air-pump, which rarefies the air. If no dust be present no dew-drops fall, while, when dust-laden air is allowed to enter, a fine rain of dew-drops is deposited on the micrometer. Though extremely ingenious and of great scientific value, the instrument does not appear to be of much practical use, at present at least, for hygienic purposes.

Enumeration of Blood-Platelets.†—Drs. T. G. Brodie and A. E. Russell have made an elaborate series of experiments to ascertain the best way to enumerate correctly the number of platelets in a given quantity of blood. The chief difficulties in this examination are due to the fact that the platelets have a great tendency to stick together, and that the red corpuscles become invisible from the action of reagents. The method adopted by the authors was to obtain blood from the finger, either puncturing through a layer of the diluting fluid, or dropping the blood into a glass vessel containing the fluid. The fluids selected after numerous trials were solutions of dahlia in strong glycerin or diluted glycerin; but excellent results were obtained from equal parts of glycerin saturated with dahlia and 2 per cent. NaCl. These solutions have the disadvantage of dissolving out the hæmoglobin from the red-cells, so that the stroma eventually becomes invisible; but as this action takes some time, it is easily possible to complete the enumeration. By adding

* Trans. Brit. Inst. Preventive Med., 1st series, 1897, pp. 142–51 (1 pl.).
† Journ. Physiology, xxi. (1897) pp. 390–5.

oxalates (Na, K, NH_4) it was also found possible to stain the stroma. A great many other solutions were tried, but for these the original should be consulted. In performing the manipulation it is necessary that the blood should flow freely, and in all cases it must be ascertained that the platelets are distributed uniformly over the field of the Microscope, and that they do not form groups or clumps. The results the authors obtained are that the ratio of the platelets to red corpuscles is as 1 to 85, or 635,300 per cubic mm.

Cleansing of Slides and Cover-Glasses.*—Dr. Emma L. Billstein advocates the use of acid alcohol for cleaning slides and cover-glasses. The mixture recommended consists of alcohol 70 per cent. 99 ccm., and hydrochloric acid 1 ccm.; in this the glasses should be immersed for about 5 minutes, transferred to plain alcohol, and then dried.

For removing anilin stains the authoress uses "silver ends," a fossil earth, sold in the form of a greyish-white powder. This mixed with water makes a turbid solution, alkaline on reaction and soapy to the touch, which cleans quickly and imparts a brilliant polish. The glasses should be afterwards washed in water or spirit, to prevent the possibility of any of the microscopic fossils adhering to the surface.

Cleaning Used Slides.†—Herr A. Zielina cleans used slides in the following way. After the cover-glasses have been removed, the slides are left until the balsam is dry, and they are then placed in water for a few days. The balsam is then scraped off with a smooth piece of wood, and the slides washed and dried with a cloth.

Glass-Blowing and Working.‡—This little volume by Mr. T. Bolas is intended for amateurs, experimentalists, and technicians, and is based on a course of lecture-demonstrations delivered by the author, whose aim has been to make the present work a laboratory and workshop guide to the various phases of glass-working at the blowpipe. Amongst those who will find the instructions useful is the Microscopist. In the little volume will be found descriptions of the necessary tools and utensils and how to work them, the various methods of making glass of different composition so as to be suitable for special purposes, the methods for working and blowing glass, how to colour and modify materials, &c., and remarks on the disintegration and decay of glass.

The volume concludes with a chapter on the bibliography of glass; and this contains a short list of works which are of interest either from intrinsic or historical importance or from their ready accessibility.

* Micr. Bulletin, xiv. (1897) p. 45.
† Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 368–9.
‡ Dawbarn & Ward, London, 1898, 212 pp. and 104 figs.

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on February 16th, 1898, at 20 Hanover Square, W., A. D. Michael, Esq., F.L.S., Vice-President, in the Chair.

The Minutes of the Anniversary Meeting of January 19th last were read and confirmed, and were signed by the Chairman.

The following Donation was announced:—

From

R. Braithwaite, British Moss Flora, pt. xviii. (4to, London, 1898) *The Author.*

The Chairman moved that a vote of thanks be given to Dr. Braithwaite for this new part of the great and valuable work upon which he had so long been engaged. This was a special copy, so far as the printing of the plates was concerned, as they were upon specially prepared paper. He thought they might well congratulate Dr. Braithwaite upon the progress which he had made in this extremely laborious work.

The thanks of the Society were unanimously voted to Dr. Braithwaite for this donation.

Mr. J. E. Barnard said that when he gave his demonstration at the meeting of the Society in November last, on the application of the electric arc light to photomicrography, Mr. E. M. Nelson suggested that it would be of interest to the Fellows if he would bring down to a future meeting some slides taken in that way, so as to show what results could be obtained. He had accordingly brought with him a few specimens for exhibition on the screen, and by way of giving some definiteness to the series, he proposed first to show a number of slides of Ringworm Fungi (*Ectothrix trichophyta*, *Endothrix trichophyta*, and *Microsporon*), which would, he thought, be found to have some interest, apart from the method by which the photographs had been produced.

A number of these slides were then shown, illustrating the appearance of the fungi in various stages, and under conditions in which the external portions or internal structure of the hair of man and animals had been attacked, and their appearance when cultivated artificially. The essential differences in the various species were pointed out, and also the variations in the appearance of the cultivations, due to slight differences in the culture media. The photographs were from microscopical preparations, kindly lent by Dr. T. Colcott Fox.

Other slides were shown of the bacilli of anthrax, tuberculosis, typhoid fever, and bubonic plague. A photograph of the proboscis of a fly and one of a portion of Podura scale were also exhibited.

Dr. Hebb, in reply to the Chairman, said he was unable to say more upon this subject than Mr. Barnard had done, for bacteriology had now become so specific a study that there were men nowadays who spent their whole time upon branches of it. He was aware of much that had been done in this particular subject by Dr. Blaxall and others, so that the facts which Mr. Barnard had mentioned were not altogether new to him, but he did not know that he had ever seen them so beautifully illustrated as they had seen them that evening.

Mr. T. C. White could quite endorse all that Dr. Hebb had said. For high amplification he did not know that he had seen anything so sharply defined, especially in the case of a Podura scale magnified 6000 diameters.

The Chairman was sure they would thank Mr. Barnard very heartily for, what had been to him, an extremely interesting exhibition. No one could fail to be struck by the clear manner in which these minute objects had been shown. It had certainly been a very excellent demonstration as to what the process was capable of.

The thanks of the Society were unanimously voted to Mr. Barnard for the exhibition.

Mr. T. C. White read a paper on 'Micro-Crystallography,' which he illustrated by the exhibition on the screen of a number of slides of the crystals described, many of the photographs having been taken by polarised light. He had selected these to show how large a number of beautiful forms might be obtained from the same salt by causing it to crystallise under different conditions.

Mr. White further illustrated the subject by exhibiting the formation of crystals under the Microscope at the close of the meeting.

The Chairman thought they might fairly congratulate Mr. White upon his success in devising means for producing these beautiful forms. He thought it quite possible that when they came to examine these groups of crystals very carefully, they would find that the ultimate form did after all agree with the typical form; but it was remarkable to see how other forces could modify these forms, and how puzzling it might be to recognise what might be called the basal substance. Some of those present would probably recollect the beautiful slides which were produced by Mr. Waddington, by the gradual admixture of one substance with another, either whilst the crystals are forming, or otherwise. It would be a most interesting study for any one to endeavour to ascertain the nature of these modifying forces.

The thanks of the Society were, upon the motion of the Chairman, cordially voted to Mr. T. C. White for his interesting paper and exhibition.

The Chairman said they had another paper on the Agenda, on Foraminifera, taken chiefly from shallow water in the Malay Archipelago by Mr. Durrand. The author was not present that evening, but the paper had been handed to Dr. Hebb, who would give them the substance of it.

Dr. Hebb said he found it scarcely possible to give a *resumé* of a paper like this, as it was for the most part highly technical, and would not form by any means interesting reading. He therefore only read the introduction, from which the general scope of the paper could be understood. Appended to the paper was a report, by Mr. F. W. Millett, but this was simply a description of species intended rather for reference than reading.

The Chairman said that papers of this kind were not of much interest as read at a meeting, but they were very valuable contributions to the Proceedings of the Society, and were extremely useful for reference. This paper would, of course, appear in the Journal, and would, he hoped, be a worthy successor to the series of papers on the Foraminifera of the Gault by Mr. Chapman, which had been so recently concluded.

The thanks of the meeting were unanimously voted to Mr. Durrand for his communication.

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

Mr. J. E. Barnard:—Lantern slides produced by the aid of the electric arc, as described at the meeting in November last.

Mr. T. C. White:—Lantern slides illustrating his paper on Micro-Crystallography, with preparations showing the formation of micro-crystals under the Microscope.

New Fellow:—The following was elected an *Ordinary* Fellow:—Dr. George May Lowe.

MEETING

Held on the 16th of March, 1898, at 20 Hanover Square, W.
E. M. Nelson, Esq., President, in the Chair.

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

The following Donation was announced:—

	From
Annual Report of the Local Government Board, 1894–95. (2 vols. 8vo, London, 1896.)	*The Local Government Board.*
Annual Report of the Local Government Board, 1895–96. (8vo, London, 1896.)	*Do.*
Annual Report of the Local Government Board, 1896–97. (8vo, London, 1897.)	*Do.*

The Secretary said the only donation to the Library since the last meeting (with the exception of exchanges and reprints) consisted of four volumes of reports from the Local Government Board. These would not perhaps at first sight be regarded as very useful to microscopists or as entertaining literature; but inspection of them would prove that they contained much that was of considerable value, especially on pathogenic microbes, and that was well worth perusal.

The thanks of the Society were unanimously voted to the Local Government Board for their donation.

Mr. C. L. Curties exhibited and briefly described a new removable mechanical stage which had been suggested by Mr. Allen, which he thought would be found to possess some advantages over others now in use. One of these was that, being attached to the side of the stage, there was a clearer space for the slide than if fixed on the top. It had a movement of one inch in each direction, which was ample for all ordinary purposes, and being divided, the position of a specimen could be quickly logged. The way in which it was attached, viz. by one screw above and one below the stage, rendered it very steady, but easy to remove. The construction was simpler than in the usual Mayall stages, and this would reduce the cost. He placed it in the hands of the Fellows to be passed round for their personal inspection.

The President thought this arrangement might be regarded as a simplification and an improvement upon the well-known Mayall mechanical stage. One of these improvements was its increased steadiness; in using the Mayall stage, he found that when the milled heads were moved there was always a little shake which made the slide jump on the stage; but in this new form the bearing of the vertical movement was very long, which made the movement quite steady. A further advantage also arose from the method of fastening the mechanical to the edge of the ordinary stage; this increased the breadth of the stage, and enabled an extra long slip to be used if desired.

The thanks of the meeting were voted to Mr. Curties for bringing this stage for exhibition.

The President said they had also received from Mr. Philip Jourdain, for exhibition that evening, two lenses which were known as Cooke lenses for photography; their chief use was for making enlargements of comparatively large objects. They were not, properly speaking, Microscope lenses, because in comparison with these their aperture was small, but regarded as photographic lenses their aperture was large. He had no doubt that they would be very valuable in taking low-power photographs, and were certainly worth the attention of persons who did work of this kind. He was sure the Society would appreciate the kindness of Mr. Jourdain in sending these new lenses for exhibition.

The thanks of the meeting were voted to Mr. Jourdain for sending these lenses for exhibition.

Mr. C. F. Rousselet read a short note with reference to his method of mounting Rotifera, a process which he had carried out with such success that he now had a collection of about 400 slides comprising nearly 300 different species. He had been induced to attempt the mounting of these creatures in such a way as to preserve their natural form and appearance, from the felt want of reliable specimens with which to compare those which were obtained from time to time by microscopists; all previous attempts in this direction having resulted only in failure to preserve the objects in such a way as to retain any resemblance to the natural aspect of the living creature. The details of the process of killing, preserving, and mounting having been already published, Mr. Rousselet made only a brief reference to these, but he called special attention to the difficulties met with in obtaining a cement for the covers of his cells, which would prevent the evaporation of the watery preservative fluid; as Clark's spirit-proof cement, which had been at first relied upon, had proved faulty in this respect. He believed, however, that a cement made of a mixture of half gold size with a solution of gum dammar in benzol would be found to answer the purpose, if this, when dry on the outside, was coated with another varnish, such as Ward's brown cement, which is impervious to the solvents of the first cement, to keep the cement from losing all its moisture and becoming porous in consequence.

Mr. Rousselet also recommended a variety of gold size known by the makers as "extra stout," which is thicker and less fluid than ordinary gold size, and will never dry hard and brittle.

The President expressed the great indebtedness of the Society to Mr. Rousselet for bringing together so many beautiful examples of mounted rotifers for their inspection, and moved a hearty vote of thanks to him for having done so. This was put from the Chair and carried by acclamation.

The meeting was then resolved into a Conversazione whereat the beautiful collection of preparations of Rotifera by Mr. Rousselet attracted special attention. The specimens exhibited were shown under about thirty Microscopes kindly lent for the occasion by Mr. C. Baker and Messrs. Ross. Many of the specimens were life-like in all respects but that of movement, and the admirable way in which such difficult objects as Melicerta, Stephanoceros, Floscularia, Limnias, &c., were shown, in apparently natural condition, was a matter of general remark.

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

The President:—Two "Cooke" lenses made by Taylor, Taylor, and Hobson.

Mr. Chas. Baker:—A new Mechanical Stage.

Mr. Chas. Rousselet:—A collection of about 80 Rotifers, mounted.

New Fellows:—The following gentlemen were elected *Ordinary* Fellows of the Society:—Mr. H. D. Kyrle Money Bellew, Mr. George Shields Eckford, Mr. Alfred Herbert Marsh, Mr. William Pearl, Rev. Jas. Thos. Pinfold, Mr. William Pinkney, Mr. F. Shillington Scales.

JUL 27 1898

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

JUNE 1898.

TRANSACTIONS OF THE SOCIETY.

V.—*On Anchor Mud from the Malay Archipelago.*

By A. Durrand, F.R.M.S.

(*Read* 16*th February*, 1898.)

Narrative.

Ever since perusing A. R. Wallace's 'Malay Archipelago,' which so attractively and graphically depicts the terrestrial life of the islands, curiosity about the denizens of the deep thereabouts existed in my mind; dredgings I had made in Western Australia, Port Jackson, and at various stations within the Great Barrier Reef, Queensland, from Townsville to Cape York and Thursday Island, led me to expect richer hauls on the north coast of Australia and in the warm shallow seas about the islands of the Archipelago.

In 1884, and several times subsequently, in passing from Torres to Sunda Straits, I had stray opportunities of obtaining small samples of bottom which showed traces of a rich foraminiferal fauna; and in 1886, in steaming from Java to Singapore, I sounded at Muntok, Banka, and Rhiouw, with good results in Foraminifera and Diatoms, the latter station furnishing *Navicula Durrandii.*

These casual results led to my getting the Netherlands India Steam Navigation Company, then (1889) controlled by the British India Steam Navigation Company, to instruct the commanders of their fleet plying about the islands of the Archipelago, to collect bottom from each port of call, the results of which are now submitted.

The cleaned material was picked over first by me, and then by Mr. Fortescue W. Millett, who finally determined species, and whose careful elaboration speaks for itself.

When it is remembered that all this series of material was taken from shallow water, more or less close inshore, in about 12 or 14 fathoms generally, some idea of the richness of this great area in minute marine life may be formed, and what awaits those who can systematically conduct series of soundings or dredgings from shallow to deep water at the most typical stations indicated in this paper.

Stations.

A number of the labels on flasks had become illegible through getting soaked by leakage ; but the flasks were so packed that I could pretty well determine the section of the Archipelago whence they came. Each flask contained about four pounds of solid matter.

The material as a whole represented very shallow water gatherings from two leading areas: namely, Area 1, from Celebes in the north and west, to Java in the south and New Guinea, Aru, and the Islands in the east, including such stations as Banda, Amboina, Flores, Sumbawa, and Timor ; Area 2, Singapore in the north, Banka in the south, Sumatra in the west, and Borneo in the east.

Stations 1 to 16 are in Area 1.

Stations 17 to 31 are within Area 2.

Where name of station is not mentioned, the label has become illegible.

Area 1.

Station 1. Debbo Aru Islands, yielding almost nothing.
„ 2. Plastic mud, brownish tinted, rich in floatings.
„ 3. Brownish mud with lumps of blueish clay throughout, residue about one quarter-pound and floatings small.
„ 4. Black heavy mud, with lumps of pumice and fine pumice throughout, practically sterile.
„ 5. Blue ooze, residue and floatings small.
„ 6. Blue ooze, fair residue and rich floatings.
„ 7.
„ 8. Results nil.
„ 9. Results poor.
„ 10.
„ 11.
„ 12.
„ 13. Segaar, New Guinea, coral sand and mud, residue about six ounces, floatings rich.
„ 14. Similar to Station 13.
„ 15.
„ 16.

Area 2.

Station 17. Muntok Banka, blue mud, residue eight ounces, floatings rich.
„ 18. Asjahan, north-east coast of Sumatra, rich in diatoms, but poor in Foraminifera.
„ 19. Earthy coloured, river-looking mud, few Foraminifera.
„ 20.
„ 21. Paney, north-east coast of Sumatra.
„ 22. Bawean Roads, between Java and Borneo, fourteen fathoms, light blue mud, rich in deposit and floatings.

Station 23. Soglie, north coast of Sumatra.
„ 24. Edie, east coast of Sumatra.
„ 25. Rich deposit and floatings, twelve fathoms.
„ 26.
„ 27.
„ 28.
„ 29.
„ 30.
„ 31.

Note.—Where the material showed volcanic sand, as in Station 4, results were more or less barren. Other stations, not described above, furnished ordinary looking mud and sand, with fair show of Foraminifera.

It is important to bear in mind that all this series was obtained from shallow water close inshore, with the exception perhaps of Station 22, Bawean Roads, apparently a roadstead well off shore, to judge by the comparative cleanliness of crude material and the absence of vegetable fragments so often present in other stations.

Of course one required to be present at each station to understand the real nature of such; and it is my desire to personally visit the Malay Archipelago to investigate matters, and to take lines of soundings or dredgings from shallow gradually into deep water, when I can find any qualified person to accompany me, or when I can arrange for a portion of expenses or cost of such exploration to be borne by others who participate in results, as I am not at present disposed to defray the whole cost myself.

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

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

(*Read 16th February*, 1898.)

Plates V. and VI.

Dealing with material from nearly thirty stations, which form an unbroken chain extending from the north coast of Australia to the Malay Peninsula, Mr. Durrand's collection is of great importance, and this not only from the extraordinary variety of the forms contained in it, and their deviation in many instances from the ordinary structure of the Foraminifera, but because the rhizopodal fauna of this great region has hitherto been much neglected.

Mr. Durrand's Area 1 was not touched by the 'Challenger' Expedition; and, although the 'Challenger' Stations 188 to 195A may be considered to come within Area 2, neither in Dr. H. B. Brady's

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EXPLANATION OF PLATES.

Plate V.

Fig. 1, 2.—*Nubecularia fusiformis* sp. n. × 75.
,, 3. ,, *tibia* Jones and Parker. × 90.
,, 4. ,, *divaricata* Brady. × 60.
,, 5. ,, *dubia* sp. n. × 90.
,, 6. ,, *Bradyi* nom. nov. × 60.
,, 7. ,, *lucifuga* Defrance. × 60.
,, 8.—*Biloculina ringens* Lamarck sp. var. *striolata* Brady. × 90.
,, 9–12.—*Spiroloculina nitida* d'Orbigny. Figs. 9–11 × 40, fig. 12 × 45.
,, 13. ,, ,, var. × 40.
,, 14.—*Miliolina oblonga* Montagu sp. × 40.
,, 15. ,, *rotunda* d'Orbigny sp. × 45.
,, 16. ,, ,, Biloculine form. × 45.

Plate VI.

Fig. 1.—*Miliolina Bosciana* d'Orbigny sp. × 75.
,, 2. ,, ,, Alveolate var. × 75.
,, 3. ,, ,, Costate var. × 75.
,, 4. ,, ,, Agglutinate var. × 75.
,, 5. ,, *transversestriata* Brady. × 75.
,, 6.—*Biloculina coronata* sp. n. × 75.
,, 7.—*Miliolina Durrandii* sp. n. × 40.
,, 8. ,, ,, Biloculine form. × 40.
,, 9. ,, ,, ,, ,, × 60.
,, 10. ,, ,, ,, ,, From a specimen mounted in balsam. × 40.
N.B.—In this diagram the sutural lines and some other details have been omitted in order to show more clearly the form of the earlier chambers.
,, 11.—*Miliolina cultrata* Brady (passage form). × 40.
,, 12. ,, ,, × 40.
,, 13. ,, *Rupertiana* Brady. × 40.

'Report on the Foraminifera,' * nor in the 'Summary of the Scientific Results' by Dr. John Murray,† is there to be found any detailed list of the Foraminifera of these stations. This is the more to be regretted, as a comparison of the deep-water forms of the 'Challenger' dredgings with the shallow-water forms of Mr. Durrand's collection would have been of great interest.

Of other researches in this region the following may be noted.

In 1863, Harting ‡ described and figured a few species of Foraminifera from a deep-sea sounding in the Banda Sea.

In 1872, F. W. O. Rymer Jones § reported on some interesting *Lagenæ* from a sounding (1080 fathoms) in the Java Seas, and alluded to some other genera of Foraminifera which accompanied them.

Ehrenberg has several scattered notes on Foraminifera from Singapore, Batavia, and other localities in or adjoining the Malay Archipelago.

In 1881, ‖ Prof. Otto Bütschli, in describing the geographical distribution of the Foraminifera, devotes a column of the table to the Malay Archipelago. Unfortunately the species are there represented only by numerals; but Prof. Bütschli has with great kindness allowed me the use of his manuscript notes which contain the key to these numerals, and I am therefore in a position to make use of the list.

About ten years ago Mr. W. H. Harris, then of Cardiff, obtained from the late Capt. Seabrook some dredgings from the Java Seas. These were distributed among various rhizopodists, and excited much interest from the number of remarkable forms contained in them. It was from these dredgings that Mr. Harris procured the specimens of the new genus *Seabrookia* which forms the subject of a paper by the late Dr. H. B. Brady, published in this Journal in the year 1890.

In 1893 appeared Dr. J. E. Egger's report on the Foraminifera contained in the soundings made by the German exploring ship 'Gazelle.' Some of the sounding stations were in or about Mr. Durrand's Area 1, and the results, as tabulated by Dr. Egger, are available for comparison.

To economise space it has been deemed inexpedient to give the full synonymy of each species. This has been so fully dealt with of late years by Goës, Brady, Rupert Jones, Fornasini, de Amicis, and others, in works easily accessible, that it will suffice here to give only

* H. B. Brady, 'Reports on the Scientific Results of the Voyage of H.M.S. Challenger,' vol. ix. (Zoology), 1884.

† John Murray, 'A Summary of the Scientific Results obtained at the Sounding, Dredging, and Trawling Stations of H.M.S. Challenger,' 1895.

‡ P. Harting, 'Bijdrage tot de Kennis der Mikroskopische fauna en flora van de Banda-Zee,' Verh. Koninkl. Akad. Wetensch., vol. x. 1864.

§ F. W. O. Rymer Jones, 'On some Recent Forms of Lagena from Deep-sea Soundings in the Java Seas,' Trans. Linn. Soc. London, vol. xxx. 1872.

‖ Otto Bütschli, in Bronn's 'Klassen und Ordnungen des Thier-Reichs,' vol. i. (Protozoa), 1880, 1881.

such synonyms as may be considered necessary for the elucidation of the species. At the same time attention will be called to the forms figured by authors under other names, when those forms have characters differing in some respects from those of the type.

In selecting synonyms, preference has been given to those works in which the species are illustrated by figures, as so many of the forms given by authors prove to be wrongly diagnosed, that a mere list of names must be always regarded with a certain amount of suspicion.

The well-known tendency of the various types of Foraminifera to gravitate towards one another from every direction, although setting at defiance all strict rules of classification, can yet be made useful by observing in any given locality or formation the direction in which the different types tend to vary. To take an illustration: *Discorbina turbo* may in one locality approach *D. rosacea,* and in another *Rotalia Beccarii.* Attention to these variations serves to indicate the particular facies of a locality, and to show its distinguishing characters in a way which attention to the type forms only would fail to express.

For much assistance in the determination of species I am indebted to Prof. T. Rupert Jones and Messrs. Chapman and Sherborn of London, Dr. Axel Goës of Sweden, and M. Schlumberger and the late M. Berthelin of Paris.

Sub-kingdom **PROTOZOA**.

Class RHIZOPODA.

Order Foraminifera (Reticularia).

PORCELLANEA vel IMPERFORATA.

Family II. MILIOLIDÆ.

Sub-Family I. **Nubecularinæ.**

Nubecularia Defrance.

Nubecularia fusiformis sp. n., plate V. figs. 1 and 2.

Test free or (?) adherent, monothalamous, elongate, fusiform, more or less flexed, with a circular aperture at each extremity. Length 0·7 mm.

This is a porcellanous isomorph of *Lagena gracillima,* and bears the same relation to *N. tibia* that the *Lagenæ* bear to the *Nodosariæ,* but it does not seem necessary on that account to create a new genus for it. It shows no tendency to become jointed, but some specimens have a lateral supplementary aperture, and sometimes one of the terminal apertures has a thickened margin. It occurs sparingly in both areas.

Nubecularia tibia Jones and Parker, plate V. fig. 3.

Nubecularia tibia Jones and Parker, 1860, Quart. Journ. Geol. Soc., vol. xvi. p. 455, pl. xx. figs. 48–51. *N. tibia* Brady, 1884, Chall. Rept., p. 135, pl. i. figs. 1–4. *N. tibia* Chapman, 1892, Quart. Journ. Geol. Soc., vol. xlviii. p. 516, pl. xv. fig. 1.

The typical form is not numerously represented, and most of the Stations where it occurs are in Area 1. The figured specimen curiously resembles the restoration of the specimens as indicated by dotted lines in the figures given by Jones and Parker, *loc. cit.*, pl. xx. figs. 50, 51.

Nubecularia lucifuga Defrance, plate V. fig. 7.

Nubecularia lucifuga Defrance, 1825, Dict. Sci. Nat., vol. xxv. p. 210, Atlas Zooph., pl. xliv. fig. 3. *N. lucifuga* Brady, 1884, Chall. Rept., p. 134, pl. i. figs. 9–16. *N. lucifuga* Egger, 1893, Abhandl. d. k. bayer. Akad. d. Wiss., Cl. II. vol. xviii. p. 250, pl. xxi. figs. 4–7.

Occurs in various forms, attached as well as free, but the spiral form is not represented. Most of the specimens are elongate, with a tendency to approach *N. tibia*. Egger has a somewhat similar form from near Kerguelen Island. The figured specimen (from Station 2) shows little signs of septation; the shell is thick, and has agglutinated to it grains of sand and organic matter. The species is most plentiful in Area 1.

Nubecularia divaricata Brady, plate V. fig. 4.

Sagrina divaricata Brady, 1879, Quart. Journ. Micr. Sci., vol. xix. n.s., p. 276, pl. viii. figs. 22–24. *N. divaricata* Brady, 1884, Chall. Rept., p. 136, pl. lxxvi. figs. 11–15.

This is a rare form, and has hitherto been recorded from only three 'Challenger' Stations, viz. Humboldt Bay, Papua; off Raine Island, Torres Strait; and off Tongatabu, Friendly Islands. It occurs but very sparingly at Mr. Durrand's Stations 2 and 14 in Area 1, and Station 22 in Area 2.

Nubecularia Bradyi nom. nov., plate V. fig. 6 *a, b*.

Nubecularia inflata Brady, 1884, Chall. Rept., p. 135, pl. i. figs. 5–8.

Occurs in the normal form at several stations, mostly in Area 1. From my friend Mr. H. Sidebottom I have many specimens dredged by Mr. C. H. Nevill in the Gulf of Ægina, where it seems to be abundant; and Mr. Nevill tells me it is common off the Island of Delos. Amongst published figures of fossil Foraminifera resembling this form, are *N. novorossica* type *nodula* Karrer and Sinzow,* and

* Sitz. k. Akad. Wiss. Wien, vol. lxxiv. 1876, p. 281, pl. figs. 16–18.

the form placed by Terquem * amongst the *Testæ incertæ sedis* and assigned provisionally to *Guttulina.* It should be mentioned, however, that Jones and Chapman † attribute the latter form to *Polymorphina,* and name it var. *circularis.* The specific name given by Brady is so appropriate that it is unfortunate that it should have to be given up, but priority must be given to Terquem who used the same name for a *Nubecularia* in 1876. ‡

Nubecularia dubia sp. n., plate V. fig. 5 *a–c.*

Test free, monothalamous, oviform, concave on two opposite sides which are smooth, the remaining sides being convex and wrinkled, aperture small, circular, situated in a cup-like depression at the apex of the test.

A doubtful form, which may be claimed by the algologists, and have to go the way of *Dactylopora.* Somewhat analogous forms, bearing a superficial resemblence to this, occur in the Eocene of the neighbourhood of Paris, and are usually considered to be unicellular calcareous algæ. In these, however, the cell-walls are thick and porous, whilst those of *N. dubia* are thin and imperforate. The specimens are remarkably uniform in size and shape. It is found only at Station 2, where it is not uncommon.

Sub-Family II. **Miliolininæ.**

Biloculina d'Orbigny.

Biloculina ringens Lamarck sp.

Miliolites ringens Lamarck, 1804, Ann. du Muséum, vol. v. p. 351; vol. ix. pl. xvii. fig. 1. *Biloculina ringens* Brady, 1884, Chall. Rept., p. 142, pl. ii. figs. 7, 8.

A few small specimens, normal, and generally distributed.

Biloculina ringens var. *denticulata* Brady.

Biloculina ringens var. *denticulata* Brady, 1884, Chall. Rept., p. 143, pl. iii. figs. 4, 5.

Found sparingly in Area 1.

Biloculina ringens var. *striolata* Brady, plate V. fig. 8.

Biloculina ringens var. *striolata* Brady, 1884, Chall. Rept., p. 143, pl. iii. figs. 7, 8.

Found only at Station 22 in Area 2. The specimens are small, and approach *B. elongata,* whilst those figured by Brady resemble *B. depressa.* Its geographical range is much restricted, as it was

* Mém. Soc. Géol. France, sér. 3, vol. i. 1878, p. 48, pl. ix. fig. 41.
† Journal Linnean Society (Zoology), vol. xxv. 1896, p. 505, fig. 24.
‡ 'Essai sur le Classement des Animaux qui vivent sur la plage et dans les environs de Dunkerque,' fasc. 2, 1876, p. 73.

found only at three or four 'Challenger' Stations, all off the southern shores of Papua.

Biloculina bulloides d'Orbigny.

Biloculina bulloides d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 297, No. 1, pl. xvi. figs. 1–4. *B. bulloides* (d'Orbigny) Brady, 1884, Chall. Rept., p. 142, pl. ii. figs. 5, 6.

Found only at Station 14, very rare. It occurs at only five 'Challenger' Stations, two of which are amongst the islands south of New Guinea. In the 'Gazelle' soundings it is recorded from Kerguelen Island and New Guinea, rare in both localities.

Biloculina elongata d'Orbigny.

Biloculina elongata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 298, No. 4. *B. elongata* (d'Orbigny) Brady, 1884, Chall. Rept., p. 144, pl. ii. fig. 9 *a*, *b*.

Found sparingly in both areas; specimens small, but characteristic.

Biloculina coronata sp. n., plate VI. fig. 6 *a–c*.

Test fusiform, chambers few and inflated, sutures depressed, aperture circular, surmounted by a series of incurved lamellæ, which approach or inosculate over the centre of the aperture. Shell substance thin, translucent, and much wrinkled. Length 0·58 mm.

Apertures of the same type, but of a more complex character, are to be found in some specimens of *Idalina antiqua* and *Lacazina compressa* Munier-Chalmas and Schlumberger.* It is very rare, being represented by a solitary specimen from Station 18.

Biloculina depressa d'Orbigny.

Biloculina depressa d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 298, No. 7. *B. depressa* (d'Orbigny) Brady, 1884, Chall. Rept., p. 145, pl. ii. figs. 12, 15–17; pl. iii. figs. 1, 2.

Occurs at Station 13, very rare. Found in New Guinea amongst other 'Gazelle' Stations.

Biloculina lævis Defrance sp.

Pyrgo lævis Defrance, 1824, Dict. Sci. Nat., vol. xxxii. p. 273, Atlas, pl. lxxxviii. fig. 2. *Biloculina lævis* (Defrance sp.) Brady, 1884, Chall. Rept., p. 146, pl. ii. figs. 13, 14. *B. lævis* (Defrance) Goës, 1894, Kongl. Svenska Vetenskaps-Akad. Handl., vol. xxv. p. 119, pl. xxiv. figs. 914–918.

A solitary specimen of the *depressa* type from Station 22 in Area 2. Occurs at three 'Challenger' Stations, one of which is at Humboldt Bay, Papua, shallow water. Found by Goës at Spitzbergen, in deep water.

* Bull. Soc. Géol. de France, sér. 3, vol. xiii. pp. 273 *et seq.*

Biloculina ventruosa Reuss. (See *Miliolina circularis.*)

Spiroloculina d'Orbigny.

Spiroloculina planulata Lamarck sp.

Miliolites planulata Lamarck, 1805, Ann. du Muséum, vol. v. p. 532, No. 4. *Spiroloculina planulata* (Lamarck sp.) Brady, 1884, Chall. Rept., p. 148, pl. ix. fig. 11 *a–b*. *S. planulata* (Lamarck), T. Rupert Jones, 1895, Palæontographical Soc., p. 103, pl. iii. figs. 37, 38; woodcut, fig. 1.

Spiroloculina excavata d'Orbigny.

Spiroloculina excavata d'Orbigny, 1846, For. Foss. Vienn., p. 271, pl. xvi. figs. 19–21. *S. excavata* (d'Orb.) Brady, Chall. Rept., p. 151, pl. ix. figs. 5, 6. *S. excavata* (d'Orb.) T. Rupert Jones, 1895, Pal. Soc., p. 106, pl. v. fig. 2; woodcuts, figs. 2*a*, 2*b*.

Spiroloculina dorsata Reuss.

Spiroloculina limbata Bornemann, 1855, Zeitschr. deutsch. geol. Gesell., vol. vii. p. 348, pl. xix. fig. 1. *S. dorsata* Reuss, 1866, Denk. k. Akad. Wiss. Wien, vol. xxv. p. 123. *S. limbata* (d'Orb.) Brady, 1884, Chall. Rept., p. 150, pl. ix. figs. 15–17; var. pl. x. figs. 1, 2. *S. dorsata* (Reuss) T. Rupert Jones, 1895, Pal. Soc., p. 110; woodcuts, figs. 4, 8*a*, 8*b*.

Spiroloculina impressa Terquem.

Spiroloculina impressa Terquem, 1878, Mém. Soc. Géol. Fr., sér. 3, vol. i. p. 53, pl. x. fig. 8. *S. impressa* (Terq.) Brady, 1864, Chall. Rept., p. 151, pl. x. figs, 3, 4.

These four forms, with the exception of *S. planulata*, are well represented, the specimens being large as well as numerous, and form an unbroken series from one to another. They are found in both areas. *S. planulata* appears in Bütschli's list of Foraminifera from the Malay Archipelago.

Spiroloculina acutimargo Brady.

Spiroloculina acutimargo Brady, 1884, Chall. Rept., p. 154, pl. x. figs. 12–15. *S. acutimargo* (Brady) Balkwill and Wright, 1885, Trans. Roy. Irish Acad., vol. xxviii. p. 323, fig. 1. *S. acutimargo* (Brady) Egger, 1893, Abhandl. d. k. bayer. Akad. d. Wiss., Cl. II. vol. xviii. p. 222, pl. i. figs. 26–28.

A few small specimens from both Areas.

Spiroloculina tenuiseptata Brady.

Spiroloculina tenuiseptata Brady, 1884, Chall. Rept., p. 153, pl. x. figs. 5, 6. *S. tenuiseptata* (Brady) Egger, 1893, Abhandl. d. k. bayer. Akad. d. Wiss., Cl. II. vol. xviii. p. 223, pl. i. figs. 48, 49.

Found only at Station 2, and there very rare and poorly developed. Brady has it from the Ki Islands and two other localities, all over 500 fathoms. Egger's rather doubtful form is from the West Coast of Africa, about 10° north of the equator, depth about 370 fathoms.

Spiroloculina crenata Karrer.

Spiroloculina crenata Karrer, 1868, Sitz. k. Akad. Wiss. Wien, vol. lviii. Abth. i. p. 135, pl. i. fig. 9. *S. crenata* (Karrer) Brady, 1884, Chall. Rept., p. 156, pl. x. figs. 24–26. *S. crenata* Murray and Renard, 1891, Chall. Rept., pl. xiv. fig. 2^{17}. *S. crenata* (Karrer) Egger, 1893, Abhandl. d. k. bayer. Akad. d. Wiss., Cl. II. vol. xviii. p. 225, pl. i. figs. 42, 43.

Found in both Areas, but most abundantly in No. 1.

Spiroloculina nitida d'Orbigny, plate V. figs. 9–13 *a*, *b*.

Spiroloculina nitida d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 298, No. 4. *S. nitida* (d'Orb.) Brady, 1884, Chall. Rept., p. 149, pl. ix. figs. 9, 10. *S. complanata* Egger, 1893, Abhandl. d. k. bayer. Akad. d. Wiss., Cl. II. vol. xviii. p. 225, pl. iii. figs. 7, 8. *S. nitida* (d'Orb.) T. Rupert Jones, 1895, Crag Foraminifera, Pal. Soc., p. 112, pl. v. fig. 3, and woodcut fig. 5.

One of the commonest forms; the shell is usually thin and translucent, and slightly rugose. It is a wild-growing form often deviating from the normal plan of growth, as shown by the figures on plate V. A form closely resembling the arenaceous *Ammodiscus gordialis* is represented by fig. 12. Terquem and Berthelin, in their Report on the Foraminifera of the Middle Lias of Essey-les-Nancy,* under the name of *S. longiscata*, *S. concentrica*, &c., and Terquem, in his Monograph of the Foraminifera from the Fuller's-Earth of Warsaw,† under the name of "Agathistègues irréguliers," figure a large number of wild-growing specimens, most of which may be assigned to this species. That a peculiarity of this character should have survived for so vast a period of time, is an interesting fact in biology.

Brady, in his 'Challenger' Report,‡ assigns to this species a form in which the peripheral margin of the last formed chamber is acute or carinate, whilst that of the penultimate is square or even slightly excavated. A similar form occurs at several of the Malay Stations,

* Mém. Soc. Géol. de France, sér. 2, vol. x. 1875, p. 78, pl. xvi. &c.
† Op. cit., sér. 3, vol. iv. 1886, p. 77, pls. xv, xvi.
‡ P. 149, pl. ix. figs. 9, 10.

but the test is thinner, and the chambers have not the inflation characteristic of *S. nitida.* It is associated with the thin form of *Spiroloculina* from the coast of Papua, which Brady, *loc. cit.*, describes as a variety of *S. limbata,** and is distinguishable from it chiefly by the partially acute periphery. Prof. T. Rupert Jones says of Brady's form, "It is evidently a limbate sub-variety of *nitida* d'Orb., which is a sub-type or variety of the type *Spiroloculina planulata* (Lamarck)." † The *S. nitida* of the same monograph, pl. v. fig. 3, is carinate. It should be mentioned that the wildness of growth is confined to the form which has cylindrical chambers.

S. nitida when striate, is the *S. grata* of Terquem; when reticulate, the *S. foveolata* of Egger; and when arenaceous, the *S. asperula* of Karrer.

Spiroloculina nitida (Striate variety.)

Spiroloculina grata, Terquem, 1878, Mém. Soc. Géol. Fr., sér. 3, vol. i. p. 55, pl. x. figs. 14, 15. *S. grata* (Terquem) Brady, 1884, 'Challenger' Rept., p. 155, pl. x. figs. 16, 17, 22, 23. *S. grata* Terquem, Egger, 1893, Abhand. d. k. bayer. Akad. d. Wiss., Cl. II. vol. xviii. p. 224, pl. i. fig. 39.

This common coral-reef species is found abundantly at most of the Stations in both areas. In a large proportion of the specimens the chambers are square in transverse section, like *S. planulata.*

Spiroloculina nitida (Reticulate variety).

Spiroloculina foveolata Egger, 1893, Abhandl. d. k. bayer. Akad. d. Wiss., Cl. II. vol. xviii. p. 224, pl. i. figs. 33, 34.

This may be described as a large thick-shelled *S. nitida,* which has the surface markings of *Miliolina reticulata.* It attains its extreme development in the coral sands of the South Pacific. Egger's figured specimen was from the Mauritius, and is an immature example of the species. It occurs only at Station 1, and is very rare.

Spiroloculina (?) *convexiuscula* Brady.

Spiroloculina (?) *convexiuscula* Brady, 1884, 'Challenger' Rept., p. 155, pl. x. figs. 18–20.

Assigned by Brady, with some hesitation, to this genus, it is more probably an arrested form of *Articulina.* It is remarkable for its uniformity, specimens from all localities being almost identical in size and structure. It occurs only at two 'Challenger' Stations, both on the coast of Papua. In the Malay Archipelago it is common and widespread over Area 1, but rare in Area 2.

Spiroloculina (or *Hauerina*) *fragilissima* Brady. (See *Hauerina.*)

* P. 150, pl. x. figs. 1, 2. † Pal. Soc., 1895, p. 114.

Miliolina Williamson, 1858.

Group of *Miliolina oblonga.*

Aperture dentate.

Miliolina oblonga Montagu sp., pl. V. fig. 14 *a, b.*

Vermiculum oblongum Montagu, 1803, Test. Brit., p. 522, pl. xiv. fig. 9. *Miliolina oblonga* (Montagu) T. Rupert Jones, 1895, Pal. Soc., p. 120, pl. iii. figs. 31, 32, and pl. v. fig. 5.

The type is rather rare, but several varieties and passage forms are represented at most of the Stations.

Miliolina rotunda d'Orbigny sp., pl. V. figs. 15, 16.

Triloculina rotunda d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. No. 4, p. 299. *T. rotunda* (d'Orb.) Schlumberger, 1893, Mém. Soc. Zool. de France, vol. vi. p. 206, pl. i. figs. 48–50.

This is a variety of *M. oblonga* with inflated chambers and a large circular aperture. It is as common in the Biloculine as in the Triloculine condition, but the former is slightly the larger. Forms closely allied or identical are *Triloculina lævigata*, d'Orb., *Quinqueloculina vulgaris* d'Orb., *Miliolina anconensis* Schultze, and *M. cuneata*, Biloculine variety, Brady.* The form from Humboldt Bay, Papua, assigned by Brady to *M. gracilis*,† appears to be an elongate form of this variety, and is common in the Malay Archipelago. *M. rotunda* is recorded from several parts of the Mediterranean, and occurs plentifully in several of Mr. Durrand's Stations in both Areas. As a fossil it attains a large size in the Pliocene (?) clay of St. Erth, Cornwall. If the form ascribed by A. Silvestri to *M. cuneata* ‡ is identical, it also occurs of great size in the Pliocene of Siena, Italy.

Miliolina Bosciana d'Orbigny sp., plate VI. fig. 1.

Quinqueloculina Bosciana d'Orbigny, 1839. De la Sagra, Hist. Physique de l'Ile de Cuba, Foraminifères, p. 191, pl. xi. figs. 22–24.

A form of *M. oblonga*, in which the chambers are more numerous and the sutures oblique. Worthy of notice from the diversity of its surface ornamentation.

Alveolate var., plate VI. fig. 2.

In this variety the aperture has not the thickened margin characteristic of the other forms, thus more nearly approaching d'Orbigny's specimens from the Antilles. The markings are very variable, ranging from a few scattered shallow depressions to striato-punctate as in *M. Rupertiana.*

* 'Challenger' Report, 1884, p. 139, pl. i. figs. 19, 20.
† Tom. cit., p. 160, pl. v. fig. 3.
‡ Mem. Pontif. Accad. dei Nuovi Lincei, vol. xii. 1896, p. 35, pl. i. fig. 12.

Costate var., plate VI. fig. 3.

In this form the markings are more uniform, varying only in size. Becoming more robust, it develops in the direction of *M. bicornis.*

Agglutinate var., plate VI. fig. 4.

Closely resembles *M. fusca.* The surface is beset with minute glittering scales and very small grains of sand attached to, but not enclosed within, the porcellanous shell-substance.

All the foregoing varieties are common and widespread in both areas.

Treating of the *Miliolinæ* with surface ornaments, Brady writes, "A few varieties may be disposed of by referring them to the smooth-shelled species having the same general contour." * Holding this opinion, Brady might with advantage have carried the process a little further than he did. Taking, for example, the species *M. tricarinata* and its varieties, the terms striate variety and reticulate variety are self-explanatory, whilst Brady's names for the same forms, *M. Terquemiana* and *M. Bertheliniana*, give no idea of their character and affinities.

In these Malay gatherings, so numerous are the transition forms that much light is thrown by them on the affinities of the *Miliolinæ*, although unfortunately not sufficient to enable us to link together the whole of the species.

Miliolina transversestriata Brady, plate VI. fig. 5.

Miliolina transversestriata Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 45. *M. transversestriata* Brady, 1884, Chall. Rept., p. 177, pl. iv. fig. 6.

Hitherto recorded only from the 'Challenger' dredgings, and in them in but two localities, Raine Island, Torres Strait, 155 fathoms, and in harbour-mud from Port Louis, Mauritius.

It is rather rare, but occurs at Stations in both Areas.

Aperture edentate.

Miliolina Durrandii sp. n., plate VI. figs. 7–10.

Test broadly elliptical, much depressed, chambers few, periphery acute or carinate, sutures slightly excavated, aperture large, elliptical or fusiform, surrounded by a thickened lip, edentate. Length 0·77 to 0·99 mm.

This is one of an interesting group in which the aperture is a large elliptical or fusiform opening without teeth. As in *M. rotunda*, the Biloculine form (figs. 8–10) is the larger. The costæ represented in fig. 7 are confined to the anterior portion of the test, and are

* 'Challenger' Report, 1884, p. 172.

remarkably uniform both in number and position. They are not present in all of the specimens, and are entirely wanting in the Biloculine form. The earlier chambers, as shown in fig. 10, are elongate, much resembling *M. Rupertiana* in contour. Elongate specimens of the Biloculine form as represented by fig. 9 are very common. Probably this is an arrested form which does not develop the final enclosing chambers.

Of the two forms, the Biloculine is the more numerous. The species is abundant at several Stations in both Areas.

Miliolina cultrata Brady, plate VI. figs. 11, 12.

Miliolina cultrata Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 45. *M. cultrata* Brady, 1884, Chall. Rept., p. 161, pl. v. figs. 1, 2. *M. cultrata* (Brady) Egger. 1893, Abhandl. d. k. bayer. Akad. d. Wiss., Cl. II. vol. xviii. p. 231, pl. ii. figs. 29–31.

This is an edentate form, although it is not so described by Brady or Egger. Its affinity with both *M. Durrandii* and *M. Rupertiana* is shown by the passage form fig. 11. Brady records it from two localities only, Papua, and off Calpentyn, Ceylon. Egger found it at three 'Gazelle' Stations, Mauritius, New Amsterdam, and West Australia.

In the Malay Archipelago its distribution is co-extensive with that of *M. Durrandii*, and it is just as abundant.

Miliolina Rupertiana Brady, plate VI. fig. 13.

Miliolina Rupertiana Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 46. *M. Rupertiana* Brady, 1884, Chall. Rept., p. 178, pl. vii. figs. 7–12.

The carinate variety is not represented in this collection by anything nearer than the smooth passage form fig. 11, nor is there the variation of aperture figured by Brady.

The 'Challenger' specimens are from the islands off the south shores of Papua, west of Torres Strait; but Brady names a few other localities from which it has been procured.

It occurs at several Stations in both Areas, but only in very small numbers.

(*To be continued.*)

VII.—*A few Notes on Micro-Crystallography.*

By T. Charters White, M.R.C.S., L.D.S., F.R.M.S.

(*Read* 16*th February*, 1898.)

Every member of a corporate body ought, in my humble opinion, to do something to further the objects for which that body is incorporated. I regret I can do but little in forwarding the progress of our Society, but "I do my diligence to give gladly of that little," in offering the small contribution of this evening. I must ask you to consider it simply as a casual communication, being as it is a brief record of a few experiments made with a view of producing pretty polarising objects, which I thought might interest my fellow members as a relief from more arduous investigations.

When I use the term "pretty" as applied to these objects, I do so because I think at present that is the only attribute to which they are entitled; but as great events often spring from small beginnings, so these experiments and illustrations may be utilised by others, and may prove the threshold of something more important as years roll on.

The subject of crystallisation in its larger aspect is outside the sphere of microscopy; but we are all familiar with the fact that a hot and saturated solution of some saline substance will deposit crystals on cooling, and that these crystals assume definite shapes peculiar to the salts dissolved. Watts in his Manual of Chemistry says, "Almost every substance, simple or compound, capable of existing in the solid state, assumes under favourable circumstances a distinct geometrical figure, usually bounded by plane surfaces and having angles of constant value." However correct this definition may be when applied to the crystallographic systems under which we find grouped the cubic form, the rhombohedra, and so forth, we must remember that in a solution the crystals are free to build up the system to which they rightly belong; but in the method of crystallisation it is my privilege to call your attention to this evening, the forces of crystallisation are locked up in a hard and attenuated film, instead of being free to act as in a solution, and are only set free when the hygroscopic character of the surrounding atmosphere gradually liberates them. Hence the presence of much or little moisture will modify the forms produced; as will also the character of the surrounding air, whether it be gaseous, alcoholic, or ammoniacal; so will varying degrees of temperature; and it will be an almost endless source of entertainment to try and produce varying conditions under which micro-crystals may be formed. But it will be found, after you have tried the three or four chemicals that I shall introduce to your notice, that you will have come to the end of your tether in the production of pretty crystals; and it will save a great deal of time and trouble in making experiments, if I name those I have found successful, and that have been so much pleasure to me. They are hippuric acid, hydroquinone, picric acid alone and in combination with hippuric acid, and an aqueous solution of bichromate of potassium crystallised in a tolerably thick emulsion of gum arabic. This is the only aqueous solution; the other solvents have been methylated spirit, acetone, and absolute alcohol, taking these three solvents as types of the greatest volatility, because in making these crystals it is necessary that the solvent should evaporate very quickly, or else the crystals will assume to a great extent their natural forms. It is desirable to make saturated or even super-saturated solutions of the three chemicals named, as the colours produced under polarised light are of a deeper and richer character than they are if made from weaker solutions.

It will be found that of these three, hippuric acid is the most manageable, allowing of more time being taken in modifying the forming crystals. To produce these varying forms it is advisable to have the microscopical slide slightly warmed so that it is not unbearably hot if placed on the back of the hand, as the evaporation of the spirit is accelerated thereby, and as it spreads it leaves a clean thin film on the glass. Should there be moisture in the air of the room, a number of dots appear in this film, marking the commencing formation of centres of crystallisation. If now the slip is alternately warmed and cooled, these centres will be seen surrounded by concentric rings formed by the alternations of temperature to which they have been subjected. If they are blown upon while under the Microscope, an advancing wave of a fringe-like character may be watched as it increases the diameter of the growing crystal; if it now be sharply breathed upon, a star-like radiation will surround each centre, and the crystallisation will be completed. Now this is the physical history of one such formation, but the modifications in the character of these crystals may be made very numerous by changing the conditions under which they are formed. I shall have an opportunity afforded me of showing you by means of the lantern some of the forms assumed by this salt.

Hydroquinone crystallises fairly well out of an alcoholic solution, but its best effects are produced from a solution in acetone (= pyro-acetic spirit, C_3H_3O); this quickly dissolves the hydroquinone, especially if it is boiled; and as it boils at 132° F., this method of getting a saturated solution can be readily accomplished; but, owing to the extremely rapid evaporation, it is not possible to modify the resulting crystalline forms; but these are so beautiful that one does not seek to modify them to any great extent. Unlike hippuric acid, which crystallises in round characters, hydroquinone resolves itself into very decided curvilinear forms, whose only chance of modification arises from the degree of warmth to which you subject the slide before putting on the solution; but with these modifications most charming designs can be obtained. These salts are generally employed in single solutions unmixed with any other salt.

The third chemical I have experimented with is picric acid dissolved in alcohol; but this, while giving a variety of crystals that were rather peculiar, inasmuch as it gathered itself up in strange Japanesque designs, induced me to believe that by combining with it a solution of hippuric acid I might produce a modification of this character, and it produced a conformation quite different from any I had ever previously obtained. I will call your attention to it when thrown on the screen. There is no difficulty in obtaining the very curious crystals obtained by the use of bichromate of potassium in gum arabic. An aqueous solution of the bichromate is incorporated with some gum arabic, and this is placed upon the slide and warmed. As soon as a pellicle is seen to form around the margin of the drop of solution, it is put aside to cool, when crystallisation takes place, giving a peculiar twisted appearance to the crystals; and these, taking up the bulk of the solution, leave a thin layer of fluid which results in a fine feathery spray in the interspaces left between the larger crystals. This salt is not capable of any great modification.

I have photographed any particular form that struck me as being curious or out of the ordinary character, as I have experienced great difficulty in preserving the specimens when mounted. No difficulty is met with in mounting hippuric acid crystals if mounted as a dry object, but hydroquinone will not stand even that treatment, but breaks up under the cover-glass when shut in; I have therefore generally kept it on an open slide. Neither hippuric acid nor hydroquinone bears mounting in any of the usual fluid media, or in balsam, as hydroquinone disappears altogether, and hippuric acid breaks up and becomes a disfiguration instead of a thing of beauty and a joy for ever. But these solutions may be made and will keep indefinitely, so that they are always ready for a demonstration, the hydroquinone crystals being very attractive for dark-ground illumination.

VIII.—*On some Organic Substances of High Refractivity, available for Mounting Specimens for Examination under the Microscope.*

By H. G. Madan, M.A., F.C.S., Fellow of Queen's College, Oxford.

(*Read* 20*th April*, 1893.)

In the course of experiments made with a view of obtaining some cement having the same index of refraction as Iceland spar for the ordinary ray (viz. 1·66), and therefore suitable for use in certain forms of polarising prism made of that material, I have had occasion to prepare, or procure, and examine several of the less known organic compounds of high refractivity. One or two of these do not seem as yet to have attracted the notice of microscopists, and I am induced to bring them before the Society, in the hope that they may be considered worth a trial by some who have had more experience than myself in the mounting and critical examination of specimens.

I must say at once that I have not yet been successful in finding an entirely satisfactory material; but I have thought it worth while to give a short account of what I have done up to the present time, in the hope of stimulating others in the search and of receiving suggestions for future experiments.

In the first place, let me state clearly and definitely what we want; the requirements of physicists and microscopists being in this matter pretty nearly identical. We want an irreproachably colloidal substance, with no tendency whatever to crystallise under any conditions, colourless, transparent, solid and tough at ordinary temperatures, but easily liquefied (or at any rate rendered viscous) by a gentle heat, stable under ordinary conditions of light and temperature, with no tendency to act upon or injure even delicate preparations, and—most important point of all—possessing a very high refractive power on light.

Perhaps we may consider Canada balsam (and one or two other similar gum resins) to have all the properties referred to except the last; and we may state our aim to be the discovery of a balsam-like substance, with a refractive index for rays of mean wave-length of not less than 1·66.

I do not propose to consider now any of the compounds of metals, such as arsenic tribromide, thallium chloride, mercury-potassium iodide, &c., which have been tried. Such substances, though useful for special purposes, and fulfilling excellently the requirement of high refractivity, have not the permanency and harmlessness which are desirable; they would quickly ruin, for instance, a polished surface of Iceland spar. I shall only draw attention to a few organic bodies which seem to possess, in a greater or less degree, the qualities above mentioned.

1. *Meta-cinnamene*, or *meta-styrol* (formula of molecule, C_8H_8). This is a body obtained by Blyth and Hofmann in 1845,* from cinnamene, the essential oil prepared by distillation of styrax, a substance used occasionally as a mounting medium itself. When cinnamene is either (*a*) exposed to sunlight for three weeks, or (*b*) heated to 100° C. for three days, or (*c*) heated in a sealed tube to 200° C. for half an hour, it is converted, without change of chemical composition, into a polymeric form, a transparent, glass-like solid, viz. meta-cinnamene. The specimen I exhibit was prepared by the last-mentioned method, and retains the shape of the tube in which it was made. It is quite colourless and transparent, permanent under all ordinary conditions, and without the slightest tendency to crystallisation even after twelve years' keeping. It is remarkably tough, like horn, at ordinary temperatures, but is softened by a moderate heat, becoming flexible like gutta-percha, but not a viscous fluid like Canada balsam, except at a temperature slightly above 200° C., at which it begins to volatilise and change back into the liquid form,—ordinary cinnamene. It shows no considerable adhesiveness to glass, and its coefficient of expansion differs so much from that of glass that a layer of it spread, while hot, upon a glass plate separates from it on cooling. In order to determine its refractivity, I constructed a small hollow prism of brass, open at the top, with sides of thin glass plates, and having a refracting angle of 51° 7′ 0″. This was heated in an air-bath, and some meta-cinnamene was placed in it, the heat being raised until the body melted down into close contact with the sides of the prism. The angle of minimum deviation for several rays was then determined by a spectrometer, and the indices of refraction calculated by the usual formula. Thus the index of refraction for yellow sodium light (Fraunhofer's line D) was found to be 1·597 (at 15° C.). This is decidedly higher than that of most other resins; and although meta-cinnamene itself is hardly adapted for a cement or mounting material, it is likely to be very useful, from its toughness, transparency, and permanency, for giving body and strength to other cements, as I shall have occasion to notice further on.

2. *Quinidine* (formula of molecule, $C_{20}H_{24}N_2O_2$). This is one of the group of alkaloids occurring in cinchona bark, and is so essentially crystalloidal in character that I never thought of examining it until a few weeks ago, when my attention was kindly drawn to it by Mr. Lewis Wright and Mr. Nelson. I believe that it has pleased and plagued microscopists for several years, the conditions for ensuring its permanency in the colloidal form not having been satisfactorily made out.

As ordinarily obtained, quinidine is a hydrated salt (one molecule associated with two molecules of water), crystallising in colourless

* 'Memoirs of the Chemical Society,' ii. p. 334.

monoclinic prisms. The associated water of crystallisation is readily given off at temperatures between 120° and 130° C., and the crystals break up into a white powder, which, on being heated to a temperature of 170° C., melts into a nearly colourless liquid. At 200° C. the liquid begins to darken in colour, owing to incipient decomposition and liberation of carbon; hence in dealing with the substance as a "mountant" it is important not to raise the temperature more than necessary above the melting point. On cooling the liquid it solidifies into a light yellow resinous mass, having so slight a cohesion and so low a conductivity for heat that a block of it cracks up into small fragments under a slight stress or change of temperature, almost like unannealed glass; nor does very slow cooling appear to prevent this. I have also tried the effect of quick cooling by pouring liquid quinidine into cold water, but the only result seemed to be to make it more like a "Rupert's drop" than before.

When this resinous solid is again heated gradually, it changes into a mass of interlacing prismatic crystals and rosettes, forming a very beautiful polariscopic object. The change certainly begins below 90° C., but proceeds more rapidly at a few degrees higher. On further heating, the crystals melt, passing into the resinous colloidal condition mentioned above. I think it likely that the tendency to crystallisation complained of by those who have mounted objects in quinidine is mainly due to the slides having been exposed to a rather high temperature, such as that of a very hot room.

Also it should be noted that the presence of a few nuclei, such as particles of dust or of one or two minute unconverted crystals in the resin, would materially promote crystallisation. It would be advisable to filter the liquid, if practicable, before placing any upon the slide.

The fragility and unstable equilibrium of the colloidal form of quinidine caused me considerable difficulty in making a prism of it for the purpose of determining its refractivity. I was anxious, however, to do this, as the index of refraction was reported to be as high as 1·7 (for what wave-length I do not know). I am disappointed to find that the index for yellow sodium light is no higher than 1·602. Its coefficient of dispersion, moreover, is not particularly high; $(\mu_{H\gamma} - \mu_{H_\alpha} =)\ 0{\cdot}043$ (that of a-monobromonaphthalene between the same wave-lengths is 0·051).

From the above observations on the effect of heat on quinidine, it would seem advisable, in using the substance as a mounting material, to cool the slide pretty quickly, in order to get the resin past the turning point of 90° before it has time to take the wrong turn. But in this and similar substances there must, I fear, always remain the inherent tendency to revert to the crystalline condition, which is obviously the condition preferably assumed by the molecules when they are free to do as they like.

The parallel case of sulphur will occur to the mind of everyone. This substance takes three allotropic forms, two of them crystalline. When either of these latter forms is heated to 150° C., it passes into a plastic colloidal condition, but can only be retained even temporarily in this form by being poured suddenly into cold water. In a few days it inevitably reverts to the crystalline condition; and the same change (as with quinidine) takes place quickly on heating the colloid to 100° C. Mr. Lewis Wright suggested to me that admixture with Canada balsam might prevent this; but on trial I do not find it answer.

3. *Naphthyl-phenyl-ketone* (formula of molecule, $C_{16}H_{12}CO$). This was discovered by Grucarevic and Merz,* and seemed at first likely to be an unexceptionable cement for polarising prisms. I prepared it by a method given in the paper referred to, which I need not describe here, as the details might not be intelligible without previous study of organic chemistry. It is a light yellow substance, viscous like Canada balsam at ordinary temperatures, but becoming more liquid when moderately heated, almost odourless, with little or no tendency to act on or injure other substances. The index of refraction for yellow sodium light I found to be 1·669 (at 15°), almost exactly that of Iceland spar for the "ordinary" ray. If there was no doubt as to its permanency, it would be very valuable for the purposes both of physical optics and of microscopy. The first specimen which I prepared remained for months quite unchanged (although tested by exposure to a temperature as low as − 20° C.), but eventually turned into a mass of yellow crystals; and a fine polarising prism made for me in Paris on M. Bertrand's principle, in which this cement was used, after lasting for four or five years at least, has now become useless from the same cause. The ketone may be easily restored to the colloidal condition by re-distillation, but the change is not permanent. Hence, while I think the substance worth the attention of microscopists for temporarily mounting objects, my recommendation cannot extend further.

4. *a-monobromonaphthalene* (formula of molecule, $C_{10}H_7Br$), discovered by Laurent † in 1835. This substance is so well known to microscopists that I need not say much about it.

The index of refraction for sodium light is 1·66 (at 23° C.), and its dispersive power is almost exactly the same as that of carbon disulphide ($\mu_{H_\gamma} - \mu_{H\alpha} =$) 0·051. It has a very high boiling point (285° C.), and is more stable than such bromo-compounds usually are. Hence it would be well adapted for filling hollow spectroscope-prisms but for its incurable yellow colour, which implies of course loss by absorption of the more refrangible part of the spectrum. It seemed possible that this yellow colour might be due to the presence of a trace of free bromine, and I have digested the liquid with zinc, sodium,

* 'Berichte der deutschen chemischen Gesellschaft,' vi. p. 1238.

† 'Annales de Chimie et de Physique,' lix. p. 216.

and mercury in the hope of removing this if present. I have also re-distilled it under greatly reduced pressure ($\frac{1}{10}$ atmosphere), and filtered it through animal charcoal, but the yellow colour, though much reduced in intensity, still remains.

5. *Phenyl-thiocarbimide* (formula of molecule, C_6H_5CNS), a substance belonging to the class of mustard oils, one of the many discoveries of Dr. A. W. Hofmann.* I need not go into the details of its preparation, which are of more interest to chemists than to physicists, especially as I find that it can now be obtained commercially from Schuchardt, of Görlitz (English agents, Messrs. F. E. Becker and Co., 33 Hatton Wall, London, E.C.).

It is a perfectly colourless liquid, practically unalterable by light (I have exposed some to sunlight for a whole summer without more than a trace of yellow colour appearing). It has a characteristic but not disagreeable smell like that of ordinary mustard oil; when warmed, however, rather pungent vapours are given off. Its boiling point is very high (222° C.), and it is not readily inflammable,—in fact, a lighted match may be thrown into it without setting it on fire.

I have determined carefully the indices of refraction for the principal Fraunhofer lines. For sodium light, $\mu_D = 1 \cdot 654$ at 10° C.; and its dispersive power is rather higher than that of carbon disulphide, viz. $(\mu_{H_\gamma} - \mu_{H_\alpha} =)\ 0 \cdot 060$. These high refractive and dispersive powers are attributed by Dr. Gladstone † to the presence of the phenyl radicle and the sulphur atom in it, both of which have a very high specific refractive energy.

It is evident from what has been said that phenyl-thiocarbimide possesses all the good qualities of α-monobromonaphthalene and of carbon disulphide, without the yellow colour and doubtful permanency of the first, and the dangerous inflammability and volatility of the second. I have used it in a prism belonging to my spectrometer for many years, and found it very satisfactory in every way, giving excellent definition (especially in the more refrangible part of the spectrum), and being much less liable to disturbance by internal convection currents than carbon disulphide. I have also made a polarising prism on Jamin's principle,—a thin plate of Iceland spar placed obliquely in a cell filled with phenyl-thiocarbimide,—and found it to answer well; though of course a solid prism is preferable, as long as pieces of Iceland spar of sufficient size can be obtained.

Phenyl-thiocarbimide readily dissolves meta-cinnamene, forming, when equal weights of the substances are taken, a viscous mass like Canada balsam, having an index of refraction about the mean of the two constituents ($\mu_D = 1 \cdot 63$ at 15° C.). This does not harden so readily as balsam, but in all other respects it seems excellently fitted for use in mounting microscopic objects.

* 'Proceedings of the Royal Society,' ix. p. 256.

† 'Journal of the Chemical Society,' xlv. p. 241.

I have tried the solubility of phosphorus in phenyl-thiocarbimide, but I find it to be very slight, except while the solvent is hot; on cooling, the greater part of the phosphorus is precipitated again.

6. *Piperine* (formula of molecule, $C_{17}H_{19}NO_3$). This, like quinidine, is a substance so strongly imbued with what perhaps I may call the "original sin" of crystallisability, that until lately I never thought it worth examination.

It is, as its name implies, the alkaloid existing in ordinary pepper, from which it may be extracted by alcohol. It occurs in commerce as yellowish-white monoclinic prisms, isomorphous with those of quinidine, but containing no water of crystallisation. When heated, the crystals begin to melt at 135° C., forming a yellowish slightly viscous liquid, which solidifies into a light yellow tough transparent resinous mass, soft enough to be easily indented with the finger-nail, and rather "tacky." This resin-form of piperine when heated to 100° C. is converted (like quinidine, but not quite so readily) into a white mass of crystals, which on further heating melt at 135° C., passing into the resinous condition. If the temperature is raised still further, at about 200° the substance begins to decompose, and the liquid becomes dark yellow or brown, owing to separation of carbon.

Resinous piperine has, unlike quinidine, very strong cohesive properties, and does not give the slightest trouble by cracking under mechanical stress or thermal changes, even when in thick pieces. I find its refractivity to be remarkably high, its index of refraction for yellow sodium light being 1·681 at 18°; but its dispersive power is more remarkable still, the coefficient of dispersion being no less than $(\mu_{H_\gamma} - \mu_{H_\alpha} =)$ 0·141. I have not yet determined the indices for a sufficient number of wave-lengths to enable me to state exactly where the greatest extension of the spectrum takes place, but it is certainly in the part including the shorter waves, corresponding to green and blue (as in the case of carbon disulphide).

It will be seen from the above-mentioned properties that piperine would serve admirably for a cement and mounting material, if it were not for its suspicion of crystallisability and its abnormal dispersion. Both of these defects seem likely to be lessened by admixture with other more orderly materials, and the most promising which I have tried at present is Canada balsam. A mixture of four parts (by weight) of piperine with one part of balsam has a refractive index for yellow sodium light of 1·657 at 16°, and a coefficient of dispersion of 0·130. The tendency to pass into the crystalline condition when heated to 100° seems greatly lessened, though not removed altogether.

One other point I would notice with regard to piperine (and quinidine also) for the purpose of eliciting the experience of others. I am inclined to think that the tendency towards crystallisation becomes greater when the resin-form has been once or twice re-melted. It is well known that some kinds of glass, especially the German " soft soda-glass," behave in a similar way, becoming semi-opaque or "devitrified" when heated to the softening point and retained long in that condition, owing to the formation of crystalline silicates in the colloidal mass.

7. *Methylene di-iodide* (formula of molecule, CH_2I_2), discovered as long ago as 1858 by Butlerow.*

This is in several respects a very remarkable substance, and I am surprised that, while it has been known and used for many years by mineralogists on account of its high density,† it does not appear to have attracted the notice of microscopists.

It is, when pure, a pale yellow liquid with a slight sweetish smell, boiling at 181° C., freezing at 5° C., and hardly at all inflammable, at any rate at ordinary temperatures. Its density is no less than 3·34 times that of water, so that nearly all kinds of glass, as well as most minerals (even fluor spar and hornblende) float in it.

Its refractive and dispersive powers have been accurately determined by Dr. J. H. Gladstone,‡ who finds its index of refraction for yellow sodium light to be 1·756 at 10·5° C. My own examination of a different sample gives 1·743 at 15° C.,—a very close agreement when the correction for decrease of refractivity with temperature is made. This, it will be observed, is exceptionally high, in fact the highest of any single organic substance I have met with, and induces me to recommend methylene di-iodide (which is easily procured commercially) as a temporary mounting medium. I regret that I must say "temporary" only; for like many other iodides it has a slight tendency to decompose, especially when exposed to light, with liberation of iodine, which colours the liquid red, and would act upon and damage some delicate tissues and crystals. I find that after one hour's exposure to direct sunlight the liquid becomes perceptibly darker, and four hours' exposure turn it a light orange about the tint of "golden sherry." Another day's exposure to ordinary daylight only deepens the colour slightly, and after a week's exposure the liquid is still only light red, a tint hardly perceptible in thin films. In the dark it may be kept for years without alteration, and the free iodine may at any time be readily removed by shaking up the liquid with dilute solution of potassium hydrate ("caustic potash"), allowing it to stand, decanting off the potash, and removing the last traces of moisture by leaving a lump of calcium chloride in the liquid for a short time. Most of the colour may be removed more simply, but more slowly, by placing a strip of zinc in the liquid for a day or two.

One drawback to the use of methylene di-iodide is that it freezes, as already mentioned, at a point a little above the freezing point of water. This, however, can be prevented by adding to it about one-

* Comptes Rendus, xlvi. p. 595.

† 'Neues Jahrbuch für Mineralogie,' 1886, ii. p. 72; 1888, i. p. 213; 1889, ii. p. 185.

‡ 'Journal of the Chemical Society,' lix. p. 293.

third its volume of phenyl-thiocarbimide. The refractivity is, of course, slightly lowered thereby, but the mixture remains liquid at a temperature at least as low as $-12°$ C.

The coefficient of dispersion of methylene di-iodide is ($\mu_{H_\gamma} - \mu_{H_\alpha} =$) 0·062, nearly the same as that of phenyl-thiocarbimide, and decidedly higher than that of carbon disulphide.

8. *Solution of sulphur in methylene di-iodide.*—When heated, methylene di-iodide dissolves a considerable quantity of sulphur, but much of this crystallises out on cooling. Sufficient, however, remains in solution at ordinary temperatures to raise the index of refraction of the liquid to 1·778 (at 16° C.) for yellow sodium light.

9. *Solution of phosphorus in methylene di-iodide.*—This solution seems worthy of special attention as a substitute for the solution in carbon disulphide sometimes employed. I find that methylene di-iodide dissolves phosphorus very freely, in fact it will dissolve its own weight of the element without reaching the point of saturation. The refractivity of the light yellow solution thus obtained is, as might be predicted, very high indeed. I find the index of refraction for yellow sodium light to be 1·95 * at 18° C., and the coefficient of dispersion is ($\mu_{H_\gamma} - \mu_{H_\alpha} =$) 0·092.

The solution is far safer and pleasanter to deal with than phosphorus itself or its solution in carbon disulphide. I have poured some on filter paper and left it freely exposed for hours and even days, without its catching fire. I have left some similarly exposed in a watch-glass for a week without inflammation taking place. The scarcely inflammable solvent seems to form a kind of varnish over the phosphorus which protects the latter from rapid oxidation. Still the precaution of having a basin of water and a wet cloth at hand should not on any account be neglected in dealing with the solution.

Light acts strongly and inevitably on this medium, as on phosphorus itself and other preparations containing it, causing the conversion of the phosphorus into the allotropic form known as "red phosphorus," which is insoluble and nearly opaque. Hence such substances can only be considered available for temporary purposes, where their very high refractivity enables critical points of structure to be made out with greater distinctness. In the dark they keep fairly well, but a slight red deposit is liable to form.

I have now brought before the Society the principal substances which I have examined at present. None of them, it will seen, come up to a high standard of excellence as mounting and cementing media; but I still hope that I or others may discover something

* I do not give the third decimal place owing to a remarkable and not easily explicable difficulty which occurs in getting a sharp image of the spectrometer slit through the solution. The same difficulty was noticed by Dr. Gladstone and Mr. Dale in examining the refractivity of solutions of phosphorus in carbon disulphide. ('Philosophical Magazine,' [4] xviii. p. 30.)

better. The most hopeful direction in which to look is towards compounds containing either or both of the radicles naphthyl and phenyl, in which, as Dr. Gladstone's researches have shown, the carbon-atoms are so situated in the molecule as to cause exceptionally high refractivity in the resulting compound.

Table of Optical Constants of some Highly Refractive Organic Substances.

Name of Substance.	* μ_{H_α}	μ_D	μ_{H_β}	μ_{H_γ}	Temp. Cent.	Coefficient of Dispersion $(\mu_{H_\gamma} - \mu_{H_\alpha})$.
Meta-cinnamene (or Metastyrol)	1·592	1·597	1·612	1·624	15°	0·032
Quinidine	1·596	1·602	1·621	1·639	15	0·043
Phenyl thiocarbimide	1·646	1·654	1·681	1·706	10	0·060
α-Monobromonaphthalene † ..	1·649	1·658	1·682	1·704	20	0·051
Naphthyl-phenyl-ketone	1·659	1·669	1·697	‡	15	..
Piperine	1·665	1·681	1·734	1·806	18	0·141
Methylene di-iodide	1·732	1·743	1·767	1·794	15	0·062
Solution of sulphur in methylene di-iodide	..	1·778	..	..	16	..
Solution of phosphorus in methylene di-iodide (equal weights of each)	1·929	1·944	1·984	2·021	18	0·092

* The observations of the hydrogen lines were made with an "end-on" vacuum tube, a form which was first proposed by Prof. Piazzi Smyth, and which gives a remarkably brilliant hydrogen light.

† B. Walter, Ann. Phys. und Chem. [N.F.], 1891, p. 511.

‡ It was found impossible to observe H_γ, owing to the strong absorptive power of the substance for the more refrangible part of the spectrum.

IX.—*Instantaneous Photomicrography.*

By E. B. Stringer, B.A.

(*Read 20th April*, 1898.)

I have now adapted the apparatus described in this Journal, *ante*, p. 174, and figured on p. 175, in the following way.

To the nose T of the converging system or cone is fitted an ordinary drop shutter with pneumatic release. This, at the "set" position, has an opening, in which is placed a piece of ruby glass. Now, when the shutter is "set," a red non-actinic image is projected by the Microscope, which may safely be allowed to fall upon the plate.

The door N at the further end of the camera is opened, and into the opening is slid a piece of yellow glass, through which the image may be watched, and adjusted and focused upon the plate itself, up to the instant of exposure.

Upon pressing the pneumatic ball the shutter falls, a flash of white light passes through the Microscope, and the exposure is made.

It is better that the room should be partly darkened; the red image on the plate can then be seen clearly enough for the most accurate focusing.

In order that the focal point of the red and actinic (or blue) rays may coincide, the objective must be apochromatic; and the plate must be an ordinary and not an isochromatic one. But, seeing that the living objects which it is necessary to photograph in this way are of course unstained, these would in any case be the best conditions.

It will be seen that the above arrangement can be used without in any way permanently altering the apparatus employed for ordinary work; the shutter is, moreover, in such a position that it cannot possibly shake either the camera or the Microscope.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.

*Including Original Communications from Fellows and Others.**

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Influence of Temperature on Development.‡—Prof. O. Hertwig has made a beautiful series of experiments showing that the rate of development of frogs' eggs is within limits (15°–24°), a function of the temperature. Above the upper limit monstrosities result; below the lower limit growth ceases. By means of curves the parallelism between "the developmental work" (cell-divisions, &c.) and the temperature is very clearly shown. It seems likely that this correlation depends in part on the influence of temperature on chemical reactions concerned with the production of nuclein and the like, increased warmth promoting their more rapid occurrence, lowered temperature having the opposite effect. But Hertwig does not believe that this is by any means the only, though it may be the most important, influence of alterations in temperature.

Birth-Period of Trichosurus vulpecula.§—Dr. J. Beard describes the uterine embryo and newly-born young of this marsupial, and finds that the "critical phase" must begin immediately before birth takes place, and must end soon after the animal is born, with the initiation of mammary nutrition. *The critical and birth-periods coincide.*

He gives a fuller definition of the critical period than in his previous papers. "The critical period in a morphological sense is that epoch of the development when all parts of the organism are first present as the foundations or *Anlagen* of all the organs; it is that state when epigenesis is ended, and evolution or unfolding is beginning; it is that

* 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., li. (1898) pp. 319–81 (2 pls. and 36 figs.).

§ Zool. Jahrb. (Abth. Anat.), xi. (1897) pp. 77–96 (1 pl.).

point where the individuality of the organism is first attained, when it has acquired a something setting it down as the embryo of some particular form, and—the wording is important—when it is first beginning to resemble its progenitors. It then bears no absolute likeness to them, but it is just beginning to look like them."

In the final part of his paper Beard argues that the mammary apparatus of Eutheria is, as compared with that of Metatheria, arrested in its development.

Fertilisation in Ascaris.*—Prof. J. B. Carnoy replies to criticisms by the late von Erlanger and by Flemming, and argues in support of the conclusions which he has elsewhere † sought to establish along with his colleague H. Lebrun.

The spermatozoon does not furnish either the alleged spheres or the central corpuscles seen before the first cleavage. These are part and parcel with the conjugated nuclei, and are the nucleoli. At the moment of segmentation they leave the nucleus and form the first kinesis. They only serve once, and are formed anew in the daughter-nuclei. Far from being permanent organs, the corpuscles are transitory structures associated with division. As to the spheres, they do not exist, except as transitory modifications of the ordinary cytoplasm. Carnoy protests against the theoretical prejudices which seem to him to be vitiating the observation of facts.

Spermatogenesis in Mammals.‡—Herr M. von Lenhossék has made a detailed investigation of spermatogenesis in mammals, especially in the rat. He lays most stress upon two conclusions:—(1) that the spermatozoon is to be regarded as an entire cell, as an element in which all the three characteristic components of the cell are to be found, viz. cytoplasm, centrosome, and nucleus; and (2) that the second of these components, the centrosome, lies in the middle portion of the spermatozoon in the form of Jensen's terminal knob.

Interstitial Substance of Testis.§—Herr Hans Beissner agrees with Herr Plato and others that the interstitial substance is constant in the functioning testis of the cat. But its distribution is not uniform throughout the organ, and its granular content varies considerably. It cannot be regarded as essential to spermatogenesis.

Beissner did not find any preformed canals in the walls of the tubules, nor do the interstitial cells directly touch the membrana propria of the tubules. If there is an absorption of fat from the interstitial substance by Sertoli's cells, it must be by means of fine pseudopodia from these cells. It is possible that pseudopodia from Sertoli's cells penetrate the walls of the tubules and come into relations with the fat.

Behaviour of Reproductive Cells in Plants and Animals.‖—Prof. V. Hæcker has made a detailed comparison of the phenomena of growth and maturation in the reproductive cells of plants and animals. The following common phenomena are emphasised; we use m. and f. as contractions for male and female.

* La Cellule, xiv. (1898) pp. 7–25.

† Verh. Anat. Ges., xi. Vers. (1897) pp. 65–9; La Cellule, xiii. (1897) pp. 63–195 (2 pls.).

‡ Arch. Mikr. Anat., li. (1898) pp. 215–318 (3 pls. and 1 fig.).

§ Tom. cit., pp. 794–820 (1 pl.).

‖ Biol. Centralbl., xvii. (1897) pp. 689–705, 721–45 (about 40 figs.).

(1) Early passage of the nucleus into the coil state and long persistence therein, often associated with early longitudinal splitting; e.g. *Canthocamptus* m., *Pristiurus* f., *Larix* m., *Lilium* f.

(2) Transitory concentration of the coil at one side of the nuclear space, Moore's "synapsis"; e.g. *Ascaris* m., *Canthocamptus* f., *Lilium* m. and f., *Pteris*.

(3) Relatively early appearance and long duration of a phase corresponding to the "segmented coil" stage. The chromatin elements may be loosely distributed, inclining to be peripheral, forming ring and cross figures; e.g. *Pristiurus* f., Copepoda f., *Lilium* m. and f. The chromatin elements may be densely massed together in the older stages; e.g. Selachii m., Copepoda f., *Larix* m., *Lilium* m. and f., *Equisetum*, *Pteris*.

(4) Appearance of a "main nucleolus" in the earlier phases, with accession of paler adventitious "accessory nucleoli" in the later phases; e.g. Selachii m., Copepoda f., *Larix* m. Individual differences in the state of the nucleolar substance; e.g. Selachii f., *Ophryotrocha* f., Phanerogams m. Persistence of the nucleolar body during division; e.g. *Myzostoma* f., *Lilium* m.

(5) Multipolar spindles as transitional stages to the bipolar form; e.g. *Ascaris* f., *Cyclops* f., *Lilium* m., *Larix* m., *Equisetum*.

(6) Relations to the heterotypic mode of division,—*either*, a long duration of the equatorial plate stage with much thickened and shortened chromatin elements (the animal type); e.g. *Gryllotalpa* m., *Cyclops strenuus* f., *Allium* m., *Pteris*; *or*, a longer duration of the metakinetic phases with double V and cross figures (the vegetable type); e.g. *Pristiurus* m., *Prostheceræus* f., *Thysanozoon* f., *Diaulula* f., *Larix* m., *Lilium* m.

It does not seem possible as yet to generalise the results; but Hæcker has done service in gathering together the evidence of close parallelism.

Maturation of Pelagic Teleostean Eggs.*—Dr. T. Wemyss Fulton has studied the marked changes which occur in the maturation of the ovarian eggs of Teleostei. "The final stage is characterised by the comparatively rapid imbibition of a watery and probably saline fluid of low density, which seems to be secreted by the follicle, and is associated with the dissolution of the germinal vesicle and the rearrangement of the chromatin. In eggs which become pelagic the volume of fluid imbibed is relatively very large, dissolving also the yolk-spherules, and reducing the specific gravity of the whole ovum below that of sea water. It is in virtue of this change that the eggs of certain marine species become buoyant or pelagic (those of fresh-water species could not by this device be enabled to float); but inasmuch as it also occurs in demersal eggs, it is clear that its signification lies deeper. It is probable that not only among Teleosteans, but among some other groups, the apparent vanishing of the germinal vesicle and the rearrangement of chromatin is due to the absorption of fluid from without, and that this is the primary and essential meaning of the process."

Development of Liver and Pancreas in Birds.†—Dr. M. Brouha finds that in the chick the liver develops as usual from a hepatic groove

* Zool. Anzeig., xxi. (1898) pp. 245–52 (2 figs.).
† Anat. Anzeig., xiv. (1898) pp. 234–42 (6 figs.).

on the ventral wall of the gut in front of the umbilical aperture. From this groove there arise in succession, a dorsal or cephalic bud, a ventral or caudal bud, a posterior bud to the right, and the bile vesicle. The peculiarities are the close relation between the hepatic groove and the intestinal umbilicus, and the successive appearance of the various outgrowing buds, the cystic part being formed last.

The triple origin of the pancreas is suggested in the adult only by the three ducts. In the chick the two ventral diverticula form the final pancreas. In *Larus* and *Sterna* there is only one diverticulum; in Reptiles there are two rudiments, but one of them atrophies.

Epiphysis and Hypophysis in Frog.*—Dr. F. Braem has made a fresh study of these structures. The epiphysial upgrowth is differentiated into a terminal vesicle (the parietal organ), a solid stalk which elongates into a thin strand, and a tubular basal portion (the epiphysis proper). The parietal organ does not undergo fatty degeneration, as is often said. It measures 0·1 mm. in diameter in the larva with internal gills, 0·25 mm. in the sexually mature frog. The original nervous connection between the parietal organ and the epiphysis also persists in some measure, but this is a complex matter.

The hypophysis of the frog consists of three parts, two being glandular and the third nervous. The two glandular parts, arising from the mucus epithelium of the mouth, are quite separate in the adult, but connected in the young. A short nerve-strand connects the nervous part of the hypophysis with the anterior surface of the infundibulum. Braem makes reference to the figures which he has recently executed for Leuckart's "Wandtafeln."

Hypophysis of Mammals.†—Dr. Hans Salzer has studied this in the pig and guinea-pig. What marks his paper is that he gives a continuous account of the gradual transformation of the organ. He starts where so many leave off, with the establishment of the infundibular process and of the hypophysial saccule from the oral epithelium, and follows the differentiation onwards. Moreover, he compares the two mammals, and finds that, though there is much in common, there are also marked peculiarities in each case.

Development and Structure of the Lens.‡—Prof. C. Rabl has published the first part of a detailed comparative account of the development and structure of the lens. This part deals especially with (1) the development in *Pristiurus melanostomus*, (2) the structure in various Selachians, (3) the development in *Siredon pisciformis*, and (4) the structure in various Amphibians.

Development of External Form of Trout Embryo.§—Herr Fr. Kopsch describes a series of twelve stages in the development of the trout, and gives beautiful drawings of the successive superficial appearances. He seeks to find "the typical form" for each stage, and to relate to this the numerous deviations.

* Zeitschr. wiss. Zool., lxiii. (1898) pp. 433–9 (1 pl.).
† Arch. Mikr. Anat., li. (1897) pp. 55–68 (1 pl.).
‡ Zeitschr. wiss. Zool., lxiii. (1898) pp. 496–572 (4 pls., 14 figs.).
§ Arch. Mikr. Anat., li. (1897) pp. 181–213 (2 pls.).

Post-Larval Fierasfer.*—Prof. W. C. McIntosh describes a post-larval stage of this interesting fish, captured by Miss Delap at Valentia, on the south-west coast of Ireland. It probably belonged to *Fierasfer acus*, a form not hitherto known off British coasts.

Metamerism of Head in Torpedo.†—Herr A. N. Sewertzoff finds that the Squaloid head (*Pristiurus*, &c.) and the Batoid head (*Torpedo*) are segmented after the same type. He concludes that the occurrence of more segments in the Batoid head is secondary, and is probably associated with the general shortening of the body.

Copulation in Ophidians.‡—R. Rollinat gives a preliminary account of egg-laying and copulation in *Tropidonotus viperinus*. The species appears in March and disappears in November, passing the winter in a hole. The eggs are laid in June or July, and the young hatched in September or October. Rollinat invariably found that the oviducts of females which had already laid eggs contained abundant living spermatozoa in November, while those of females of full size whose organs showed no trace of previous egg-laying, contained none. He concludes that in fully mature females copulation takes place before the hibernating period, and not in March or April as has hitherto been supposed. In females laying for the first time, copulation probably takes place in early spring.

In *Coronella lævis*, a less common ovoviviparous species, pairing occurs very shortly after egg-laying; in *Vipera aspis* in March.

Sex and Molecular Dissymmetry.§—M. Félix le Dantec hazards the hypothesis that some of the plastic substances of the germ-cells have dextral and sinistral (dissymmetrical) molecules, and that the sex of the offspring depends on the preponderance of the one or the other under the influence of nutritive and other stimuli. M. Edmond Perrier appends some account of recent observations bearing on the determination of sex.

Variations in Weight of Hens' Eggs.‖—Dr. Ch. Féré has weighed over a thousand eggs, the average being 60 grammes. The number weighed was not sufficient to warrant a conclusion; but so far as the statistics go, they suggest (1) the inferiority in weight of the first egg in a laying, and (2) a progressive increase in mean weight in successive layings.

Convergence in Development.¶—Dr. Karl Peter has studied the structure and development of the chondrocranium, and the subsequent formation of the skull in *Ichthyophis glutinosus*, one of the "blindworms." His general result is of much interest, that almost every peculiarity in the skull of *Ichthyophis*, which makes it divergent from that of the Urodele-type, is also seen in the skull of Amphisbænidæ. The resemblance is often very striking. He concludes that the deviations are not expressions of old-established characters, but are adaptive phenomena.

* Irish Naturalist, vii. (1898) pp. 61–4 (1 pl.).
† Anat. Anzeig., xiv. (1898) pp. 278–82.
‡ Bull. Soc. Zool. France, xxiii. (1898) pp. 59–63.
§ Comptes Rendus, cxxvi. (1898) pp. 264–7, 267–72.
‖ Journ. Anat. Physiol., xxxiv. (1898) pp. 123–7 (1 fig., curves).
¶ Morphol. Jahrb., xxv. (1898) pp. 555–628 (3 pls. and 1 fig.).

The likeness between the Amphibian and Reptilian type illustrates homoplasty or convergence. This leads the author to a short essay on convergence, in which he distinguishes (*a*) direct convergence, in relation to similar function, e.g. the worm-like shape of burrowers; (*b*) indirect convergence, in relation to similar bionomic conditions, e.g. the whiteness of many arctic animals; and (*c*) mimicry.

b. Histology.

Growth of Injured Nerves.*—Prof. L. Ranvier has studied the modifications produced in the nerves of the cornea by superficial cuts, and corroborates a conclusion which he formulated in 1880, that nerves exhibit persistent growth. The nervous fibres of the cornea, divided by section, but still in continuity with their originative cells, vegetate with a rapidity and activity which was unsuspected.

Effect of Poisons on Cortical Nerve-Cells.†—Dr. H. J. Berkeley has made an important research on the lesions produced by the action of certain poisons (alcohol, serum, ricin, &c.) on the cortical nerve-cells. What he has to say in regard to the pathological alterations in the nuclei and nucleoli is of some general histological interest, and so is his discussion of the intra-cerebral nerve-endings.

Peculiar Ganglion-Cells in Spinal Cord of Perch.‡—Dr. R. Kolster has studied the minute structure of the spinal cord in numerous Teleostei, and has found peculiar nerve-cells in *Perca fluviatilis*, which he suspects may be associated with the raising and sinking of the dorsal fin. They seem to be absent from other Anacanthini, but there are somewhat similar elements in the angler.

Optic Nerves of Fishes.§—Dr. K. Krause has studied these nerves experimentally in the gold-fish (*Cyprinus auratus*), and finds that there are several kinds of fibres. The main mass arises from retinal cells, and atrophies when the eye is removed. These *fibræ oculares* perhaps end in small part in the *ganglion geniculatum laterale*, but for the most part they end in the external and internal tract in the median grey matter of the *tectum opticum*. From cells in this region, especially from the most dorsal portion between the two tracts of optic fibres, there arise some *fibræ tectales*, which may be followed into the chiasma and form a *small* part of the optic nerve.

Electric Organ of Torpedo.‖—Dr. Fr. Crevatin discusses the so-called *Stäbchennetz* in the electric organ of *Torpedo marmorata*,—an organ which has been the fruitful source of histological controversy for forty years, since Remak's description in 1856. The author worked with the quick Golgi method, and has been forced to deny the existence of the *Stäbchennetz*; it is nothing but the nervous terminal network, faintly coloured.

Osmotic Phenomena in Mitosis.¶—Prof. F. Houssay argues in favour of the hypothesis that the attractive sphere is the centre of osmosis, as

* Comptes Rendus, cxxv. (1897) pp. 1004–8.
† Johns Hopkins Hospital Reports, vi. (1897) pp. 1–108 (15 pls.).
‡ Anat. Anzeig., xiv. (1898) pp. 250–3 (1 fig.).
§ Arch. Mikr. Anat., li. (1898) pp. 820–39 (1 pl.).
‖ Anat. Anzeig., xiv. (1898) pp. 243–50 (2 figs.).
¶ Tom. cit., pp. 305–10 (7 figs.).

was suggested by Eismond. It has a double power, attracting in endosmosis, repelling in exosmosis. Its position, combined with the changes in osmosis, determines the movements in mitosis.

Chromatoid Bodies of Sperm-Cells.*—Dr. F. Hermann maintains that the stainable granular structures described by Benda and von Lenhossék in sperm-cells have nothing to do with the genuine "chromatoid accessory bodies" which represent the centrosome of the spermatid and give rise to the apical knob of the fully formed spermatozoon.

Lactation.†—Dr. L. Michaelis has studied this in guinea-pig, mouse, and cow. From the facts disclosed by a study of the guinea-pig's mammary glands, he draws the following conclusions. (1) The change in the form of the epithelial cells is partly due to a filling of the alveoli with secretion, which causes the cubical cells to flatten; but the assumption of a papilla-like form is quite independent of this. (2) Epithelial nuclei pass out into the milk and undergo chromatolysis, helping to form casein. They are replaced by direct constriction of epithelial nuclei. (3) The leucocytes do not share in *forming* the milk, though they migrate through the epithelium. They grow in the alveoli, and either break up there, or take up fat-globules and form colostrum corpuscles. (4) The fat of the milk is a true secretion, not a result of epithelial disruption. These results were confirmed more or less by the author's study of mouse and cow.

Composition of Nucleoli.‡—M. Aug. Michel finds that the nucleoli of *Nephthys* and *Spiophanes* consist of two substances,—a main substance staining with safranin and carmine, and probably equivalent to pyrrhenin, and an accessory substance, perhaps excretory and equivalent to the paranuclein of List.

Cell-Plates and Cell-Plate Rudiments.§—Herr R. Wolfgang Hoffmann gives a very full discussion of this subject. There is no doubt that cell-plates occur very widely among animal cells, but they are very variable and rudimentary in character, and have a very subordinate rôle. In a few cases they may prepare the way for cell-division, and may even be sufficiently developed to be comparable to those in plants; usually, however, their presence seems more or less indifferent, though they may delay the mechanism of division and the final separation of the daughter-cells.

Classification of Forms of Dentine.‖—Mr. C. S. Tomes has some critical notes on Röse's proposed classification of the forms of dentine. Even Röse's definition of true dentine is open to criticism. True dentine, according to Röse, is a hard tissue with a smooth surface, which grows on one side only, and is developed under an epithelial sheath. Mr. Tomes shows how this definition breaks down in application, for instance, to the teeth of *Carcharias* and *Lamna*.

Canaliculi of Bone-Cells.¶—Herr A. Spuler finds that the walls of the cell-cavities and canaliculi in bone are quite well differentiated,

* Anat. Anzeig., xiv. (1898) pp. 311–6.
† Arch. Mikr. Anat., li. (1898) pp. 711–47 (2 pls.).
‡ CR. Soc. Biol. Paris, x. (1897) pp. 190–2. See Zool. Centralbl., v. (1898) p. 69.
§ Zeitschr. wiss. Zool., lxiii. (1898) pp. 379–432 (2 pls. and 7 figs.).
‖ Anat. Anzeig., xiv. (1898) pp. 343–8.
¶ Tom. cit., pp. 289–92 (2 figs.).

probably of an elastoid nature, staining dark with orcein, and resisting the action of alkalies and acids. The canaliculi do not arise secondarily by absorption, but are there from the first as the bone is formed.

Histogenesis of Cartilage in Cyclostomes.*—Prof. F. K. Studnička shows that the origin of cartilage does not imply occurrence of *special* cells. In the post-embryonic life of Cyclostomes, cartilage may arise from (1) the dense connective-tissue of perichondrium and fascia; (2) the loose connective-tissue; (3) the so-called *Schleimknorpel*; (4) the *Vorknorpel* (vesicular supporting tissue of Schaffer); (5) the axial connective-tissue of the caudal fin; (6) highly specialised tissue, such as fatty tissue; and (7) the epithelium of the notochord.

Closing Bands in Epithelium.†—Dr. Th. Cohn has studied the bands or strands (*Schlussleisten*) which close up epithelium superficially. He has found them of very wide occurrence in embryos and in adults, endodermic as well as ectodermic, even in epithelial-like connective-tissue cells of the mesoderm. Their general occurrence, and the constancy of their structural character, suggest some important function, such as closing the intercellular spaces, but this is as yet uncertain.

Nerve-Endings of the Sweat-Glands.‡—Dr. P. Sfameni finds that the terminations of secretory nerves in connection with the sudorific glands lie in the membrana propria of the secretory tube, in the form of a network, in direct and intimate relation to the secretory epithelium. It is very probable that the amyeline nervous network described by Tomsa, Hermann, Ficatier, Coyne, and Ranvier, is formed by vasomotor nerve-fibres distributed on the capillaries of the glands.

Process of Cicatrisation.§—Prof. L. Ranvier has made some interesting observations on the process of healing in the cornea of the rabbit. Incisions made on the epithelium may be closed by direct re-union of the severed cells, helped by the intercellular "cement," but apart from any proliferation. The same is true of incisions in the conjunctival part. The cells give off prolongations which cross the gap and anastomose to form a protoplasmic cicatrix. In this case there is no cement, but simply a growth of the protoplasm and a fusion of its prolongations.

Structural Changes in Nerve-Cells.‖—Prof. A. van Gehuchten finds that there is a dissolution of chromatophilous elements in the protoplasm of a nerve-cell whenever the cell is injuriously affected either in its structural or functional integrity. This chromatolysis occurs within limits, and is not produced spasmodically; it does not appear to be in any way a serious disorganisation; it remains to be seen whether it is or is not compatible with normal functioning.

Neuroglia of Brain in Fishes.¶—M. — Catois finds that the supporting or ependym cells, which are primitively disposed with their internal ends on the walls of the ventricular cavities, may in the adult migrate

* Arch. Mikr. Anat., li. (1898) pp. 452–60.
† Verh. Phys. Med. Gesell. Würzburg, xxxi. (1897) pp. 171–200 (1 pl.).
‡ Atti R. Accad. Torino, xxxiii. (1898) pp. 321–8 (1 pl.).
§ Comptes Rendus, cxxvi. (1898) pp. 308–10.
‖ La Cellule, xiii. (1897) pp. 315–90 (1 pl.).
¶ Comptes Rendus, cxxvi. (1898) pp. 433–5.

from this position. The displaced elements have their terminal expansions, whether peripheral or central, more or less modified or atrophied. Even in the white matter of the brain these spider-cells or astrocytes may be found, and in the cerebellum and medulla as well as in the fore-brain. Their distribution suggests an isolating or insulating rôle, preventing useless contacts between the nervous elements.

Supra-Renal Capsules of Teleostei.*—Messrs. B. Moore and Swale Vincent have continued their investigation of these bodies. The known supra-renal bodies of Teleosts resemble anatomically and histologically the inter-renal of Elasmobranchs and the cortical portion of the supra-renal capsules of higher Vertebrates. An extract made from them does not contain the physiologically active principle characteristic of supra-renal medulla, nor the characteristic chromogen. The same is true of the lymphoid head-kidney. Removal of the cortical gland of eels showed that the organ was not absolutely essential to the life of the animal. One survived 28 days, another 64, and a third was killed on the 119th day.

c. General.

Means of Defence among Animals.†—L. Cuénot, in an address delivered before the Zoological Society of France, gives a graphic and popular account of the means of defence among animals. He classifies these means of defence, and gives some examples under each heading. He describes first those animals which save themselves by flight and by autotomy; those which are protected by a coat of mail, whether formed by an exoskeleton or by a calcareous envelope, as in molluscs, or borrowed entire, as in the case of the hermit-crab, or constructed of materials taken from the outside world, as in many tube-making larvæ. Here too are included those animals which are defended by spines, passively like the porcupine or hedgehog, or actively as in *Uromastix*. Electric fishes are next treated of, and then follow those which are defended by a chemical product, from the simply adhesive mucus of the snail and the acrid secretion of the toad to the sting of the bee, the poison of the snake, and the nauseous fluid ejected by the skunk. Animals which feign death, which assume terrifying attitudes, and whose colour harmonises with their environment; mimicry, commensalism, and the setting apart of special individuals for the defence of a colony, are all discussed, and the lecture ends with a brief account of how some of these means of defence may have been acquired, and a note on the necessity for very precise and critical experiment to obviate the danger of estimating their value from the point of view of human instead of animal sensations and appreciations.

Instinct and Intelligence.‡—Prof. C. Emery criticises Wasmann's position. Unlike Wasmann, he thinks it very probable that animals form general and abstract ideas. Many of their activities not only show the adaptation of means to ends, but conscious purposefulness. It is the power of speech which gives distinctiveness to man's position; it is at once a product of reason and a factor in its development.

* Proc. Roy. Soc. London, lxii. (1898) pp. 352-6.
† Bull. Soc. Zool. France, xxiii. (1898) pp. 37-58 (6 figs.).
‡ Biol. Centralbl., xviii. (1898) pp. 17-21.

Influence of Chemical and Luminous Stimuli on Red Blood-Corpuscles.*—Prof. H. Kronecker and Dr. H. Marti have experimented with rats, and reach the following conclusions.

(1) Slight chemical irritations of the skin promote the formation of red blood-corpuscles, but have a variable effect on the formation of hæmoglobin.

(2) Strong chemical irritations of the skin diminish the number of red blood-corpuscles, and in a less degree the content of hæmoglobin.

(3) Darkness lessens the number of blood-cells, which in about two weeks sinks to a minimum.

(4) Exposure to intense and persistent light stimulates the formation of red blood-corpuscles, and in less degree that of hæmoglobin.

Variations in Spinal Plexus and Sacrum of Newt.†—Dr. H. Adolphi, continuing his studies on this subject, finds that in *Triton tæniatus*, the sacral and the brachial plexus tend to be shifted in the same (a proximal) direction. The sacrum also moves towards the head.

Cholesterin and Bile-Salts as Vaccines against Viper's Venom.‡—Dr. C. Phisalix calls attention to Prof. Fraser's discovery that minimal doses of bile, whether of snake or mammal, can neutralise a fatal dose of venom. For some years Phisalix has studied the subject, and has obtained the same results as Fraser. Moreover, he has shown that the biliary salts and cholesterin have, like the intact bile, a neutralising or immunising effect.

Tyrosin as a Vaccine for Snake-Bite.§—Dr. C. Phisalix has already shown that cholesterin, whether animal or vegetable, makes animals immune to the viper's venom. He now shows that tyrosin, abundant in the tubers of the dahlia and in the genus of Fungi *Russula*, may also be considered as a vaccine against the same poison. This is the first case in which a vegetable juice (freshly squeezed from the dahlia) has been shown to have immunising properties.

Function of the Liver in Relation to Iron.‖—M. — Dastre gives an account of observations, made along with M. Floresco, on the livers of many different animals, Invertebrates as well as Vertebrates, in regard to what he calls their "martial function," i.e. their relation to the iron in the organism.

The quantity of iron fixed by the liver is greater than in other parts of the body, sometimes, as in Cephalopods, twenty-five times greater. This elective fixation is peculiar to iron; it is not true of copper, which is common in the blood of many Invertebrates. The quantity of iron present in the liver varies within narrow limits. In Mammals the blood and spleen are more ferruginous than the liver. The author regards the store of hepatic iron as a reserve on which the organism can draw.

Criticism of Chemical Theory of Life.¶—Dr. E. Baur draws a distinction—surely a legitimate one—between what is at present chemically explicable and what may be at some future time chemically explicable.

* Atti R. Accad. Lincei, vi. (1897) pp. 315-20.
† Morphol. Jahrb., xxv. (1898) pp. 544-54 (8 figs.).
‡ Comptes Rendus, cxxv. (1897) pp. 1053-5.
§ Op. cit. cxxvi. (1898) pp. 431-3. ‖ Tom. cit., pp. 376-9.
¶ Biol. Centralbl., xviii. (1898) pp. 239-40.

There are, he says, processes of metabolism of which a chemical account can be given, but this is not true of the adaptive power of protoplasm, of its power of adjustment to new conditions, of the peculiar striving of living material towards a maximum of stability. Perhaps, as Prof. Mach says, our chemical ideas may in time deepen and broaden so as to include the phenomena of organic growth; but this is not true as yet.

Organs of Sight in Amphioxus.*—Dr. R. Hesse gives an account of his investigations on the pigment-spots in the spinal cord of *Amphioxus*. He found these spots grouped together in a definite order corresponding obviously to the segmentation. Each individual pigment spot was cup-shaped, and contained a cell, one portion of which filled the hollow of the pigment-spot, while the other, containing the nucleus, was prolonged into a nerve, which could be traced for some distance among the fibres of the spinal cord. These organs closely resemble in structure the cup-eyes of *Planaria torva*. They lie on each side of, and below the central canal of the spinal cord, beginning in the third muscle segment, where there are only two on each side. From the fourth segment onwards there may be as many as twenty-five such cup-eyes grouped on each side, but from the middle of the body they decrease rapidly in number, and in the posterior segments they may be entirely wanting. Those on the right side lie about half the length of a segment behind those on the left. The cup-eyes lying underneath the central canal have their openings directed downwards; those on each side have the openings directed upwards, but while the former are symmetrical in structure, the latter have one wall of the cup higher than the other—on the right side the inner, on the left the outer wall, so that the organ is turned towards the right. There is, however, not sufficient evidence to prove a connection between this arrangement and the animal's habit of lying on the right side. Those underneath the central canal are probably functional when the lancelet lies on its back in the sand.

Dr. Hesse's physiological experiments yielded results similar in the main to those of Nagel, and corroborated his morphological investigations. It might be suggested that "cup-eye" is too big a name for these little spots.

Origin of Corpus Callosum.†—Dr. G. Elliot Smith has studied the brain in *Perameles nasuta*, in the bat *Nyctophilus*, and other forms. "The great feature which far more than any other distinguishes the mammalian brain from that of all submammalia is the possession of a definite pallium—distinct alike in its histological features and its morphological relations—giving rise to a definite internal capsule of projection-fibres, and well-defined and fully-medullated commissural fibres. At first, in the Monotremata and Marsupialia, this pallium (like the parent mass of the basal ganglion from which it appears to have sprung) is united to its homologue of the opposite hemisphere by means of the 'commissura ventralis'—'the commissure of the cerebral hemisphere' *par excellence*.

"But the rapid growth in extent and complexity of this general

* Zeitschr. f. wiss. Zool., lxiii. (1898) pp. 456-62 (1 pl.).
† Trans. Linn. Soc. (Zool.), vii. (1897) pp. 47-69 (2 pls. and 8 figs.).

cortex or pallium is accompanied by a richer and more abundant commissural system. This growing commissural system from the dorsal part of the enormous pallium not only finds in the 'commissura dorsalis' a shorter path, but a clearer scope for longitudinal extension than the ventral commissure provides; and thus we have pallial fibres invading and subsequently superseding the dorsal limb of what was previously the hippocampal commissure.

"Pallial commissural fibres probably first make their appearance in Reptiles, and form a very insignificant constituent of the ventral commissure. In Monotremes and Marsupials these fibres become extremely abundant, and swell the proportions of the ventral commissure enormously. But in Eutheria a rapidly increasing proportion of these fibres forsake the commissura ventralis, and form the new 'dorsal commissure of the pallium'—the corpus callosum—which throws the 'parent' commissure into insignificance. The remnant of the commissura ventralis is known in man by the somewhat misleading name 'anterior commissure.'"

INVERTEBRATA.

Sources of Error in Plankton Method.*—Prof. C. A. Kofoid discusses the Hensen method, which consists essentially in drawing a silk net vertically through the water. Its accuracy depends upon the efficiency of the silk in really catching the organisms. Experiments at the Illinois Biological Station show, however, that the leakage is great. The method is satisfactory only for the larger forms, such as the Entomostraca and the larger Rotifera and Protozoa. For the smaller and often very abundant "planktonts," such as *Melosira*, *Peridinium*, *Dinobryon*, *Raphidium*, *Scenedesmus*, *Euglena*, *Trachelomonas*, and *Chlamydomonas*, the Hensen method is wholly inadequate. From water in which these smaller forms were not extremely abundant the silk retained 248,200 organisms per cubic metre, while the catch of the Berkefeld filter indicated 767,556,000 planktonts in the same amount. "The plankton lost by leakage is of prime importance, for it is composed very largely of minute Algæ, which constitute a fundamental link in the cycle of aquatic life. Any attempt to unravel the complex interrelation of the constituents of the plankton, or to correlate its ever-progressing changes with the factors of its environment, must be based upon reliable data. Biological theory and aquiculture alike demand improvement in the plankton method."

Heleoplankton.†—Dr. O. Zacharias uses this term for the plankton of ponds and pools, which is in some ways different from that of lakes. It is, so far as is known, richer in species. There are fewer Diatoms, but a larger number of Desmids and Protococcaceæ; and there is a much more abundant occurrence of Rotifers and Ceriodaphniæ. Detailed lists are given.

Freshwater Fauna of Canary Islands.‡—M. Jules Richard gives a list of the Phyllopoda, Cladocera, Copepoda, Ostracoda, Polyzoa, and Rotifera which he observed in the freshwater pools of the Canaries.

* Science, vi. (1897) pp. 829–32. † Zool. Anzeig., xxi. (1898) pp. 24–32.
‡ Comptes Rendus, cxxvi. (1898) pp. 439–41.

The list is not a long one; it includes *Artemia salina*; *Daphnia similis*, otherwise known only from Syria and Palestine; a large local variety of this species; *Alona alluaudi*, a large new species; the remarkable Calanid, *Diaptomus alluaudi*; *Canthocamptus palustris*, hitherto found in much higher latitudes; and millions of *Pedalion mirum*.

As the islands are volcanic, the freshwater animals must have been borne thither by winds and birds. Most of them are doubtless to be found in the adjacent parts of Africa.

Fauna of Vallombroso.*—Dr. G. Cecconi gives a faunistic list of the earthworms, crustaceans, arachnids, and insects of Vallombroso.

Lacustrine Fauna.†—Dr. O. E. Imhof gives a summary of some recent researches. Thus F. Steindachner and J. Richard have co-operated in studying the pelagic fauna of Turkish lakes, hitherto unknown. The results show agreement with those obtained in Alpine lakes, e.g. in the occurrence of *Asplanchna helvetica*, *Daphnella brachyura*, *Leptodora hyalina*, and *Cyclops Leuckarti*. Also of interest is the occurrence of *Diaptomus Steindachneri*, hitherto known only from the Janina lake. Imhof also gives a summary of investigations by R. Blanchard and J. Richard on the fauna of high-lying lakes in the Alps of Savoy.

Mollusca.

Abyssal Molluscs.‡—M. Arnould Locard maintains that the abyssal molluscs of the North Atlantic have a wider distribution than is usually supposed. On the results of the 'Travailleur' and 'Talisman' expeditions especially, he bases the conclusion that the fauna in question extends over a vast triangle, the apex of which is near Iceland, while the sides extend to the European and American continents, and the base line runs between Africa and America, about 15° north of the Equator. The apex represents a depth of about 50 metres, the African basal angle about 2000 m., the American angle about 800 m.

α. Cephalopoda.

Spindle-Formation in Cephalopod Blastoderm.§—The late Prof. R. von Erlanger was led, by his observations on this subject, to the conclusion that the whole spindle-figure arises in consequence of the influence of the central corpuscles on the cytoplasm and karyoplasm. Around each central corpuscle the polar radiation arises. Physically or chemically the central corpuscle influences the surrounding cytoplasm so that the alveoli are arranged in rows converging towards the corpuscle. Soon there collects around the central corpuscle a sheath of very finely alveolar protoplasm which then attracts fluid out of the nucleus, and thus causes all the achromatin substance that is not used in the constitution of the chromosomes to take the form of the so-called spindle-fibres. The centroplasms certainly play an important part in mitosis, and even if they are not actually spherical, still deserve their more familiar title of attraction spheres.

* Bull. Soc. Entom. Ital., xxix. (1898) pp. 145–224.
† Biol. Centralbl., xviii. (1898) pp. 169–73.
‡ Comptes Rendus, cxxvi. (1898) pp. 441–3.
§ Biol. Centralbl., xvii. (1897) pp. 745–52 (4 figs.).

γ. Gastropoda.

Spermatogenesis of Snail.*—Mr. A. Bolles Lee has made a detailed study of the spermatogenesis in *Helix pomatia*. The basal cells—the male ovules of Duval, the blastophoral cells of Blomfield—do not produce the spermatogenetic cells which they bear; in fact they are wholly supporting and nutritive elements. The spermatogenesis concerns three categories of cells, the spermatogonia and two sets of spermatocytes. In the kinesis of the spermatogonia, there is a peculiar phase with scattered nuclear segment—*la phase de l'éparpillement*—intercalated between the stage of regular corolla-like distribution (*de peloton segmenté*) and the equatorial corona. It is possible that there is in this intercalated phase a qualitative reducing division.

The kinesis of the first set of spermatocytes resembles the kinesis *à bâtonnets droits* of Carnoy, the heterotypic division of Flemming, the essential feature being that the segments resulting from the longitudinal splitting of a primary nuclear segment fuse into a single chromosome. Thereafter ensues a resting stage, followed by the kinesis of the second set of spermatocytes in which there is a qualitative and quantitative, but not a numerical reduction. Indeed, there is no numerical reduction throughout the whole process. What various authorities call centrosomes are really "siderophilous corpuscles" produced by and expelled from the nuclei, but quite devoid of any mechanical rôle in kinesis. Both karyoplasm and cytoplasm show a reticular structure. The cytoplasm is not centered in relation to a centrosome, and has no "organic radii" nor "attraction spheres."

Repeated Bipolar Mitoses in Mother-Sperm-Cells of Snail.†—Herr E. Godlewski, jun., finds evidence of 2, 4, 8, and perhaps more bipolar mitoses in one cell. Sixteen spermatozoa may thus arise from one mother-cell. Unlike Bolles Lee, he always finds centrosomes at the spindle-poles. The details of the change from spermatid to spermatozoon are given, and the author substantiates the generally accepted view that the centrosome enters into the middle portion of the sperm.

Asymmetry of Gastropods.‡—Prof. H. Simroth concludes that the oldest molluscs had paired copulatory organs, corresponding to the primitively paired disposition of the gonads and nephridial ducts. But the increase of sedentary habits, on rocks (where the shell arose) and in the mud (Scaphopods and bivalves), led to the disappearance of copulatory organs. The mobile Cephalopods retained them, on both sides or on one. The Gastropods kept them or re-acquired them on one side only. It seems to Simroth that the evolution of the asymmetry of the Gastropods is wrapped up with the history of the copulatory apparatus. A review of other theories is given.

Connective Tissue of Paludina.§—M. Joannes Chatin has studied the behaviour of the connective tissue elements in *Paludina vivipara*, when this mollusc is affected with Cercariæ. The general result of his

* La Cellule, xiii. (1897) pp. 199–278 (3 pls.).

† Anzeig. Akad. Wiss. Krakau, 1897, pp. 68–81 (2 pls.), pp. 263–7 (3 figs.) See Zool. Centralbl., iv. (1897) pp. 880–3.

‡ Biol. Centralbl., xviii. (1898) pp. 54–63.

§ Comptes Rendus, cxxvi. (1898) pp. 659–62.

investigation is to show the extraordinary polymorphism of these elements and the existence of transitions between the different forms. What have been called "ramified," "vesicular," "plasmatic," "stellate," "multipolar" cells, and by many other names according to their forms, are all reducible to one type.

Tylodinidæ.*—Dr. G. Mazzarelli describes the structure of *Tylodinella trinchesii* g. et sp. n., for which, along with the two known species of *Tylodina* Raf., he proposes to establish a new Tectibranch family Tylodinidæ. Of this a full diagnosis is given. After discussing the affinities, the author agrees with Pelseneer that the type represents the stock from which the Pleurobranchidæ are derived.

Parasitic Prosobranchs.†—Prof. W. Kükenthal describes six species, two new, which he found associated with Echinoderms at Ternate. He discusses their structural peculiarities in relation to their mode of life. They belong to two distinct series, the one having its nearest relatives in the Eulimidæ, the other in *Capulus* and *Hipponyx*. An extreme is represented by *Stilifer*, whose peculiarities, such as the false mantle, are made more intelligible by a study of *Mucronalia eburnea* and other species.

Freshwater and Terrestrial Gastropoda from Halmahera, &c.‡—Dr. W. Kobelt gives an account of Kükenthal's collection from Halmahera, Batjan, Celebes, and North Borneo, and establishes numerous new species.

Opisthobranchs of Ternate.§—Prof. R. Bergh describes Kükenthal's collection, including *Kentrodoris maculosa*, *Asteronotus cespitosus*, *Phyllidia varicosa*, and *Doridium alboventrale* sp. n.

Species of Vaginula.‖—Prof. H. Simroth describes three of these slugs collected by Kükenthal,—*Vaginula Strubelli* from Java, *V. djiloloënsis* sp. n. from Halmahera, and *V. borneensis* sp. n. from Borneo.

Degenerative and Regenerative Processes in Breathing Tubes of Janellidæ.¶—Prof. L. Plate has been studying the remarkable New Zealand slugs (*Janella schauinslandi* and *Aneitella berghi*) of the family Janellidæ, in which the proper mantle-cavity is reduced and non-vascular, but gives off a large number of arborescent thin-walled tubules projecting into a blood-sinus surrounding the cavity. In these tubes there is an intense cellular disruption, perhaps due to the fact that the respiratory cells have also to keep the tubes moist by secreting mucus. The dying cells are for the most part extruded into the *sinus dorsalis*, where they are destroyed by phagocytic blood-corpuscles and plasma-cells, or partly dissolved. In both species described the nuclei of the cells in question are remarkable in being much lobed. The most interesting fact, however, is that the replacement of these used-up cells occurs by direct division. Here we have a clear case of a specialised tissue in which direct nuclear division is regenerative.

* Zool. Jahrb. (Abth. Syst.), x. (1897) pp. 596-608 (2 pls.).
† Abh. Senckenberg. Nat. Gesell., xxiv. (1897) pp. 1-14 (3 pls.).
‡ Tom. cit., pp. 19-92 (8 pls.). § Tom. cit., pp. 97-130 (2 pls.).
‖ Tom. cit., pp. 137-44 (1 pl.).
¶ Arch. Mikr. Anat., li. (1898) pp. 839-56 (1 pl.).

Chitonidæ.*—Prof. L. H. Plate has published the first part of a memoir on the Anatomy and Physiology of the Chitonidæ, based on his Chilian collection. He has been able, on some of the larger forms, to clear up certain points concerning the excretory and circulatory systems, which are difficult to study in the European species. The comparative and phylogenetic considerations are to be discussed in a general part; the present publication includes the first half of the special part, and deals with the two families Toniciinæ and Liolophurinæ. The gigantic *Acanthopleura echinata* is described in special detail.

δ. Lamellibranchiata.

Phylogeny of Lamellibranchs.†—H. Douville adopts Neumayr's classification:—Taxodonts, Dysodonts, Desmodonts, Heterodonts, and the imperfectly known Cryptodonts, an arrangement based essentially on the structure of the cardinal apparatus. He maintains that the Taxodonts represent the primitive source from which the Heterodonts are derived by simplification of the hinge and acceleration of development; that the Dysodonts are Taxodonts progressively modified by their byssal fixation; and that the Desmodonts are Heterodonts originally transformed by imprisonment within the cavity which they excavate.

Yoldia.‡—Mr. Gilman A. Drew gives an account of the development, structure, and habits of *Yoldia limatula* Say, a member of Pelseneer's order Protobranchia.

The chocolate-brown eggs are laid free in the water; cleavage results in sub-equal blastomeres; an epibolic gastrula is formed. Some of the ectoderm-cells wander into the interior, the endoderm-cells divide, and at one side of the resulting cell-mass a narrow tube appears, which opens to the exterior through the blastopore. As it has not been determined whether this tube is ectodermic or endodermic, it may be called the ventral tube. About 42 of the ectoderm-cells become ciliated test-cells, and inside this a new ectoderm is formed. Some ectoderm-cells form the shell-gland, which is never a distinct invagination. The mid-gut is formed, as it were, as a continuation of the anterior end of the ventral tube. Two thick-walled ectodermic pouches are formed anteriorly, as the rudiments of the cerebral ganglia, and the other ganglia soon appear. An anus breaks through into the upper part of the blastopore. At about the age of 105 hours, the embryo stops swimming and settles to the bottom; the cilia shrivel, the test-cells break up, the animal is left in its clear white shell. The most striking peculiarities are connected with the formation and disappearance of the locomotor test, which resembles that in *Dondersia*, but is otherwise unique. The condition presented by the mouth and anus both opening through the blastopore, and the formation of cerebral ganglia from invaginations, are also of much interest. The sensitive burrowing foot, the food-collecting palp-appendages, the muscular membranes suspending the gills from the body-wall, and other features of interest, are briefly described.

* Fauna Chilensis. Supplementheft iv. Zool. Jahrb., 1897, pp. 1–243 (12 pls. and 8 figs.). † Comptes Rendus, cxxvi. (1898) pp. 916–9.

‡ Ann. Nat. Hist., i. (7th series) 1898, pp. 267–77 (6 figs.). Johns Hopkins Univ. Circ., Nov. 1897, pp. 11–14 (6 figs.).

Arthropoda.

a. Insecta.

Remarkable Mode of Reproduction in Encyrtus.*—M. Paul Marchal has studied *Encyrtus fuscicollis*, one of the parasitic Hymenoptera, which lays its eggs in those of *Hyponomeutes*. The remarkable peculiarity is that the ovum of *Encyrtus* gives rise, not to one embryo, but to "a legion of small morulæ," which form a chain of 50–100 embryos. The amniotic envelope loses its vesicular form, and becomes a long flexible tube, within which lie the embryos surrounded by granular material apparently derived from a disruption of part of the original egg. As the author says, this is a mode of reproduction unique among Arthropods, if not among animals.

Structure and Life-History of Phalacrocera replicata.†—Prof. L. C. Miall and Mr. R. Shelford have studied the larva of these Dipterous insects, locally abundant upon submerged mosses and aquatic plants. The authors describe the structure of the larva and pupa.

A very peculiar feature is described in connection with the heart. Two cellular *epidermic* cords pass into the heart and traverse it from end to end. In the pupa the cords become beaded, break up, and disappear. They perhaps represent reserve nutritive masses.

Baron C. R. Osten Sacken adds an appendix on the literature of the earlier stages of the Cylindrotomina, a section of the Tipulidæ, including *Phalacrocera*, *Cylindrotoma*, &c.

New Colonies and Fungus-Gardens in Ants.‡—Dr. H. von Ihering describes the foundation of new colonies and new fungus-gardens by the leaf-cutting ants of Brazil. The winged insects of *Atta sexdens* make repeated short flights between the end of October and the middle of December; apparently, however, not for the purpose of pairing, for all the females examined by the observer were already fertilised. The females rid themselves of their wings, and seek out a bare spot of ground to begin boring operations. A tube so small that the ant is unable to turn round in it is bored to a depth of 20–40 cm., and enlarged at the end into a chamber. Then the tube is closed up at a short distance from the entrance. In many chambers examined the females were found to have died, apparently from exhaustion; in others a packet of 20–30 eggs was found, and beside it were the first beginnings of a fungus-patch. Dr. Ihering's great difficulty was to find out in what way the necessary material for starting the garden was carried into the hole; and his investigations have shown him that each mother-ant carries from the old nest, in the posterior part of the mouth-cavity, a tiny ball consisting of the hyphæ of *Rhozites gongylophora* mixed with pieces of bleached leaf remains.

Apparatus for keeping Ants.§—M. Charles Janet gives those interested in observing ants in captivity the benefit of his experience, which is great. He describes and figures horizontal and vertical cases in which a *normal* life may be secured for the tenants.

* Comptes Rendus, cxxvi. (1898) pp. 662–4.
† Trans. Entomol. Soc. London, 1897, pp. 343–66 (4 pls.).
‡ Zool. Anzeig., xxi. (1898) pp. 238–55.
§ Mem. Soc. Zool. France, x. (1897) pp. 302–23 (1 pl. and 3 figs.).

Rectum and Rectal Glands of Orthoptera.* — M. L. Bordas has studied the structure of these parts in forty species belonging to diverse families. There is great uniformity. The rectum is an ovoid rectangular or fusiform region, with thick musculature, and six glandular ridges parallel to the longitudinal axis. In Forficulidæ the glands are somewhat divergent, being spherical and disposed in two alternating tiers. As in Hymenoptera, these glandular ridges consist of groups of unicellular glands.

Segmental Glands of Ocypus.† — Dr. Jivoca Georgevitsch has studied the integumentary glands on the young stages of the Staphylinid *Ocypus olens* Müll. He distinguishes the more regular segmental glands from others which he calls globiform. Of the former there are 14 pairs, one in the head, three in the thorax, and ten in the abdomen. Each consists of a large number of digitate glandular tubes. While the segmental glands occur both on larvæ and embryo, the globiform glands seem to be exclusively embryonic. Apart from the head, each segment has normally four globiform glands, each consisting of a giant glandular cell. As both sets of glands appear to be ectodermic, there is no warrant for comparing them with the nephridia of Annelids.

Articular Membranes in Hymenoptera.‡ — M. Charles Janet has made a careful study of the articular membranes and the morphological limits of the segments in adult ants; but his results are not readily summarised. The articular membrane is situated in the vicinity of the morphological boundary between two segments, but almost entirely on the relatively less mobile segment. Thus the prothoracic and mesothoracic segments in ants bear their articular membrane towards the anterior border, while the post-thoracic segments bear their articular membrane towards their posterior border.

Taxonomic Value of Nervures.§—Dr. A. Griffini, after describing the wings of Haliplidæ (*Cnemidotus* and *Haliplus*), notes that the taxonomic value of the nervures in Coleoptera is not great. In Dytiscidæ, for instance, the disposition of the nervures changes from genus to genus. Thus, as to nervures, *Hydroporus* differs from *Dytiscus* and *Acilius*, and the two last differ from the Haliplidæ, while *Dytiscus*, *Cybister*, and *Acilius* are identical with *Calosoma* among the Carabidæ.

Changes in Structure of Butterflies' Wings.‖ — Mr. A. Radcliffe Grote finds that the changes in the veins of the wings, as deduced by comparative study, "take a direction which stands probably in relation to the mode of flight, and that the processes themselves may be distinguished as follows :—firstly, the reduction by absorption of the radial veins; secondly, the disintegration of the median series; and thirdly, the reduction and suppression of veins above the radius and below the cubitus." The changes appear to have their origin in the hind wings, on which there is a greater strain in flight.

* Comptes Rendus, cxxvi. (1898) pp. 911–2.
† Zool. Anzeig., xxi. (1898) pp. 256–61 (4 figs.).
‡ Comptes Rendus, cxxvi. (1898) pp. 435–9 (3 figs.).
§ Ex Miscellanea Entomologica, No. 9, 1897 (2 pp., 2 figs.).
‖ Trans. Entomol. Soc. London, 1897, pp. 333–42.

North African Galls.*—Dr. P. Marchal gives an account of eleven galls, new as regards their substratum, found on *Quercus Mirbecki*, and due to *Biorhiza terminalis*, various species of *Cynips*, and other forms. Various cecidomyid galls on *Quercus coccifera* and *Atriplex halimus* are described, and others due to Lepidoptera, Hemiptera, and Phytoptidæ.

Life-History of Œstrid Larvæ.†—Prof. Schneidemühl discusses in particular the life-history of *Hypoderma* (*Œstrus*) *bovis*, which is still in some respects puzzling. His general conclusions are that the ova, or in some cases the larvæ, are licked up by the cattle, partly from the skin, partly with the fodder from the ground; that the larvæ pass from the pharynx into the submucosa connective tissue of the œsophagus; that they creep in this tissue into the vicinity of the diaphragm, where they bore through the wall of the œsophagus, and thence pass to the skin often, but not necessarily, viâ the vertebral column and neural canal.

Casting and Regeneration of Mid-Gut Epithelium in Water-Beetles.‡—Dr. C. Rengel describes the minute structure of the mid-gut in *Hydrophilus piceus*, supplementing what has been done by Frenzel, Vangel, and Bizzozero, and describes the periodic casting and re-growth of the whole mid-gut epithelium, with especial reference to the muscular mechanism. The same process occurs in *Hydrous caraboides*, *Hydrobius fuscipes*, and in some Lamellicorns.

Studies on Plecoptera.§—Dr. P. Kempny gives an account of the structure and life of those Plecoptera which are included in the genus *Nemura* Latr., and describes the palæarctic species.

Studies on Termites.‖—Herr E. Wasmann discusses ten Madagascar species, all new. He discusses the classification of the family, and the taxonomic value of the soldiers. Hagen's four genera—*Hodotermes*, *Termopsis*, *Calotermes*, and *Termes*—are recognised, the last being divided into ten sub-genera. The mouth-parts of the soldiers are compared with those of the other forms;—thus it is noted that while the mandibles of the soldiers are almost always stronger than in the workers and imagines, the opposite is true in *Eutermes*, where the soldier's mandibles are microscopic. The so-called "tongue" of Termites is shown to be formed from a coalescence of the paraglossæ. On the whole the mouth-parts suggest affinities with Orthoptera.

Parasites of Pears.¶—Dr. G. Del Guercio describes three parasites of pear-fruits, discussing their life-history and injurious effects, and the preventive methods. The parasites are the Tenthredinid *Hoplocampa brevis* Klug., the Tortricid *Carpocapsa pomonella* L., and the Cecidomyid *Diplosis pirivora* Ril.

β. Myriopoda.

Morphological Notes on Diplopoda.**—Dr. F. Silvestri notes that in *Lysiopetalum fœtidissimum*, and probably in other species, the second

* Mém. Soc. Zool. France, x. (1897) pp. 5–25 (1 pl.).
† Centralbl. Bakt. u. Par., xxii. (1897) pp. 752–60.
‡ Zeitschr. wiss. Zool., lxiii. (1898) pp. 440–55 (1 pl.).
§ Ver. Zool.-bot. Gesell. Wien, xlviii. (1898) pp. 37–68 (1 pl. and 16 figs.).
‖ Abh. Senckenberg. Nat. Gesell., xxi. (1897) pp. 137–82 (2 pls.).
¶ Bull. Soc. Entom. Ital., xxix. (1897) pp. 1–25 (1 pl.).
** Atti R. Accad. Lincei, Rend., vii. (1898) pp. 52–7 (6 figs.).

pair of feet are very much reduced in the female. In *Pachyiulus communis*, and probably in all Diplopoda with direct development, the internal feet are reduced, without however affecting the joints; it may be that such reduced appendages form the point of departure in the formation of the copulatory apparatus.

In adult male Craspedosomatidæ the silk-glands are atrophied; in the females they attain great development and secrete an investment for the eggs; in both sexes of Lysiopetalidæ the glands are atrophied. The state of the glands should be attended to in classification.

New Myriopods.*—Sig. F. Silvestri describes seven new species of Diplopoda from Queensland. He also gives an account of Sicilian Myriopods,—36 species of Chilopoda (2 new), and 23 species of Diplopoda (6 new). Of the Sicilian Chilopoda, four are North African forms, and three Iberian; of the Diplopoda there are four which are common to the Italian peninsula, but are not known elsewhere in the Mediterranean region.

Malayan Myriopods.†—Dr. Carl Grafen Attems describes Prof. Kükenthal's collection, which included 64 species, 42 new, namely, three Chilopoda and the rest Diplopoda.

γ. Protracheata.

New Species of Peripatus.‡—Dr. A. Willey gives a diagnosis of *Peripatus novæ-britanniæ* sp. n., of which he obtained thirteen species in New Britain. The diagnosis shows that this species constitutes a new (Melanesian) type of *Peripatus*, conforming neither to the type of the neotropical, nor of the Australasian, nor of the Ethiopian species.

New Species of Peripatus from Ecuador.§—Sig. L. Camerano describes a new species, *P. Corradi*, from Quito, which he places beside *P. quitensis* Schm., and *P. Balzani* Camer. These are the only Neotropical forms which agree with the new species in having three teeth on the external mandible.

δ. Arachnida.

Ant-eating Spider.‖—Herr E. Wasmann has added another name, *Theridium triste* Hahn, to the list of spiders known to prey upon ants. This somewhat rare species is small, round-bodied, and of a brilliant black colour. It is found in the neighbourhood of the nests of *Formica fusca*, *F. rufa*, *F. sanguinea*, and *F. rufibarbis*. It rests upon a blade of grass, and attacks isolated ants. Its mode of procedure is as follows,—it jumps down on its victim, winds a thread round the body, and, re-ascending to its perch, slowly draws up its entangled prey. From this mode of attack the observer has called it the "gallows spider." Its very small size relative to its prey, and its brilliant black colour, have led Wasmann to suppose, with Van Hasselt, that its poison must be more than usually strong.

* Bull. Soc. Entom. Ital., xxix. (1898) pp. 225-32 (14 figs.), and pp. 233-61 (30 figs.). † Abh. Senckenberg. Nat. Gesell., xiii. (1897) pp. 473-536 (4 pls.).
‡ Ann. Nat. Hist., i. (7th ser.) 1898, pp. 286-7.
§ Atti R. Accad. Torino, xxxiii. (1898) pp. 308-10 (2 figs.).
‖ Zool. Anzeig., xxi. (1898) pp. 230-32.

Argas reflexus as a Human Parasite.*—Dr. G. Brandes records the history of observations as to infection of man by the dove-tick, *Argas reflexus*, whose bite seems to be poisonous. Recent cases make the occurrence quite certain. Only certain people are susceptible, however, especially the hyperæsthetic.

Distribution of Halacaridæ.†—Dr. E. Trouessart points out that a closer study of the distribution of Entomostraca and Acarina around the coasts has considerable practical as well as scientific interest, since these animals form an important part of the food-supply of fishes.

In studying the distribution of Halacaridæ, Trouessart has been led to distinguish four areas:—

(1) The littoral or coralline areas, characterised by *Rhombognathus*, which is restricted to this area, and by the frequency of *Halacarus spinifer*, *H. Chevreuxi*, *Agaue brevipalpus*, &c.

(2) The granite floor, characterised by *Acaromantis squilla*, *Coloboceras longiusculus*, and *Scaptognathus tridens*.

(3) The Bryozoen-area, characterised, for instance, by *Halacarus Murrayi*.

(4) The abyssal area, characterised by very distinct forms:—*Halacarus abyssorum*, *H. Caudani*, *Agaue aculeata*, *A. tricuspis*, *Colobocera Koehleri*.

ε. Crustacea.

Nervous System of Crab.‡—Herr A. Bethe makes a third communication in regard to the nervous system of *Carcinus mænas*, the common shore-crab.

Besides the "primitive fibrils" which pass from the lateral processes or from the axis-process of the nerve-cell into the peripheral fibre, there are many others in the neuron. Experiments make it practically certain that the primitive fibrils form the conducting elements of the nervous system.

The remarkable conclusion is maintained that almost all the functions which a nervous system has in relation to the muscular system may occur in the crab without the nucleus-bearing portion of the neuron, and without the fibrillar framework of the ganglion-cells.

We cannot unfortunately find space to follow the ingenious author in his interesting study of the complex reflexes, in the course of which he finds evidence for a morphological conclusion, viz. that the stalked eyes represent a pair of appendages. The most important conclusion is that ganglion-cells are not necessary for the occurrence of reflexes.

The brain of the crab is shown to be in part "a reflex inhibiting organ," and the facts lead Bethe to deny it any intelligence ("jede Art von psychischen Qualitäten abzusprechen"). He ends, however, very pessimistically, saying that his attempt to make things clearer has only resulted in disclosing numerous unsuspected difficulties.

Peripheral Nervous System of Crayfish.§—Herr W. Schreiber confirms previous accounts of the presence of a sub-epithelial plexus of

* Centralbl. Bakt. u. Par., xxii. (1897) pp. 747–52.
† Mem. Soc. Nat. Cherbourg, xxx. (1896–7) pp. 91–8 (3 figs.).
‡ Arch. Mikr. Anat., li. (1898) pp. 382–452 (2 pls.).
§ Anat. Anzeig., xiv. (1898) pp. 273–7 (3 figs.).

multipolar nerve-cells in *Astacus*, and has succeeded in showing the definite connection between the cells and the branches of the nerves.

Amphipods from Copenhagen Museum.*—Rev. T. R. R. Stebbing discusses nine genera and ten species, six of each being new. "Some of the species are so like their previously known neighbours that a short-sighted person might think them not worth distinguishing. Others stand oddly apart, with so queer a combination of characters that more than one existing family must look at them askance." "Opinions will differ on the policy of promptly establishing new families for eccentric forms, or of postponing that responsibility to as late a date as possible." "In the amiable endeavour to oblige the partisans of either view," the author "offers tentatively a new family for one of these perplexing species, boldly assigns one to an old family, and leaves one for the present homeless."

New Copepods from the Clyde.†—Messrs. T. and A. Scott describe *Stephos Fultoni* sp. n., *Dactylopus pectinatus* sp. n., and *Eurynotus insolens* g. et sp. n., additions to the faunal list of the Clyde area.

Choniostomatidæ.‡—Herr H. J. Hansen has monographed this family of Copepoda, parasitic on Malacostracan Crustacea. He describes 43 species in place of the five previously known. The larval and post-larval development of numerous forms has been investigated. The relations of parasite and host, e.g. the frequently ensuing castration of the latter, are fully discussed. As a reviewer (F. Zschokke) says, Hansen's work is so thorough that there is now no group of parasitic Copepods better known than the Choniostomatidæ.

Trilobites and Crustaceans.§—Mr. C. E. Beecher gives an outline of a natural classification of the Trilobites. This includes a diagnosis brought up to date; a detailed comparison (as to eighteen features) between Trilobites, Entomostraca, and Malacostraca; a summing up of what is known as to the development; and a classification into the three orders: Hypoparia, Opisthoparia, and Proparia.

Annulata.

Earthworms of Madagascar Region.‖—Dr. W. Michaelsen describes about two dozen species from Madagascar, the Seychelles, and the Mascarenes. They may be ranked in two groups:—(*a*) forms introduced by man, e.g. *Benhamia bolavi*, *Eudrilus eugeniæ*, *Pontoscolex corethrurus*, *Megascolex armatus*, and some species of *Perichæta*; (*b*) endemic forms, such as the dominant genus *Kynotus*, a generalised type near the common root of the Lumbricini and Geoscolecini, and three species of *Acanthodrilus*, a genus which the author believes to have been almost cosmopolitan in distant geological periods.

Supposed Auditory Cells in Pontoscolex.¶—Dr. G. Eisen has studied the peculiar cells which occur in the equatorial line of each segment in

* Trans. Linn. Soc. (Zool.), vii. (1897) pp. 25–45 (9 pls.).
† Ann. Nat. Hist., i. (7th ser.) 1898, pp. 185–90 (2 pls.).
‡ Copenhagen, 4to, 205 pp., 13 pls. See Zool. Centralbl., v. (1898) pp. 181–8.
§ Amer. Journ. Sci., iii. (1897) pp. 89–207 (1 pl.).
‖ Abh. Senckenberg. Nat. Gesell., xxi. (1897) pp. 217–52 (3 figs.).
¶ Festschrift f. Lilljeborg, Upsala, 1896 (received 1898), 16 pp. and 2 pls.

Pontoscolex. They were first described by Perrier (1872) as unicellular glands. They are highly differentiated, with associated nerve-endings or ganglia (not very satisfactorily proved), and each contains a peculiar globular body towards the outer side. "The cell seems especially constructed so as to keep this otosome in place, confined to the upper vacuole, while the beautiful protoplasmic structure below it might serve to propagate the sound-waves to the nerves below. The central cytoplasmic floor, which always seems to be in the same tension as regards the cell-walls, and always in the same position to the base of the cell, may serve as a kind of sounding-board." It is also principally in the equatorial of this floor that the supposed ganglion-cells or nerve-plates are situated. Eisen describes *Pontoscolex Lilljeborgi* sp. n. from Guatemala, and a Mexican variety of *P. corethrurus* F. Müller.

Pelagic Polychæte Larvæ.*—Dr. V. Hæcker distinguishes (*a*) the resident forms, (*b*) the regular visitors, and (*c*) the casual intruders.

(*a*) In the first place there are the larvæ of many Polychæta which are, so to speak, at home in the open sea,—various Phyllodocidæ, Alciopidæ, Tomopteridæ, &c. Most of the larvæ, as Reibisch has pointed out, soon lose their ciliated rings, and acquire more effective locomotor and sensory appendages. They tend to suppress the trochophore and metatrochophore stage, and to pass directly to the Nectochæta stage.

(*b*) The second set includes those which are normally pelagic during a certain period (at least) of their larval life. Especially well adapted are the Nitraria and Rostraria types, which are discussed at some length. Their remarkable adaptations which increase their capacity for drifting, and their power of energetic movement, are illustrated.

(*c*) The third set includes wanderers from the littoral plankton. They are the larvæ of various errant and tubicolous forms, and have been swept out from the shore. They are "lost children," and most of them must perish.

Polychæta of French Coast.†—Baron de St. Joseph concludes his valuable systematic account of the Polychæta found off the French coast.

Ampharetidæ.‡—Pierre Fauvel describes *Ampharete grubei* Malmg. in detail, and deals more briefly with some related forms. The family is in many ways more nearly related to the Terebellidæ than to the Amphictenidæ; the three families are parallel branches from an unknown starting point.

Spirorbis.§—MM. Maurice Caullery and Felix Mesnil give a systematic account of the (28) species of *Spirorbis*, which they arrange in sub-genera. The genus is a Serpulid in which the number of thoracic segments shows the maximum reduction (to 3), and the coiling of the tube has become constant. With the spiral coiling of the tube an asymmetrical structure of the body is associated. In the phylogenetic

* Biol. Centralbl., xviii. (1898) pp. 39–54 (9 figs.).
† Ann. Sci. Nat. (Zool.), v. (1897) pp. 225–464 (11 pls.).
‡ Bull. Sci. France Belg., xxx. (1897) pp. 1–212 (11 pls.). See Zool. Centralbl., iv. (1897) pp. 866–8.
§ Tom. cit., pp. 185–233 (4 pls.). See Zool. Centralbl., iv. (1897) pp. 865–6.

grouping the chief emphasis is laid on the number of thoracic segments, the bristles, and the operculum.

Neck-Glands of Leech.* — Dr. S. Apáthy describes the salivary glands, or, as he calls them, the neck-glands, of the medicinal leech. He notes their exact position in the 7th, 8th, and 9th segments, and gives full instructions as to the mode of procedure in collecting the secretion of the glands, which prevents the coagulation of blood. The secretion is constant, and leeches collected at any time of the year, of any age, and without regard to the state of nutrition, may be used. But animals of middle size, in which the clitellum is not swollen, will yield the best results.

For a fuller treatment of the subject, and for details as to structure and function of the glands, Dr. Apáthy refers to his recently published paper on "The neck-glands of *Hirudo medicinalis*, with regard to the clinical use of their secretion." †

Rotatoria.

Researches on the Plankton of Ponds.‡—Dr. O. Zacharias has examined a large amount of plankton material collected by him and for him in ponds in various parts of Germany, in order to compare the micro-fauna and flora swimming or floating in the open water with that found in larger freshwater lakes. He gives a list of about 100 species of organisms found therein, 36 being Rotifers. Two of these are described as new:—*Brachionus falcatus* and *Tetramastix opoliensis*, both of which are described and figured.

Determination of Sex in Hydatina Senta.§—Prof. M. Nussbaum has followed Maupas in experimenting with this Rotifer in regard to the determination of sex. He begins by describing the animal; but it is not necessary for us to do more than re-state the essential facts as to the reproduction. The male is much smaller than the female (up to 0·25 mm. in length), without alimentary canal, and very short-lived (2–3 days). In copulation, which occurs especially with young females, the penis perforates the skin, and the sperms are discharged into the body-cavity. Fertilisation of the eggs does not necessarily follow insemination. The adult female measures 0·75 mm. in length; it may attain full size two days after hatching. The eggs are either "summer eggs" with soft shells, or "winter eggs" with hard shells; the "summer eggs" give rise to a male or a female brood, and are produced especially by females which have not been inseminated; the "winter eggs" are produced only by females which have been inseminated. Nussbaum has convinced himself that the "summer eggs" are never fertilised, and that the "winter eggs" always are. Any one individual produces only one kind of egg. But Nussbaum shows in this connection that the dimensions of the eggs are not quite reliable proofs of the sex of the forthcoming brood. On the whole it is true that the larger eggs develop into females, and the smaller into males, but the size varies considerably, and the medium-sized eggs are difficult to deal with. Thus, while Plate

* Biol. Centralbl., xviii. No. 6 (1898) pp. 218–29 (2 figs.).
† SB. Med. Nat. Siebenburg. Mus. Verein, xix. (1897).
‡ Forschungsber. a. d. Biol. Stat. zu Plön, vi. (1898) pp. 1–50 (1 pl.).
§ Arch. Mikr. Anat., xlix. (1897) pp. 227–308.

mentions 0·1 mm. as the minimum diameter for an ovum which will develop into a female, Nussbaum reared a living female from an ovum 0·08 mm. in diameter.

Maupas observed that the development of the parthenogenetic ("summer") eggs takes 26 hours at 15° C. and 12 hours at 24° C.; Nussbaum notes that the rate of development is also influenced by the oxygenation of the water, by the behaviour of the *Euglenæ* which form the normal food-supply, and so on.

Maupas also states that a parthenogenetic female will produce per diem at 15° C., 18 eggs, which become males, or 7 which become females, but at 24° C., 27 or 18 respectively; Nussbaum notes that these figures are maxima, and are much reduced when a large number of individuals are living together. The length of life of the parthenogenetic female was estimated by Maupas as 13 days at 18° C. Four days before death the female laid its fiftieth and last egg. An effectively fertilised female lived 7–8 days at 18°–20° C.

Nussbaum found spermatozoa inside the hard shelled ova; there is no doubt that they are fertilised. It remains, however, an open question whether Maupas is right in believing that only those eggs destined to become males are capable of fertilisation, and that when this happens they become hard-shelled eggs.

As has been noted, a given ovary produced only males, or only females, and Maupas concluded that the sex of the grandchildren is determined in the ovary of the grandmother. Lowering the temperature determines that the ova will develop into females, and conversely; but, after this early determination has been established, no environmental changes can affect it. He supported this by various experiments, which Nussbaum criticises. Maupas isolated five females, before maturity, and kept them at 26°–28° C. They produced 104 ova, which gave rise to females, of which 97per cent. had male eggs, and 3 per cent. female eggs. Five females of the same age and from the same culture, at 14°–15° C., produced 260 ova, which gave rise to females, of which 5 per cent. had "male eggs," and 95 per cent. "female eggs." Maupas does not state whether he estimated the sex from the size of the eggs or from the actually hatched offspring. Nussbaum, by an analysis of the experiments, seeks to show that there were other differences in the conditions besides those of temperature. The nutritive conditions and the number of associated individuals have also to be considered.

Prof. Nussbaum goes on to give an account of his own numerous experiments. We must make a selection from among the results, which are unfortunately not arranged methodically. One and the same female always produces a uniform brood. A male lives from two to three days. Temperature does not influence the sex of the brood produced by a sexually mature female; but cold retards development and productivity. With lowered temperature "winter eggs" tend to be produced. It is not possible to predict the sex of the embryo from the size of the egg. Females inseminated early and well fed during their growth produce only female summer eggs; females inseminated early and ill fed produce winter eggs, from which, so far as is known, only females arise. If a parthenogenetic female is well fed from its emergence till it lays its first egg, only female eggs are laid; if ill fed only male eggs. But the nutritive influence is restricted to the period stated. We venture to hope that in the continuation of this excellent work the author will expound his conclusions more methodically.

Cyclic Reproduction in Rotifers.*—According to Dr. R. Lauterborn's observations extending over a period of six years, there exists in the pelagic Rotifers a periodicity in the production of males and fecundated resting eggs. These are produced at certain times of the year, which times do not always correspond with the beginning of the cold season. A certain number of Rotifers are perennial. Others appear only during the summer months, and these produce males only once a year (monocyclic), generally from the end of August to the end of October, at the end of a long series of parthenogenetic generations. After this period they gradually disappear completely; but they appear again the following spring or summer. In the perennial Rotifers, which can be found more or less abundantly all the year round, there are two or more sexual periods in the year during which males and resting eggs are produced (dicyclic and polycyclic). In the Rotifers which have two sexual periods, such as *Asplanchna priodonta*, the first occurs in the spring (particularly April), and the second in the autumn (September and October); whilst during the winter and middle of summer such forms produce no males or resting eggs. The polycyclic forms have more than two sexual periods, or may produce males all the year round.

From these observations the author draws the conclusion that the beginning of the sexual period in Rotifers is not caused primarily by external circumstances, such as heat, drought, or want of food, according to the accepted belief, but that it is due in the first instance to the mode of development of each species, which may however become modified by the influence of such external circumstances.

The author further confirms, in the case of *Asplanchna priodonta*, what M. Maupas had previously observed in *Hydatina*, namely that some females of *A. priodonta* produce parthenogenetic summer eggs and others parthenogenetic male eggs, and that these male eggs alone become changed into resting eggs if they are fertilised. In *Asplanchna*, of course, the summer and male eggs are not laid, but develop in the uterus. The author observed the spermatozoon which had entered the resting egg in process of formation, its transformation into the male pronucleus, and the conjugation of the two pronuclei.

Rotatoria of New Guinea.†—Dr. Daday has examined some spirit-material collected by Dr. L. Biró in New Guinea, and found therein 47 species of Rotifers, ten of which are described as new, with his usual disregard of already known forms. At least three of the new species are "old friends," while four or five more are quite unrecognisable and therefore "dead," leaving only two that can properly be called new. The alleged new species are the following:—*Asplanchna papuana* (described from the jaws only, which may very well be those of *A. myrmeleo*), *Megalotrocha binotata* (= *M. semibullata* Thorpe), *Diplax ornata* (= *Distyla ludwigii* Eckstein), *Brachionus papuanus* (= var.

* Biol Centralbl., v. (1898) pp. 173–83.
† Mathem. Termész. Ertesitö. Budapest, 1897, pp. 131–48 (9 figs.).

of *Br. angularis*), *Diplois sculpturata* (?), *Monostyla incisa* (?), *Monostyla bicornis* (?), *Monostyla pygmæa* (?), *Brachionus mirabilis*, *Diarthra monostyla* (g. et sp. n.).

Danish Rotifera.*—Dr. Wesenberg-Lund has a preliminary report on free-swimming rotifers, of which he has observed 175 species in the neighbourhood of Copenhagen. He has also studied in particular the males and the modes of reproduction in their natural condition, as contrasted with artificial cultivations, and found that a period of increased parthenogenetic activity always precedes the appearance of the males and the production of fertilised resting eggs. The sexual period varies in different species, but the majority in Denmark appear to have it in September to October; the temperature of the water has no influence in this respect. Contrary to the accepted belief, the author found some rotifers, such as *Brachionus pala* and *angularis*, bearing male and female eggs at the same time. The resting eggs are the fertilised eggs, but the author has observed also sexual periods when no resting eggs were produced, although males were abundant.

Nematohelminthes.

Life-History of Gordius.†—Dr. von Linstow showed some time ago that in the same pool one may find the embryonic stages of *Gordius tolosanus* Duj. encapsuled in larvæ of *Sialis lutaria* and *Cloëon dipterum*, the larval stages in the aquatic beetle *Pterostichus niger*, and the sexual adults free in the water. In the present paper he gives a list of eighteen insects in which the larvæ of *G. tolosanus* occur. He also gives a list of over a dozen which he has shown to be hosts of the larvæ of *Gordius aquaticus* L.; the embryos occur in larval lampreys, and probably in small fishes. It is difficult to understand how certain of the insects (grasshoppers, *Carabus*, *Procrustes*, &c.) which are not aquatic, become infected, or how the larvæ get from them into the water. When the host is *Dytiscus marginalis*, the problem is less obscure. In the same paper the eminent parasitologist discusses *Oxyuris biuncinata* from larval lampreys, *Ascaris Myxines* from the hag, *Spiroptera mugientis* from *Rana mugiens*, and *Cercaria ericetorum* from *Xerophilus ericetorum*,—all new species. In an appendix he takes note of Camerano's recent monograph on Gordiidæ. ‡

Nematodes from Madagascar.§—Dr. von Linstow describes new species of *Ascaris*, *Physaloptera*, *Heterakis*, *Filaria*, *Spiroptera*, *Oxyuris*, *Gordius*, *Mermis*, and *Echinorhynchus* from Madagascar animals, extending the familiar observation that each species has its particular parasites.

Platyhelminthes.

Turbellaria of Concarneau.‖—Dr. O. Fuhrmann found 29 species of Turbellaria in the Bay of Concarneau, and of these five are new, viz. *Plagiostoma Fabrei*, the largest representative of the genus, *Pl. violaceum*, *Monoophorum durum*, *Macrorhynchus cœruleus*, and *Microstoma lucidum*.

* Zool. Anzeig., xxi. (1898) pp. 200–11.
† Arch. Mikr. Anat., li. (1898) pp. 747–64 (1 pl.).
‡ Mem. R. Accad. Torino, xlvii. (1897) pp. 339–419 (3 pls.).
§ Arch. Naturgesch., lxiii. (1897) pp. 27–34 (2 pls.).
‖ Zool. Anzeig., xxi. (1898) pp. 252–6.

Larval Trematodes in Gastropod Hosts.* — Sig. P. Sonsino describes seven different forms of Cercaria-larvæ found in 12 freshwater Gastropods, such as species of *Limnæa* and *Planorbis*, but he has not been able to connect them with adult forms.

Helminthological Notes.†—Sig. P. Sonsino has notes on *Distomum felineum* and *D. truncatum* from the dog, a Cysticercoid from *Ascalobotes mauritanica*, *Eustrongylus gigas* from the dog, *Syngamus trachealis*, and some other parasites.

Trematode Parasites of Fishes.‡—Dr. E. Linton describes from his own collection, and from the United States National Museum, 32 Trematodes from fishes. The account deals with species of *Nitzchia*, *Tristomum*, *Octoplectanum*, *Diplostomum*, *Monostomum*, and *Distomum*, the last forming the great majority.

Minute Structure of Genital Organs in Triænophorus.§—Herr H. Sabussow has used Golgi's chrome-silver method and the intra-vitam methylen-blue method in studying these organs. The present communication deals with some histological details, of which the most interesting is the occurrence on the cirrus pouch and vagina of what seem to be the much branched terminations of motor nerve-cells.

Cestodes of Fishes.‖—Dr. E. Linton has a series of notes on 45 species of Cestodes from fishes collected at Woods Holl and in the United States National Museum. Seven are new.

Parasites of Birds.¶—Prof. H. B. Ward gives a general popular account of parasitic worms found in domesticated birds. It is known that the turkey has 14 different parasites, the duck 32, the chicken 43; but, as the author points out, there are doubtless many more to be found. His paper is a useful one for poultry-keepers to begin with.

Tapeworms of Ducks.**—Mr. T. B. Rosseter has demonstrated by experimental infection of ducks the development of *Dicranotænia coronula*, *Drepanidotænia gracilis*, and *Dr. tenuirostris* from their cysticercoid stages.

Musculature of Dibothria.††—Dr. M. Lühe has followed up his study of the musculature in Tæniadæ by an investigation of the same system in *Dibothrium* and the like. The detailed results are beyond our scope, but it may be noticed that Lühe corroborates his previous conclusion that the entire musculature of Cestodes is referable to two systems of longitudinal and transverse muscles, effecting contraction and elongation of the tapeworm body. The transverse muscles include those termed sagittal and transversal, and the subcuticular transverse fibres.

* Atti Soc. Toscana Sci. Nat., x. (1897) pp. 249–53.
† Tom. cit., pp. 253–9.
‡ Proc. U.S. Nat. Mus., xx. (1898) pp. 507–48 (15 pls.).
§ Biol. Centralbl., xviii. (1898) pp. 183–8 (5 figs.).
‖ Proc. U.S. Nat. Mus., xx. (1897) pp. 423–56 (8 pls.).
¶ Stud. Zool. Lab. Univ. Nebraska, No. 22 (1898), 18 pp., 5 figs.
** Journ. Quekett Micr. Club, vi. (1897) pp. 397–405 (1 pl.).
†† Centralbl. Bakt. u. Par., xxii. (1897) pp. 739–47 (2 figs.).

Gonads of Tænia polymorpha.*—Herr K. Wolffhügel finds that in this tapeworm the testes, *vas deferens*, and cirrus-apparatus, are paired, the last-named being peripheral; that the female organs and uterus are simple; that the vagina is blind; and that the cirrus perforates the cuticle, penetrating into the parenchyma. These peculiarities will probably necessitate the establishment of a new genus.

Helminthological Notes.†—Dr. A. Mueller has notes on 24 parasitic worms,—including *Ancyracanthus bihamatus* sp. n. from the stomach of *Sterna risoria*, *Echinostoma tabulatum* sp. n. from the intestine of *Numenius arquatus*, and *Tænia triangularis* sp. n. from the intestine of *Scolopax galinula*.

Echinoderma.

Fertilisation and Cleavage of Echinoid Ovum.‡—The late Prof. R. von Erlanger had made this the subject of one of his last researches. Both directive spindles have centrosomes, but the pole body of the inner pole of the second directive spindle disappears. The pole-bodies of the first directive spindle originate by the division of the middle portion of the spermatozoon; and they divide again shortly before the formation of the daughter nuclei. The centroplasms or spheres are not, as Boveri alleged, much swollen central corpuscles. After the formation of the equatorial plate, the central corpuscles lie within the aggregate of vesicles, which occupy the central portion of the centroplasm. In regard to the mechanism of mitosis, the author argues against Heidenhain's theory of centered radii.

Mediterranean Species of Synapta.§—Prof. H. Ludwig discusses the different forms found at Naples and elsewhere in the Mediterranean. There are four securely established species,—*Synapta inhærens* O. F. Müller, *S. macrankyra* sp. n., *S. digitata* Montagu, and *S. Thomsoni* Herapath.

Growth-Changes in Integumentary Skeleton of Holothurians.‖—Herr Hjalmar Östergren recalls the old observations of Baur (1864), that the young of *Synapta inhærens* and *S. digitata* differ from the adults as to their calcareous bodies. Semper, Hérouard, Ludwig, Mitsukuri, and the author, have made similar observations. The present communication makes it probable that the organism distinguished as *Holothuria aphanes* is the young stage of *H. impatiens* Forsk.

Cœlentera.

Experiments on Hydra.¶—Herr H. Peebles shows that there are limits to the regenerative powers of *Hydra*. The smallest parts of *H. viridis* which regenerate a hypostome and a tentacle measure 1/6 mm. in diameter. Tentacles do not grow into polyps, even if united in groups; but if an excised tentacle has with it a small fragment of hypostome, it can regenerate a perfect hypostome and several tentacles. Similarly, a complete polyp may be regenerated from tentacles plus a portion of

* Zool. Anzeig., xxi. (1898) pp. 211–3.
† Arch. Naturges., lxiii. (1897) pp. 1–26 (3 pls.).
‡ Biol. Centralbl., xviii. (1898) pp. 1–11 (12 figs.).
§ Zool. Anzeig., xxi. (1898) pp. 1–9. ‖ Tom. cit., pp. 233–7 (4 figs.).
¶ Arch. Entwickmech., v. (1897) pp. 794–819 (34 figs.).

hypostome and a portion of the body. Fragments from isolated buds form new polyps more rapidly than do larger pieces from a full-grown animal.

Classification of Siphonophora.*—Dr. K. C. Schneider concludes a long paper on the Siphonophora, which is mainly of systematic interest. He defines the order as follows:—Free-swimming colonies of hydropolyps, with regularly arranged components, both medusoid (swimming-bells, pneumatophore, and gonophores) and polypoid (covering pieces, adhesive threads, and polyps). There are four suborders:—(1) Calycophoræ, without pneumatophore, including Prayidæ and Diphyidæ; (2) Physophoræ, with pneumatophore and swimming-bells, including Apolemidæ, Agalmidæ, &c.; (3) Cystonectæ, with unchambered pneumatophore and no swimming-bells, including *Physalia*, *Rhizophysa*, &c.; (4) Chondrophoræ, with chambered pneumatophore and no swimming-bells or main stem, *Velella* and *Porpita*.

Regenerative Phenomena in Tubularia.†—Herr Hans Driesch finds that a "reparatory zone," marked by a red substance, appears at a certain distance from the wound-surface, and forms a new *Anlage*, from which reparation proceeds. Decapitated polyps partially split longitudinally may form two complete hydranths. The reparation is quicker the second time. Oral reparation retards simultaneous aboral reparation. There is no proximal regeneration, i. e. tentacles do not regenerate hydranth, nor hydranth cœnosarc.

Driesch distinguishes somewhat subtly between different modes of regeneration, for which it is difficult to find English equivalents. A general result of interest is the absence of abnormalities; even when the usual reparatory process is disturbed the final result is normal.

New Hydroids.‡—Kristine Bonnevie discusses the classification of Hydroids, and describes numerous new forms collected by the Norwegian North Sea Expedition:—four new species of *Tubularia*, a new genus *Lampra* with three species, a new genus *Gymnogonos*, two new species of *Eudendrium*, four of *Hydractinia*, four of *Myriothela*, and two of *Coryne*.

Porifera.

Spicules of Clathrinidæ.§—Mr. E. A. Minchin, in the first instalment of "Materials for a Monograph of the Ascons," deals with the origin and growth of the triradiate and quadriradiate spicules in the family Clathrinidæ. In an introductory account of the structure of *Clathrina*, he recognises, apart from the sex-cells, two constituent layers in the sponge body, besides a class of cell-elements which seem, properly speaking, to belong to neither layer. Thus he describes:—

(1) The gastral layer, consisting of the collar-cells lining the interior.

(2) The dermal layer, consisting of (*a*) the external neuro-muscular

* Zool. Anzeig., xxi. (1898) pp. 185–200.

† Arch. Entwickmech., v. (1897) pp. 389–418 (14 figs.). See Zool. Centralbl., v. (1898) pp. 10–12.

‡ Zeitschr. wiss. Zool., lxiii. (1898) pp. 465–95 (3 pls. and 1 fig.).

§ Quart. Journ. Micr. Sci., xl. (1898) pp. 469–587 (5 pls. and 3 figs.), flat epithelium; (*b*) the internal connective-tissue layer with the spicules and their formative cells; and (*c*) the porocytes scattered about more or less evenly in the wall.

(3) The amœbocytes or amœboid wandering cells met with in all parts of the sponge.

The classification adopted is:—

Class Calcarea. Sub-class Homocœla. Order Ascones.
(1) Family Clathrinidæ. Genera *Clathrina* and *Ascandra*.
(2) Family Leucosoleniidæ. Genera *Leucosolenia* and (?) *Ascyssa*.

With regard to the origin of the triradiate systems, Minchin recognises a scheme of development common to all, with a number of constant and definite stages, as follows:—

(1) Formation of "trios" by immigration of cells from the flattened epithelium.

(2) From the trios arise the "sextets" by division of each cell into two.

(3) The spicule appears with each of its rays corresponding to two sister-cells of the sextet, i.e. to two cells which have arisen from the division of one of the cells of the trio.

(4) As the rays increase in length, the inner formative cells of the sextet remain at the apices, the outer formative cell at the bases, of the rays.

(5) Disappearance of the apical formative cells.

(6) The basal formative cells, after building up the rays to their full thickness at their bases, migrate slowly to the extreme tips of the rays, where they remain adherent as the definitive spicule-cell.

The fourth or gastral ray is an adventitious element superadded to the triradiate system, and secreted by a mother-cell which is derived from a porocyte. The nucleus of the secreting cell may remain single, or may divide into two or into four nuclei; but in all cases the cell itself remains undivided, forming a plasmodium-like investment to the spicule, or at least to its terminal portion.

In the theoretical part of his paper, Minchin discusses the origin and evolution of calcareous sponge spicules. Four theories are reviewed:—the Biocrystallisation theory of Haeckel, the Adaptation theory of Schulze, the Mechanical theory of Sollas, and the Alveolar theory of Dreyer. It is to Schulze's view that Minchin inclines, namely, that the fundamental forms of the spicules are to be explained by adaptation to the primitive types of structure in sponges.

He sums up as follows:—

The first appearance of a calcareous spicule, both ancestrally and in development, was probably in a minute vacuole in a dermal cell, filled with an organic substance in which the minute sclerite appeared as a crystal or concretion. It assumed a non-crystalline form in adaptation to its secondary function of support, and the contents of the vacuole formed the spicule sheath. The ancestral form in Calcarea was a simple monaxon, placed tangentially, and completely imbedded in the body-wall, lying between two adjacent pores.

From this ancestral form others arose:—(*a*) the primitive monaxon acquired a distal portion projecting from the surface; (*b*) groups of three united to form a single triradiate system; (*c*) to some of these a fourth ray was added; (*d*) some of the triradiate systems became secondary monaxons.

In *Leucosolenia* all the dermal cells may form monaxon sclerites, and this is the more primitive condition; in *Clathrina*, however, the skeletogenous cells migrate from the dermal epithelium inwards, and form a connective tissue layer.

The forms of the spicules are the result of adaptation to the requirements of the sponge as a whole, produced by the action of natural selection upon variation in every direction.

Fibres of Reniera.*—Dr. G. Loisel has studied the fibres of *Reniera*, (*a*) in the living sponge, (*b*) after use of Congo red, and (*c*) with the usual reagents. He worked with *R. ingalli* and *R. elegans*.

The substance composing the fibres reacts like spongin, but this is a wide word. The material appears inside spherular spongoblasts, which are in some regions isolated, in others grouped irregularly or in a necklace-like row. In the centre of each cell, beside the nucleus, a small refractive sphere is seen; this grows into a little rod; adjacent rods touch and fuse, being cemented by a plasmic substance. The spongoblasts elongate and fuse, and are then disintegrated, their nuclei being left in the semi-fluid surrounding substance. Thus the whole process is essentially very simple, and is all the more instructive as a subject of study that it continues throughout the life of the sponge.

Parenchyma-Spicules of Spongillidæ.†—Herr Fr. Petr concludes that the scattered parenchyma-spicules, as opposed to the united skeletal spicules, are important only in relation to the gemmules. They form an accessory skeleton to the gemmules, and lie on the surface of the chitinous membranes. The author describes them as migrating and grouping themselves around the young gemmules, accessory to the amphidiscs, &c.

Zanzibar Sponges.‡—Prof. R. von Lendenfeld describes about a dozen new species from Zanzibar, including two new genera *Strongylacidon* in the family Esperellidæ, and *Axinyssa* in the family Axinellidæ.

Protozoa.

Amœbæ from a Medical Point of View.§—Dr. R. Behla has written a little book on Amœbæ, especially in connection with diseases, such as dysentery.

Myxosporidia in Coregonus.‖—Herr F. Zschokke has studied these parasites, which occur in the connective tissue of the musculature in *Coregonus*, and have been referred by Gurley to three different species. To Zschokke they all seem the same, and he proposes the new name *M. bicaudatus* to supersede the older titles. The species is characterised by the unusually large size of the cysts and the length of the double tail process on the spores.

* Journ. Anat. Physiol., xxxiv. (1898) pp. 1–43 (1 pl. and 7 figs.).
† Zool. Anzeig., xxi. (1898) pp. 226–7.
‡ Abh. Senckenberg. Nat. Gesell., xxi. (1897) pp. 93–133 (2 pls.).
§ 'Die Amöben, insbesondere von parasitären und culturellen Standpunkt,' Berlin, 1898, 73 pp., 1 pl.
‖ Zool. Anzeig., xxi. (1898) pp. 213–4.

Coccidia of Passeres.*—Herr Nils Sjöbring discusses the occurrence of Coccidia in birds, to which comparatively little attention has been directed. He describes in particular *Isospora passerum* nov. nom., and has further notes on the disease in pheasants caused by *Coccidium oviforme*, and the presence of Flagellate parasites like *Trypanosoma* in the blood of many Passerine birds.

Presence of Protozoa in the Blood and Organs of Leukhæmic Persons.†—Prof. M. Löwit has observed, in the blood drawn from the finger of cases of mixed leukhæmia, appearances indicative of the presence of Protozoa. The parasites, though chiefly affecting leucocytes, in which their growth and development take place, are also found free in the blood. The parasites belong to the Sporozoa; but whether they deserve the title of *Hæmamœba leukhæmiæ* is not at present certain.

In some of the cases a resting encysted form was found in the blood and tissues after death. The parasite was not discovered in cases of pure lymphatic leukhæmia. The author's present communication is curt and preliminary.

Pathogenic Protozoa of Foot and Mouth Disease.‡—Dr. G. P. Piana and Dr. A. Fiorentini describe a pathogenic protozoon, *Protamœba aphthogenes*, which is constantly present in cases of epizootic aphthæ.

The microbe may present itself as a hyaline or finely granular body with or without vacuoles or a nucleus. Sometimes the body shows a double contour; at other times it is seen to contain corpuscles. The bacteria present in the exudation of the vesicles are not killed by heating for 15 minutes at a temperature of 50–52°, while the aphthous virus loses its activity. As a nucleus is not constantly present, this organism is classed with Monera. Like the primitive Protamœbæ, they progress by lobate extension rather than by pseudopodia, and multiply, like *Protomyxa aurantiaca*, by endogenous spores.

Amœboid Bodies in the Blood of Vaccinated Monkeys and Children and in the Blood of cases of Variola.§—Dr. W. Reed claims that he has confirmed Pfeiffer's observation that small granular amœboid bodies are present in the blood of vaccinated children and calves, and in the blood from cases of variola during the stage of fever. Granular amœboid bodies having a diameter of about one-third that of a red corpuscle are present also in the blood of the monkey during the active stage of vaccinia, and disappear with the decline of the local inflammation. A body of like appearance, granulation, and size, may occasionally be found in the normal blood of monkeys and children. Pale amœboid bodies containing a few dark pigment-like granules are present in the blood from cases of variola, and in the blood of the variolated monkey. Bodies of like appearance may occasionally be found in the blood of vaccinated children and monkeys.

* Centralbl. Bakt. u. Par., xxii. (1897) pp. 675–84 (8 figs.).
† Op. cit., 1te Abt., xxiii. (1898) p. 206. ‡ Tom. cit., pp. 323–8 (1 pl.).
§ Journ. Expér. Méd., ii. (1897) pp. 515–27 (2 pls.).

BOTANY.

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

a. Anatomy.

(1) Cell-structure and Protoplasm.

Blepharoplasts and Centrosomes.*—Mr. H. J. Webber discusses the relationship of these bodies to one another.

Blepharoplasts are special organs of the spermatic cells of *Zamia*, *Salisburia*, and some Filicineæ and Equisetaceæ, which, in certain stages of their development, resemble centrosomes. Two are formed in each generative cell, arising *de novo* in the cytoplasm on opposite sides of the nucleus, and about midway between the nuclear membrane and the cell-wall. The division of the generative cell results in the formation of two antherozoids, one blepharoplast being located in each antherozoid cell. During this division the blepharoplasts burst, and the outer membrane becomes gradually distended into a narrow helicoid spiral band, from which the motile cilia of the antherozoid are developed.

The blepharoplasts resemble typical centrosomes:—(1) in position, being located on opposite sides of the nucleus; (2) in having the kinoplastic filaments focused upon them during the prophases of the division of the generative cell. They differ from typical centrosomes:—(1) in arising *de novo* in the cytoplasm; (2) in growing to comparatively enormous size; (3) in not forming the centre of an aster at the pole of the spindle during mitosis; (4) in having a differentiated external membrane and contents; (5) in bursting, and growing into a greatly extended cilia-bearing band, the formation of which is evidently their primary function; (6) in their non-continuity from cell to cell.

New Organs of the Plant-Cell.†—In the superficial layers of the cytoplasm of some Saprolegniaceæ and Florideæ, Mr. W. T. Swingle finds abundantly bodies to which he gives the name *vibrioids*. They are slender cylindrical sharply defined bodies, exhibiting rather slow bending or undulatory motions in addition to movements which are probably due to the cytoplasm. When stained, they are sharply differentiated from the surrounding cytoplasm. They occur constantly in plants in all stages of development.

Another new organ or organoid was found at one end of the nucleus of the oosphere of *Albugo candidus*. It was a nearly spherical body, but often a little flattened on the side towards the nucleus. It seems to be more or less granular in structure, and appears before delimitation of the oosphere within the oogone, disappearing after fusion of the male and female nuclei.

Cytology of the Growing Point.‡—Dr. B. Němec records certain cytological phenomena which he has observed in the growing point of

* Bot. Gazette, xxv. (1898) pp. 109–10. Cf. this Journal, *ante*, p. 99.
† Tom. cit., pp. 110–1.
‡ SB. K. Böhm. Gesell. Wiss., 1897, No. xxxiii. (26 pp. and 1 pl.). (Bohemian with German abstract.)

several plants, especially of *Allium Cepa*, *Hemerocallis fulva*, and *Roripa amphibia*.

In the loose knot stage, a sharply defined hyaline sphere is formed round the nucleus, growing independently, and elongating, without any connection of this structure with the cytoplasm being perceptible. While the nucleus still retains its membrane, the fibres of the central spindle develop in the interior of this hyaline structure in a meridional direction from the poles; the nucleole disappearing synchronously with the development of these spindle-fibres, and the membrane of the hyaline structure also disappearing soon after the chromosomes have begun to assume their equatorial position.

Extranuclear nucleoles exhibit great variability in numbers and position during karyokinesis. They are frequently found in close contact with the newly formed cell-wall, where they have apparently been differentiated out of the unused material of the combining fibres.

The number of chromosomes is constant in the embryonal tissue (in *Allium Cepa* 12), becoming reduced in older tissues (in *Allium Cepa* 4). In pathologically abnormal cells the number is much larger. Fragmentation of the nucleus was observed in the cells which become differentiated into tracheæ.

Fusiform Proteid Substances in the Balsamineæ.*—Sig. G. Amadei has studied the peculiar proteid substances of a fusiform shape which are widely distributed through the genus *Impatiens*, though apparently not extending to all the species. According to the classification of Zimmermann, they belong to the class of proteids which occur in the cytoplasm or cell-sap. They are always found in the ovary from the period of flowering till maturity; in *I. Balsamina* and *Sultani* they occur in the epiderm of the outer wall of the capsule; in *I. parviflora* and *glanduligera* in the swelling tissues, but not in the epiderm. They occur further in the groups of cells which accompany the sieve-portion of the conducting bundles, but never in the root nor in the lower portion of the stem which is destitute of leaves. These structures vary in form with the age of the cell, apparently from the action of the acid constituent of the cell-sap; in older tissues the originally crescent-shaped bodies frequently become circular, apparently from further curvature and the joining of the two ends. From the frequent occurrence of these structures in organs containing chlorophyll and in the neighbourhood of the sieve-portion of the conducting bundles, and from their sudden disappearance in the stamens at the time of the ripening of the pollen, the author infers that they must play an important part in metabolism.

Archespore and Nucleus of Bignonia.†—According to Mr. B. M. Duggar, the mature archespore of the microsporange occupies a single boot-shaped layer. The primitive archespore is differentiated by periclinal divisions in certain regions of the outer layer of periblem. The tapete on the outer side is cut off by the next periclinal division of the hypodermal layer. The definitive archespore is formed by not more than a single division in some or all of the primitive archespore cells. The archespore of the megasporange apparently develops no primary

* Bot. Centralbl., lxxiii. (1898) pp. 1–9, 33–42 (2 pls.).
† Bot. Gazette, xxv. (1898) p. 111.

tapete, dividing simultaneously from the 2-celled stage, the 3rd or 4th cell becoming the definitive embryo-sac mother-cell. The nucleus of the archespore is peculiar in its large nucleolar-like structures.

Chromosomes in the Development of the Pollen-grains of Allium.*—In opposition to the statement of Ishikawa, Mr. D. M. Mottier states that there is no reduction in the number of chromosomes in the division of the archespore cells in *Allium Cepa*; the division is not effected in the heterotypic method. The reduction takes place only in the first division of the pollen-mother-cells themselves. This is the case in all the genera of Liliaceæ examined.

Protoplasmic Sac.†—Prof. R. Chodat states that, contrary to the general assertion, when a vegetable cell is plasmolysed, the protoplasmic sac does not become at once detached from the cell-wall, but always remains for a time attached to it by threads of hyaloplasm, often of great delicacy and in enormous numbers. This phenomenon has been observed not only in the parenchyme of Phanerogams, but in the prothallium and in the parenchyme of the leaf of Ferns, in Characeæ, the leaves of Musci and Hepaticæ, and in Saprolegniaceæ, *Vaucheria*, Conjugatæ, Chætophoraceæ, and Œdogoniaceæ. In many hairs these threads radiate in all directions, and not merely towards the base of the hair. The author regards this phenomenon as establishing the close connection which exists between the cell-wall and the protoplasm contained in it.

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

Cell-wall Mucilage.‡—Herr O. Rosenberg describes the mucilage-tissue in the seed of *Magonia glabrata* (Sapindaceæ), which differs but little from that in the leaf. In the ripe seed it exhibits pectin reactions, but still contains a little cellulose. It appears to serve the function of a storehouse of water for the use of the embryo.

Wax as an Excretion within the Cell.§—Prof. M. Möbius describes an instance of this in the case of a species of *Rhus*. In the ripe fruit of this plant, the wax-cells form a layer in contact with the resin-passages. In these parenchymatous cells the wax forms a thick incrustation on the cell-wall within the cell. The wax is probably a product of the transformation of starch. The wax-cells contain a granular protoplasm and a nucleus, but no or very little starch.

(3) Structure of Tissues.

Formation of Cork-Tissue in the Roots of the Rosaceæ.‖—According to Dr. Martha Bunting, there are intercellular spaces between the cork-cells in the root of all herbaceous and shrubby species of Rosaceæ examined; but they are absent from the arborescent species. There is an alternation of a flattened, usually pigmented, layer of cells with 1–3 layers of rounded cells in each annual ring. Protoplasm, nuclei, and starch-grains exist in cork-zones 4–5 layers removed outside the phellogen.

* Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 474–5. Cf. this Journal, 1897, p. 555.
† Arch. Sci. Phys. et Nat., v. (1898) pp. 96–9.
‡ Bih. k. Svenska vetensk. Akad. Handl., xxiii. (18 pp. and 1 pl.). See Bot. Centralbl., 1897 (1898), Beih., p. 345.
§ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 435–41.
‖ Bot. Gazette, xxv. (1897) pp. 117–8.

Internal Phloem in Gelsemium sempervirens.* — Miss Caroline Thompson states that the internal phloem in this plant originates as four longitudinal tracts in the primary meristem, and steadily increases until, by the eighth or tenth year, it has entirely destroyed the pith. In the petiole a bicollateral bundle arrangement exists at the base; but this quickly changes to the ordinary collateral relation by the passage of the internal phloem through the xylem. Each bundle, in passing out into the petiole, subdivides into three parts, two of which remain in the stem and soon come together again, while the third passes out through the xylem. From the second year onward, the internal phloem patches of the stem show areas of crushed and obliterated tissue where the previously formed phloem had been pushed inwards by the younger elements. In older stems eight large phloem patches, formed by division of the original four, entirely fill up the pith area.

Anatomy of the Hippomaneæ.†—Herr H. Herbert describes in detail the anatomy of the stem and leaf of this tribe of the Euphorbiaceæ. The most widely distributed secreting elements are unseptated latex-tubes; septated latex-tubes occur only in *Manihot*. The stomatal apparatus is greatly developed, there being almost always subsidiary cells as well as guard-cells. Stinging hairs occur in *Jatropha urens*.

(4) Structure of Organs.

Biology and Morphology of Pollen.‡—Prof. A. Hansgirg sums up his observations on various points connected with the emission of pollen-tubes, the protection of pollen-grains from rain, and the length of time during which the grains may remain functional. The variations depend on the vital conditions of the species rather than on any genetic relationship. The characters in the points named, and in the concealment or exposure of the sexual organs, are noted, from the author's personal observations, in the case of a very large number of species belonging to all the more important natural orders; and the following classification is propounded, dependent on these characters:—(A) Plants whose pollen is resistant to moisture, and germinates in pure water. (*a*) Species in which the sexual organs are more or less protected against rain, &c.; (*b*) Species in which the sexual organs are only slightly or not at all protected against atmospheric precipitation. (B) Plants whose pollen is not resistant to moisture, and does not germinate, or only very imperfectly, in pure water; (*a*) Species in which the sexual organs are completely or partially protected against rain, &c.; (*b*) Species in which the sexual organs are only slightly or not at all protected against rain, usually completely exposed.

Capsular Fruits.§—Herr A. Weberbauer gives an exhaustive treatise on the anatomy and physiology of capsular fruits, which he classifies under three groups, viz.:—(A) Capsules splitting by longitudinal fissures,

* Bot. Gazette, xxv. (1898) p. 118.

† 'Anat. Unters. v. Blatt u. Axe d. Hippomaneen,' 62 pp., München, 1897. See Bot. Centralbl., lxxiii. (1898) p. 49.

‡ SB. K. Böhm. Gesell. Wiss., 1897, No. xxiii. (76 pp.). Cf. this Journal, 1897, p. 310.

§ Bot. Centralbl., lxxiii. (1898) pp. 54–9, 97–104, 135–42, 161–8, 193–202, 250–7, 296–302 (2 pls.).

which includes by far the greater number; in these the teeth or valves exhibit a variety of imbibition or hygroscopic curvatures, according to the amount of water they absorb. The mechanical elements may occur in one only or in several layers of cells. (B) Capsules splitting by a transverse fissure (pyxis). (C) Fruits which do not split or are irregularly ruptured.

The variations of structure are then pointed out within each natural order; in some cases a special anatomical character runs through a whole group. A very large number of species are specially described as far as the capsule is concerned.

The physiological bearings of the different types of structure of capsular fruits are briefly discussed. The imbibition curvatures of the walls of the capsule are connected with the dissemination and with the protection of the seeds.

Fruit of Amphicarpæa.* — Dr. Adeline Schively finds that the minute cleistogamic flowers of *Amphicarpæa monoica*, when buried, produce one-seeded nuts with soft fruits and seed-coats; while the purple flowers, if buried in the bud state while still attached to the plant, produce perfect underground nuts instead of 3–4-seeded indurated pods.

Fibrovascular Bundles of Leaves.†—Pursuing his investigations on the number and symmetry of the fibrovascular bundles of the petiole, M. A. Chatin states that in Monochlamydeæ a single bundle is found, as a rule, only in the woody species. An affinity is established between the Laurineæ and the Daphnaceæ; while the Euphorbiaceæ are shown to have no near affinity to the Malvaceæ. The Polygonaceæ, with their sheathing petioles, always multifascicular, correspond, in this sign of degradation, with the Ranunculaceæ among the hypogynous Dialypetalæ, and the Umbelliferæ among the perigynous Dialypetalæ. There is no corresponding structure in the highest class, the Corollifloræ.

Size of the Leaves of Conifers.‡—Following out his studies on this subject, Herr R. Meissner states that in *Pinus* there is an alternate increase and decrease in the length of the leaves in successive years. In other genera the solitary leaves, whether on primary or secondary branches, exhibit the same phenomenon. An increase in thickness (especially in the sieve-portion), but not in length, takes place in those leaves whose activity extends over several years.

Adventitious Buds on Leaves of Drosera.§—Mr. A. J. Grout records an example of this phenomenon in the case of *Drosera rotundifolia*, several leaves bearing from two to ten young plants on their upper surface.

Propagating Roots in Ipomæa.‖—Mr. G. L. Clothier states that *Ipomæa leptophylla* produces propagating roots which originate from various points, most abundantly from the lower part of the vertical fleshy root. They pass out horizontally for a short distance, then rise

* Bot. Gazette, xxv. (1898) p. 117. Contrib. Bot. Lab. Univ. Pennsylvania, i. (1897) pp. 270–363 (18 pls.).

† Comptes Rendus, cxxvi. (1898) pp. 700–6. Cf. this Journal, *ante*, p. 210.

‡ Bot. Ztg., lv. (1897) 1te Abth., pp. 203–18. Cf. this Journal, 1894, p. 472.

§ Amer. Naturalist, xxiii. (1898) pp. 114–5 (1 fig.).

‖ Bot. Gazette, xxv. (1898) pp. 52–3 (1 fig.).

to near the surface of the ground several feet from the mother-plant. Here they produce adventitious buds, and a number of young plants may originate from a single propagating root.

Structure of Conopholis americana.*—Dr. Lucy L. W. Wilson has made an exhaustive study of this parasite, belonging to the Orobancheæ, found only on the oak. The extreme degradation of the parasite, and the intimate relation between it and the root of the host, are comparable rather to the parasitism of the Balanophoraceæ and Rafflesiaceæ than to that of the parasitic Scrophulariaceæ. The seedling parasite grows steadily for 10 or 12 years after it attacks the oak-root, until a huge mass 6 in. in diameter is formed. This mass is characterised chiefly by the abundance of sclerenchyme patches, developed by the host through the irritant action of the parasite. Stomates occur on the stem but not on the scale-leaves. The double circle of bundles traversing the flowering stem is peculiar in their xylem-portions facing one another.

β. Physiology.

(1) Reproduction and Embryology.

New Case of Basigamy.†—M. P. van Tieghem calls attention to the phenomena of fecundation in *Zamia*, as described by Webber,‡ which furnish a fresh example of basigamy, i.e. of the reversal of the poles in the male prothallium.

When the pollen-grain germinates at the summit of the nucellus in the pollen-chamber, the large apical cell elongates at first into a tube which enters the nucellus, but soon deviates laterally, and continues to grow at a tangent to the side of the nucellus at a short distance from the surface; not only does it not approach the archegones, but it gradually increases its distance from them. The tube then ceases to grow, but its basal extremity, to which the extine of the pollen-grain still adheres, and which encloses a stalked antherid, curves towards the base, enters the nucellus vertically, and descends in it to a short distance from the neck of the archegone. It then bursts, in order to set at liberty its two antherozoids, one of which penetrates into the oosphere and produces the ovum.

Embryology of Ranunculus.§—Prof. J. M. Coulter reports the results of a series of observations on the origin and structure of the embryo-sac in several American species of *Ranunculus* (*R. septentrionalis*, *multifidus*, and *abortivus*). Among the more important are the following.

In the young microsporange a plate of hypodermal cells becomes distinctly differentiated by means of their enlarging radial diameter and prominent nuclei. This plate of cells the author regards as the archespore. In the development of the megasporanges (*R. septentrionalis*) a single hypodermal cell frequently represents the whole of the archespore, though in many cases the archespore is formed of a group of cells. In *R. multifidus* the strong development of the antipodal cells is a notable feature, as also the general insignificance of the nuclei of the egg-apparatus, the synergid nuclei being especially small.

* Bot. Gazette, xxv. (1898) pp. 115–6.
† Journ. de Bot. (Morot), xi. (1897) pp. 323–6 (1 fig.).
‡ Cf. this Journal, *ante*, p. 98.
§ Bot. Gazette, xxv. (1898) pp. 73–88 (4 pls.).

The pollen-tube, after its entrance into the embryo-sac, increases rapidly in diameter, in some cases forming a pouch-like tip. The definitive nucleus of the embryo-sac is remarkably large. There is evidence of the occasional commencement of the formation of endosperm before the fusion of the sexual elements, and even before the entrance of the pollen-tube into the embryo-sac.

Embryogeny of Rosaceæ and Calycanthaceæ.* — Dr. B. Longo points out a remarkable resemblance in the mode of formation of the embryo in these two orders. In all the Rosaceæ there are a number of equivalent embryo-sac mother-cells; these mother-cells divide tangentially, each giving rise to a series of daughter-cells, of which usually the innermost enlarge, and may be regarded as so many embryo-sacs. Of these embryo-sacs, however, never more than one arrives at a stage of differentiation at which impregnation can take place, the others being arrested in development. Precisely the same phenomenon was observed by the author in *Calycanthus occidentalis* and *Chimonanthus fragrans*. Although a plurality of embryo-sac mother-cells is not uncommon, the Rosaceæ and the Calycanthaceæ are the only orders at present known in which it is constant.

Embryo and Endosperm in the Parietales.†—Herr E. Pritzel discusses this subject at length, especially in connection with the cell-contents. Those of the endosperm belong to two types; it contains either (1) oil or protein-grains, or (2) starch; never both of these groups of substances. The chemical character of the endosperm is constant in large groups. The contents of the embryo, on the other hand, vary greatly; all three groups of reserve-substances, oil, protein, and starch, may be found in company. If there is starch in the endosperm, there is none in the embryo, while oil and protein-substances may occur in both. Starch is present in the embryo only when there is no endosperm. The author classifies the orders which make up the Parietales under five heads, viz.:—(1) Nutrient tissue copious; embryo few-celled, undifferentiated; (2) Nutrient tissue partially consumed before maturity; embryo somewhat larger; (3) Nutrient tissue partially consumed before maturity; embryo large, but undifferentiated; (4) Nutrient tissue partially consumed before maturity; embryo large, differentiated into leaf-like cotyledons and radicle; (5) Nutrient tissue completely consumed before maturity; embryo completely differentiated into cotyledons, plumule, and radicle.

Embryology of Naias and Zannichellia.‡—Prof. D. H. Campbell describes the origin and development of the sexual elements, the growth of the pollen-tube, and the mode of impregnation, in these genera.

In *Naias flexilis* the first division of the embryo is transverse, dividing it into a basal or suspensor cell, and a terminal or embryo cell. The suspensor cell then enlarges considerably, but remains undivided, and the whole of the embryo and the secondary suspensor cells are

* Atti R. Accad. Lincei, vii. (1898) pp. 51–2.

† Engler's Bot. Jahrb., xxiv. (1897) pp. 348–94. See Bot. Centralbl., lxxiii. (1898) p. 269.

‡ Proc. California Acad. Sci., 1897, pp. 1–62 (1 pl.). See Bot. Gazette, xxv. (1898) p. 65.

derived from the embryo cell, which first becomes divided transversely into a number of segments. The terminal segment of the row thus formed gives rise to the cotyledon, the second to the stem, and the third and fourth to the root. In *Zannichellia* the terminal segment divides vertically, one half becoming converted into the cotyledon, and the other half into the stem; the second, third, and fourth segments give rise to the root, and the fifth to the root-cap. In *Naias flexilis* the embryo has no trace of a root-cap. In both genera the endosperm is rudimentary. In the later stages of the embryo-sac of *N. flexilis* there is always present near the antipodal cells a large nucleus, which increases to an enormous size, but does not undergo division. The stamen of *N. flexilis* is surrounded by two envelopes, the inner of which is regarded by the author as the homologue of the ovular integument, and the outer one as corresponding to the carpel of the female flower.

Embryology of Potamogeton.* — Mr. K. M. Wiegand has studied the origin and development of the embryo-sac, fertilisation, and development of the embryo, in *Potamogeton parviflorus*. The embryo-sac arises, as is usual in Monocotyledons, from a hypodermal cell, after the cutting off of a tapetal cell. The egg-apparatus and antipodals are somewhat abnormal. The polar nucleus and the first and second synergids appear to have been cut off successively from the mother-nucleus of the oosphere. The synergids disappear almost immediately. The definitive nucleus cuts off a very large basal nucleus, as in *Sagittaria*, before endosperm formation proceeds in the upper part of the embryo-sac.

Embryo-sac of Hybrid Narcissi.†—According to Dr. A. Preda, in all the forms of hybrid *Narcissi* examined the nuclei of the synergids and that of the oosphere are erythrophilous; and the same is the case with the secondary nucleus. On the other hand the nuclei of the antipodals are strongly cyanophilous. It is, therefore, incorrect to speak of the nuclei of the embryo-sac as being always erythrophilous.

Theories of Heredity.‡—Mr. W. T. Swingle dissents from Weismann's theory of reduction of chromosomes. Arguing from the extreme polymorphism often displayed in the first generation of hybrids between races of cultivated plants, or between closely related species, he considers it necessary to assume, in some cases at least, a predetermination of the characters of the hybrid at the time of fusion of the male and female nuclei. The male and female chromosomes probably persist side by side unchanged in number, during the whole of the ontogeny of the hybrid, reduction not occurring until the close of the first generation.

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

Action of Organic Acids on Growth.§—Experiments made by Sig. G. Lopriore on the action of organic acids—citric, malic, tartaric, tannic—on the growth of pollen-tubes showed a uniformly favourable result, but a specific variation in the influence of different acids of the same

* Bot. Gazette, xxv. (1898) pp. 116-7.
† Arch. Sci. Phys. et Nat., iv. (1897) p. 590.
‡ Bot. Gazette, xxv. (1898) pp. 111-13.
§ Bot. Ztg., lv. (1897) 2te Abth., pp. 362-3.

concentration. With solutions of the acids varying between 1 : 50,000 and 1 : 60,000 a favourable influence on growth was exhibited.

Influence of the Röntgen Rays on Germination.*—From a series of observations made by MM. Maldiney and Thouvenin on *Convolvulus arvensis*, *Lepidium sativum*, and *Panicum miliaceum*, they conclude that the effect of the X-rays is to promote germination. The young plants, on first germinating, present the usual pale green colour, from which it is inferred that these rays have no influence on the formation of chlorophyll.

Germination of the Mistletoe.†—Herr J. Wiesner confirms the statement that the seeds of *Viscum album* require a six months' period of repose before germination, which cannot take place in the dark, even when other conditions are favourable. The seedlings are ombrophobous, while those of tropical species of *Viscum* are ombrophilous. The seeds of tropical species also need no period of repose. Light is not essential for the germination of the seeds of *Loranthus europæus*. The prevalent idea that the viscin-mucilage of the seeds of the mistletoe is essential for their germination is not founded on fact; they germinate even better when freed from it.

Transpiration of Halophytes.‡—Herr O. Rosenberg points out that many plants which grow in moist situations nevertheless present partially xerophilous characters. Employing Stahl's cobalt-test § for transpiration in the case of a number of marine plants, he states that the number of stomates is by no means always a certain measure of the amount of transpiration. Many halophytes have not by any means lost the power of closing their stomates. The upper surface of the leaf has frequently a distinctly higher intensity of transpiration than the under surface, a difference not to be explained by the distribution of the stomates. In certain cases, therefore, the intensity of transpiration is not determined by the number and size of the stomates.

Movement of the Sap in Plants.‖—Herr A. Mayer discusses the reversed current stated by Böhm to occur in sunflowers when decapitated, and believes that it is a result of the tearing of the tissues. He states that, while the cell-walls in the root are permeable for pure water, or for water containing a small amount of mineral salts in solution, they are not permeable for colloidal organic substances in solution.

(3) Irritability.

New Property of Geotropically Irritated Roots.¶—Herr F. Czapek claims to have discovered a change in the chemical reactions of cells when exposed to geotropic irritation. A substance which has the property of reducing an ammoniacal solution of silver nitrate is always present in the cells of the root, especially in those of the periblem. But

* Comptes Rendus, cxxvi. (1898) pp. 548–9. Rév. Gén. de Bot. (Bonnier), xii. (1898) pp. 81–6 (2 pls.).

† Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 503–16.

‡ Ofv. K. vetensk. Akad. Förhandl. Stockholm, 1897, pp. 531–49 (1 fig.) (German).

§ Cf. this Journal, 1895, p. 130.

‖ Forsch. a. d. Geb. d. Agriculturphysik, xx. See Bot. Centralbl., lxxiii. (1898) p. 47.

¶ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 516–20.

this reaction becomes stronger when the apex of the root has been geotropically irritated. This is accompanied by a reduction in the quantity of a substance which easily gives off oxygen, and which is also normally present in the apex of roots. These results were obtained from the radicle of *Vicia Faba*, *Lupinus albus*, *Pisum sativum*, *Zea Mays*, and *Cucurbita Pepo*, and the coleoptile of *Avena sativa*.

Aerotropism in a Saprolegniaceous Fungus.*—In a culture of *Dictyuchus monosporus*, Dr. L. Celakovsky observed a constant tendency of the germinating filaments to grow towards the margin of the cover-glass. Since the conditions prevented the possibility of this growth being due to either light or temperature, the author regards it as an undoubted instance of positive aerotropism. The oxygen appears also to produce a local branching on the side exposed to its action.

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

Formation of Albumen in Plants.†—Herr W. Zaleski discusses the question, with respect to which contrary assertions have been made, whether albuminoid substances can be formed in the plant in the dark. From a series of experiments on leaves (sunflower), he has come to the conclusion that the nitrates taken up into the leaves are there decomposed, and transformed into other nitrogenous compounds. This transformation is connected with the access of sugar, which renders possible the passage of nitrates into other compounds, probably of the nature of amides. These processes can take place in the dark.

Cellulose-Enzyme.‡—In addition to the examples already known, Dr. F. C. Newcombe records the extraction of an enzyme which digests cellulose from seedlings of the date-palm and of *Lupinus albus*, and from the mycele of *Aspergillus Oryzæ*. The author does not agree with the suggestion of Grüss that the cellulose-enzyme is identical with diastase. In all the above cases the enzyme also dissolves starch; but the specific intensity of action is not the same for starch as for cellulose. The *Aspergillus* ferment is the one which acts most rapidly on the cell-wall, the date ferment least rapidly.

Ammoniacal Fermentation due to Mucedineæ.§—According to M. O. Semal, certain simple Mucedineæ, such as *Penicillium*, *Aspergillus*, and *Fusarium*, cultivated in media containing organic compounds with the amidogenous radicle NH_2, are capable of producing ammoniacal fermentation. The doubling of the nitrogenous compounds takes place with the assistance of a soluble ferment secreted by different fungi. This soluble ferment possesses, in the cases examined, an individuality belonging to each compound.

γ. General.

Metamorphosis in Plants.‖—Prof. S. H. Vines gives a historical account of the theory of the metamorphosis of the foliar organs of plants, as taught by Goethe, Wolff, and Linnæus. The statement that "all

* SB. K. Böhm. Gesell. Wiss., 1897, No. xxxviii. (11 pp. and 1 pl.) (Bohemian with German abstract).
† Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 536–42.
‡ Bot. Centralbl., lxxiii. (1898) pp. 105–8. Cf. this Journal, *ante*, p. 225.
§ La Cellule, xiii. (1897) pp. 285–312.
‖ Science Progress, ii. (1898) pp. 79–104.

parts of the plant except the stem are modified leaves" was first made by Wolff in 1767. As to the force by which the metamorphoses are brought about, the author sums up thus:—"Whilst we admit that external conditions and agencies may be the *vera causa* of any given metamorphosis, we cannot fail to perceive that they constitute but the proximate cause, whilst the ultimate cause resides in the organisation of the plant itself."

Relationship of Phanerogams and Cryptogams.*—Herr W. Belajeff gives a careful *resumé* of the development of our knowledge of the mode of impregnation in Gymnosperms from the time of Hofmeister to the recent discovery of motile antherozoids in the Coniferæ and Cycadeæ, which so clearly point to the Gymnosperms forming a connecting link between the Pteridophyta and the Angiosperms.

Evolution of Assimilative Tissue in Sporophytes.†—Mr. C. C. Curtis discusses the origin of the separation, in the Pteridophyta, of the sporogenous tissue into isolated portions (sporanges), and the development of appendages (leaves) from the sporophyte. He regards the Filicinæ as having but a remote alliance with the Equisetinæ and the Lycopodinæ; but each of the classes presents features which suggest a descent from the Anthoceroteæ, although the intermediate stages have been hopelessly lost. But among some of the simpler of the eusporangiate Filicinæ the relationship appears very manifest, especially in the structure of the so-called fertile leaf. The Gymnosperms and Angiosperms only carry out more fully the departure of the Pteridophyta from the ancestral anthocerotal type.

Winter Characters of Sporanges.‡—Mr. G. Chamberlain has investigated the condition in which certain sporanges remain dormant in the winter season, both in the higher Cryptogams and in Flowering Plants, Gymnosperms, and Angiosperms. He finds that the sporanges of different plants pass the winter in very different stages of development, though the stage is probably uniform for the same species. A very usual halting place in the development of sporanges appears to be the spore-mother-cell.

B. CRYPTOGAMIA.

Muscineæ.

Bursting of the Antherid in Polytrichum.§—Herr F. Schaar describes the mode of escape of the antherozoids in several species of *Polytrichum*, especially *P. juniperinum*. At the apex of each ripe antherid is a cap, formed of cells of the antherid-wall with greatly thickened membranes. These cells are entirely devoid of starch, which has been used up in the thickening of the walls; they contain but little protoplasm, and no chlorophyll. It is the swelling of these thickened walls that plays the greatest part in the bursting of the antherid. Their pressure causes a strong tension of the cuticle at the apex of the antherid, and this finally bursts. The cell-membranes become gradually converted

* Biol. Centralbl., xviii. (1898) pp. 209–18.
† Bull. Torrey Bot. Club, xxv. (1898) pp. 25–9.
‡ Bot. Gazette, xxv. (1898) pp. 124–8 (1 pl.).
§ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 479–82 (1 pl.).

into mucilage, and the apical cells are forced out, carrying with them the antherozoids still imbedded in the swollen membranes of their mother-cells.

Braithwaite's British Moss-Flora.*—The last part published of this work (pt. xviii.) is entirely devoted to the genus *Amblystegium*, the number of species described now amounting to forty. Each species is illustrated, both as regards its general habit and the characteristic points of its structure.

Rabenhorst's Cryptogamic Flora of Germany (Musci).†—In the two most recently published parts of this work the genus *Plagiothecium* is completed, with 31 species in all; *Amblystegium* follows, with 19 European species; and a commencement is then made of the important genus *Hypnum*. It is divided first of all into 10 subgenera, viz.:—Scorpidium, Acrocladium, Calliergon, Hygrohypnum, Chrysohypnum, Drepanocladus, Cratoneuron, Ptilium, Ctenidium, and Stereodon. The sub-genus Chrysohypnum is first taken up, with 8 species, followed by Drepanocladus (syn. Harpidium), under which 19 species are included.

Characeæ.

Migula's European Characeæ.‡—Founded on his contribution to Rabenhorst's Cryptogamic Flora of Germany, Dr. W. Migula now publishes a complete synopsis of the European Characeæ, with a reference also to the extra-European species. It comprises 13 species of *Nitella*, 6 of *Tolypella*, 2 of *Lamprothamnus*, 28 of *Chara*, 1 of *Tolypellopsis*, and 1 of *Lychnothamnus*. Every species is figured, except *Tolypella hispanica*, and in the case of the variable species, a large number of subspecies or varieties. The systematic part is prefaced by an introduction, giving a full account of the structure of the family, together with instructions for collecting and preserving the specimens. It forms a complete and admirable monograph of the order.

Algæ.

Studies in the Confervales.§—According to Herr K. Bohlin, the membrane of *Microspora* is composed of pure cellulose, while that of *Conferva* and *Ophiocytium* is, for the most part, an acid pectin compound. The membrane of *Conferva* consists of H-formed particles with the following structure. The middle portion is constructed of a transverse plate, and of a more or less cylindrical portion. On both sides of this are finger-stall-like layers, added by apposition. The last of these forms an imperfect circle, and from it, together with a probably simultaneously formed transverse wall, is formed a new middle portion, on which are laid down new finger-stall-formed lamellæ. In the species of *Microspora* examined, there was no such stratification observed; each of the H-shaped portions appeared to be homogeneous.

The membrane of an *Ophiocytium* or *Sciadium* consists of two halves, of which the lower is much longer than the upper one.

* Pt. xviii. 1898, 28 pp. and 6 pls. Cf. this Journal, 1897, p. 224.
† Pts. 31, 32. Cf. this Journal, 1897, p. 146.
‡ 'Synopsis Characearum europæarum,' Leipzig, 1898, 176 pp. and 133 figs.
§ Bih. k. Svensk. Vetensk. Akad. Handl., xxiii. (1897) 56 pp. and 2 pls. See Bot. Centralbl., xxiii. (1898) p. 213.

In *Conferva* every cell has one or two nuclei. The chromatophores of *Conferva* and *Ophiocytium* have a much more yellow-green colour than those of other Chlorophyceæ. The propagation of *Ophiocytium* is effected by cells resembling aplanospores. It is possible that all the Confervales are descended from *Chloramœba* g. n., vide *infra*, p. 329.

The author suggests the following classification of the Confervales, which he defines as uni- or pluricellular Algæ, the cells inclosing distinct disc-shaped chromatophores destitute of starch; zoospores provided with a single cilium.

Fam. I. Confervaceæ:—Thallus uni- or multicellular; gametes biciliate; pyrenoids wanting (*Polychloris*, *Botrydiopsis*, *Bumilleria*, *Ophiocytium*, *Sciadium*, *Conferva*). Fam. II. Chlorotheciaceæ:—Cells solitary or coherent into a thallus; gametes uniciliate; pyrenoids wanting (*Chlorothecium*, *Mischococcus*, *Perionella*, *Characiopsis* (?), *Actidesmium*). Fam. III. Botrydiaceæ:—Thallus unicellular, multinucleate, composed of stem and rhizoids; gametes biciliate (?); pyrenoids present in the young plant (*Botrydium*).

Phyllosiphon Arisari.*—Dr. L. Buscalioni has studied the development of this Alga within the tissue of the leaf of *Arisarum vulgare*. In the first stages of development the protoplasm of the parasite has a cloudy finely granular appearance and contains vacuoles; the nuclei are large and numerous, and contain nucleoles. At a later period the nuclei put out amœboid protuberances; they multiply by fragmentation; no karyokinetic processes were observed. The spores are formed as soon as the division of the nucleus is completed. The nucleus of the megaspore breaks up into four fragments, the cytoplasm also dividing into four segments; these unite in the centre of their mother-cell, and, after becoming clothed with a membrane, the megaspore becomes a sporange. The spores germinate while still within the tissue of the host.

Chlamydomyxa labyrinthuloides.†—Herr G. Hieronymus has made an exhaustive examination of the structure and life-history of this rare organism, first discovered by Archer.

The amœboid processes are usually formed by the entire cell-contents, always containing a number of nuclei, escaping from the cell-wall. This body then generally divides into two amœbæ, or, if into a larger number, it frequently assumes a labyrinthine condition, in which a variety of living organisms are absorbed and consumed.

The cysts contain one or more nuclei, according to their size, and are commonly found imbedded in *Sphagnum*-cells. The cell-contents may be agglomerated into distinct masses or energids connected together by fine hyaline threads of protoplasm, which contain physodes and chromatophores, but never nuclei; the chromatophores gradually assume a red colour, and become converted into oil-drops, serving for the nutriment of the organism.

Each cyst or amœba of *Chlamydomyxa* contains one or more nuclei; their division appears to combine the characters of direct and karyokinetic division. The chromatophores are undoubtedly such, and not

* Rend. R. Accad. Lincei, vi. (1897) pp. 46–52.

† Hedwigia, xxxvi. (1898) pp. 1–49 (2 pls. and 10 figs.).

green symbiotic algæ. The red pigment is of the nature of a lipochrome. The protoplasm contains crystals of calcium oxalate.

An organism found in constant association with the *Chlamydomyxa*, and believed by some to be genetically associated with it, is identified by the author as *Urococcus Hookerianus* (Rab. non Hass.)

Chlamydomyxa must be regarded as the lowest type of the Algæ characterised by yellow-brown chromatophores.

New Unicellular Algæ.*—In the shallow fresh waters near Stockholm, Herr K. Bohlin finds representatives of no less than three new genera of Unicellular Algæ, viz.:—

Brachiomonas g. n., belonging to the Chlamydomonadeæ, and distinguished from the other genera of that family chiefly by the peculiar form of the cell. The body of the cell has five appendages, one posterior in the direction of the length of the cell; the remaining four arranged symmetrically on the sides, and forming a cross. Each cell contains a nucleus and pyrenoid, and is provided with two cilia. It propagates by division, the final product being gametes, with very much the form of the mother-cell. Two species are described, *Brachiomonas submarina* and *gracilis*.

Chloramœba g. n. The usually round or broadly elliptical cell is naked; the external layer of protoplasm gives rise to amœboid movements. It is biciliated, the two cilia being of very unequal length. The green colour disappears in the dark. It multiplies with extraordinary rapidity, the cells being filled with a white oil. The author places the genus among the Chloromonadeæ of Klebs, along with *Vacuolaria* and *Raphidomonas*.

Phæodactylum g. n. Each cell has the form of a star, the three narrow arms lying in one plane, and forming square angles with one another. In each cell is a parietal yellowish-brown chromatophore. Multiplication takes place by division in a plane passing through all the arms. The author proposes to form, from this genus and *Stichoglœa* Chod., a family of yellow-brown algæ parallel to the Pleurococcaceæ among green algæ.

The author further describes *Chlorogonium tetragonum* sp. n., in which the gametes are produced by simple quadripartition of the contents of the mother-cell; and *Oocystis Echidna* sp. n., the membrane of which is covered with long slender spines.

Fungi.

Nitrogenous Pigments of Fungi.†—M. R. Van den Driés finds, in *Aspergillus niger*, *A. fuliginosus*, and *Polyporus sulphureus*, nitrogenous pigments of the nature of aspergillin. These substances are nearly related to one another, but are not identical. They have an acid reaction, and are probably true amides. Aspergillin is not a hæmatine; it does not contain a trace of iron, and does not exhibit its characteristic band in its spectrum. Aspergillin is very nearly related to the tannins. In other species of *Aspergillus*, and in *Fusarium Hordei*, colouring matters of a very different character were found, including one with a basic reaction.

* Ofv. k. vetensk. Akad. Förhandl. Stockholm, 1897, pp. 507–30 (9 figs.) (German).

† La Cellule, xiii. (1897) pp. 413–46.

Mineral Food-Material of Fungi.*—M. E. Günther confirms the conclusions of Molisch and Benecke. With a high concentration of the mineral salts, the rapidity of growth is retarded. For a favourable nutrient solution for Fungi, a potassium salt, a magnesium salt, a sulphate, and a phosphate are essential. Neither the potassium nor the magnesium can be replaced by other elements. Salts of copper, while poisonous when present in large quantities, promote growth when very dilute.

New Species of Mucor.†—In addition to the species previously enumerated, Herr W. Schostakowitsch describes the following new species of *Mucor* from Siberia :—*M. irkutensis*, *M. heterosporus sibiricus*, *M. de Baryanus*, and *M. angarensis*.

New Genera of Fungi.—Together with a very large number of new species of ascomycetous Fungi, mostly parasitic or saprophytic, from Java, Prof. O. Penzig and Sig. P. A. Saccardo ‡ describe the following new genera :—

Pteridiospora g. n. Perithecia subsuperficialia, globoso-conica, carbonacea, nigrantia, ostiolo papillato; asci paraphysati, octospori ; sporidia oblonga, bilocularia, hyalina ; membrana hyalina, mucosa, deorsum in alam spathulatam producta, obvoluta. Among Hyalodidymæ.

Melchioria g. n. Perithecia in cæspitulos superficiales botryose aggregata, sed discreta, globulosa, papillata, nigra carbonacea, stromate albo molliusculo interposito ; asci oblongo-fusoidei, octospori, obsolete paraphysati ; sporidia fusoidea, 1-septata, hyalina. As the last.

Hormosperma g. n. Perithecia superficialia, atra, globulosa, papillata, exigua, setulosa ; asci cylindracei, aparaphysati, suboctospori ; sporidia cylindricea, moniliformia, typice 8-locularia, subhyalina, loculis globoso-cuboideis, facile secedentibus. Among Hyalophragmiæ.

Boerlagella g. n. Perithecia superficialia, globulosa, setosa, nigra, typice byssiseda ; asci elongati, octospori, paraphysati ; sporidia elongata, majuscula, pluriseptato-muriformia, hyalina. Among Hyalodictyæ.

Leptosporella g. n. Perithecia superficialia, carbonacea, globosa, papillata, atra, glabra ; asci elongati, 8-spori, sporidia cylindrico-vermicularia, genuine v. spurie pluri-septata, hyalina. Among Scolecosporæ.

Bactrosphæria g. n. Perithecia superficialia, verticaliter elongato-cylindracea, sursum angulosa verruculosa, membranaceo-carbonacea, nigra, ostiolo sulcato-radiato ; asci cylindracei, aparaphysati, 8-spori ; sporidia bacillaria, pluriseptata, subhyalina, ascum subæquantia. As the last.

Prof. O. Penzig § found also in Java the type of a new genus of Tuberculariéæ, which he defines as follows :—

Amallospora g. n. Sporodochia verruciformia v. tuberculata, sessilia, mucilaginosa, hyphis radiantibus subsimplicibus tenuibus, muco obvolutis ; conidia in hypharum apice solitaria, primum simplicia, dein transverse pluriseptata, ac proliferatione laterali aucta ; maturitate in manipulos quosdam conjuncta, incoloria.

* Beitr. z. mineral. Nahrung d. Pilze, Erlangen, 1897. See Bot. Ztg., lv. (1897) 2te Abth., p. 379. Cf. this Journal, 1895, p. 545.

† Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 471–4 (1 pl.). Cf. this Journal, 1897, p. 419.

‡ Malpighia, xi. (1897) pp. 387–413.

§ Tom. cit. pp. 461–4 (1 pl.).

Parasitic Fungi.—Herr C. Schröter * finds, on the diatom *Fragilaria crotensis* var. elongata, but not on the var. curta, in plankton of the Lake of Zürich, a parasitic organism, *Rhizophidium fusus*, belonging to the Chytridiaceæ.

A pine-apple mould is found by Prof. B. D. Halsted † to be composed of *Chalaria paradoxa*, or a closely allied species, characterised by producing three different kinds of spore:—hyaline cylindrical microgonids 4–5 by 16–10 μ, and ovoid olive-brown megaconids 8–9 by 16–18 μ, together with a third form, resembling the megaconids in colour, but the microconids in size. A similar fungus is connected with the "galls" on the root of the peach.

The asparagus-rust, *Puccinia Asparagi*, is described by the same writer as becoming very destructive to crops in the United States. It is itself largely infested by a fungus parasitic upon it, *Darluca filum*.

The green spots on mandarin oranges were found by M. Trabut ‡ to be produced by a fungus which he names *Septoria glaucescens* sp. n. It produces fermentation of the sugar and of the citric acid, causing the peculiar flavour which is a modification of the special perfume.

On slime from a plane-tree, Herr R. Meissner § finds a new species intermediate between *Eurotium Aspergillus glaucus* and *E. repens*, which he names *Eurotium Aspergillus medius*. It is characterised by the orange-red colour of the older hyphæ of the mycele.

According to Mr. B. M. Duggar and Mr. L. H. Bailey ‖ the two diseases of the celery known as "early blight" and "late blight" are due respectively to the attacks of *Cercospora Apii* and *Septoria Petroselini* var. Apii.

On the fields of maize in Java, M. Raciborski ¶ finds a parasitic fungus which he names *Peronospora Maydis* sp. n., causing great destruction to the crops.

Under the name *Trichodytes Anemones* g. et sp. n., Herr H. Klebahn** describes a parasitic fungus which attacks the glandular hairs of *Anemone nemorosa*. He regards the genus as belonging to the Melanconieæ, and nearly related to *Glœosporium* and *Cylindrosporium*.

Red Yeasts.††—Miss K. E. Golden and Mr. C. G. Ferris describe three red yeasts obtained from the air of the laboratory. Though resembling Saccharomycetes in appearance, both microscopically and in gross growth, they are unable to form true ascospores. No. 1 is intermediate between *Saccharomyces* and *Torula*, in that it forms spore-like bodies, though these are not true spores, as they neither form the spore-wall nor bud in germinating, It resembles *S. rosaceus* in the appearance of the colonies and in not forming chains. No. 2 is undoubtedly *S. glutinis*. No. 3 is apparently a new species of *Mycoderma*, though in general appearance it is much like *M. Humuli*. The latter, however, liquefies gelatin, which is decomposed with the production of a foul odour. No. 3 neither liquefies gelatin nor generates any odour.

* Arch. Sci. Phys. et Nat, iv. (1897) pp. 474–5.
† Bull. Torrey Bot. Club, xxiv. (1897) pp. 505–10.
‡ Comptes Rendus, cxxvi. (1898) pp. 549–50.
§ Bot. Ztg., lv. (1897) 2te Abth., pp. 337–44, 353–7 (12 figs.).
‖ Cornell Univ. Agric. Exp. Stat, 1897, pp. 201–30.
¶ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 475–8 (1 fig.).
** Tom. cit., pp. 527–36 (1 pl.).
†† Bot. Gazette, xxv. (1898) pp. 39–46 (2 pls.).

Mycorhiza on the Roots of Philesia.* — Mr. J. M. Macfarlane records an example of this, only the second instance known of symbiosis between a fungus and a plant belonging to the Liliaceæ. The mycorhiza forms an abundant growth in the mesocortex. The large spherical starch-grains of these cells were abundantly acted on by the hyphæ, being dissolved rather than corroded. A large amount of proteid substance then appeared in the hyphæ.

Podaxineæ.†—In the forest of Vallombrosa, Sig. F. Cavara finds a fungus which he regards as the type of a new genus of this family of Gastromycetes, which is chiefly extra-European. It is diagnosed as follows:—

Elasmomyces g. n. Receptaculum semi-epigæum, stipitatum, globulare, primo clausum, dein inferne apertum, subtus lamellis spuriis crassis radiantibus donatum; stipes brevis, farctus, evolvatus in columellam usque ad peridium desinens; gleba celluloso-spongiosa; hymenium e basidiis 2–4 sterigmaticis, cystidiis, paraphysibusque efformatum; sporis sphæricis, difformibus, aculeatis.

The author regards the genus as exhibiting certain affinities with the pileate Hymenomycetes, agreeing with them in the stipitate pileus, in the constitution of the hymenium, and even in the presence of cystids, which is very unusual among the Gastromycetes. The spherical spores is another striking peculiarity; they are always of two sizes, megaspores and microspores.

Spores of the Truffle.‡—M. A. de Gramont de Lesparre gives further details with regard to the development of what he terms the "male" and the "female" spores of the truffle. After impregnation of the female spore or of its pseudospore, it puts out very delicate hypodermal filaments; these filaments produce on the surface round black spores, the teleutospores, from which the mycele is again developed.

Geopora and its Allies.§—Dr. E. Fischer identifies the underground fungus known as *Hydnocystis gyrosa* with *Geopora Cooperi*. These two genera of Hypogæi differ only in the labyrinthine appearance of the receptacle of *Geopora* caused by the folding in of its outer coat.

Stutzer and Hartleb's Nitre Fungi.—Prof. A. Gärtner ‖ characterises the views and statements of Stutzer and Hartleb ¶ about nitre fungi as erroneous. He states that the liquid culture forwarded to him by Stutzer was neither a mould nor a young or preliminary stage thereof. The mould sent was morphologically constant, and formed no nitrate. So too all the other species in the cultures were constant, and none of the micro-organisms, when grown on organic nitrogen, were able to oxidise this to nitrite, or the nitrite to nitrate.

Prof. C. Fraenkel ** also investigated the character and properties of Stutzer and Hartleb's fungi, and came to a conclusion similar to that of Gärtner.

* Bot. Gazette, xxv. (1898) pp. 106–7.
† Malpighia, xi.(1897) pp. 414–28 (1 pl.).
‡ Comptes Rendus, cxxvi. (1898) pp. 443–7 (9 figs.).
§ Hedwigia, xxxvii. (1898) pp. 56–60 (2 figs.).
‖ Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 1–7, 52–61, 109–19 (2 pls.).
¶ Cf. this Journal, 1896, p. 105; 1897, pp. 146, 236.
** Tom. cit., pp. 8–13, 62–67.

Experimental Production of Russell's Fuchsin-Bodies.*—Prof. F. Sanfelice reopens the question of the meaning of Russell's fuchsin-bodies, which by most histological investigators were held to be of artificial origin. These fuchsin-bodies have been observed in malignant tumours and in chronic inflammatory products. During the past year the author has constantly met with them in cats inoculated with *Saccharomyces neoformans*, but never in the tissues of normal cats. The appearance of the fuchsin-bodies seen in the tissues of cats infected with *S. neoformans* is well depicted in the coloured illustrations. The Blastomycetes are seen as round bodies lying free or within cells. The intracellular bodies are small and numerous. Those which are free are large and circular; some are in the act of budding, while others are surrounded by a halo or capsule. The parasites are stained blue, and the nuclei of the tissue cells red.

Cheese Ripening.†—Dr. O. Johan-Olsen records very interesting experiences in the endeavour to ascertain the fungi which effect the ripening of cheese. The author's results are quite different from those of other observers. Cheese is ripened by the symbiotic action of several fungi; thus "Gammelost" cheese is ripened by the action of lactic acid ferments, by the symbiosis of *Chlamydomucor casei* sp. n. and *Penicillium casei* sp. n. J.-O., often, but not always, assisted by *Dematium casei* and *Tyrothrix* i.

The best cheeses are better without the last two, though some people prefer cheeses with characters imparted by these fungi.

The author's method of making cheese is as follows. As perfectly skimmed milk is no use, he adds 2 per cent. of unskimmed milk to the separated milk. The mixture is then pasteurised, cooled, and when placed in wooden vessels, pure cultures of lactic acid ferments, *Mucor* and *Penicillium*, are added. The temperature is kept between 16° and 20°. When the correct degree of acidity is attained (18–20 per cent. with 1/4 normal soda solution) the fermentation is stopped. The fermented milk is then thoroughly stirred, boiled, strained, and moulded. Before being moulded, *Chlamydomucor casei*, *Mucor casei* i, and *Penicillium aromaticum casei* are added. During the moulding the cheese mass should not be under 80°, and should then be allowed to stand for 24 hours.

The cheeses are then removed from the moulds and placed in a room where the air is dry, warm, and ventilated. After this the cheese may be altered to suit the taste of the consumers—that is to say, warmth aids *Mucor* fermentation, a moderated temperature *Penicillium*. If *Mucor* predominates, the cheeses are brown; if *Penicillium*, green. If they are to be sharp they should be placed in cultures of *Tyrothrix* or *Dematium casei*, and kept moist and warm for some days. In fact, the ripening process can be manipulated as desired. The average ripening time is 6–7 weeks.

The article is well illustrated.

Production of Favus Cups by the Inoculation of a Pyogenic Trichophyton.‡—MM. Sabrazès and Brengues record the fact that a

* Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) pp. 274–80, 311–18 (1 pl.).
† Op. cit., 2te Abt., iv. (1898) pp. 161–9 (6 pls. and 17 figs.).
‡ Comptes Rendus, cxxvi. (1898) pp. 1160–1.

fungus, morphologically a *Trichophyton*, and obtained from sycosis of the beard, when inoculated on the human skin, set up suppuration, and that the affected area was bestudded with small sulphur-yellow cups, having the naked eye and microscopical characters of favus cups. Subcultures showed resemblance to the pyogenic *Trichophyton* of the horse. The same fungus inoculated on two mice produced typical favus cups. These cups are less invasive than those of human or canine favus. The authors contend that their observations prove that the barriers between *Trichophyton* and *Achorion* are less absolute than are supposed.

Protophyta.

α. Schizophyceæ.

Curvatures and Structure of the Membrane in the Schizophyceæ.*—Fresh observations by Herr R. Kolkwitz do not enable him to confirm in all points the account given by Correns of the curvature of the lower Algæ. The curvatures are not spontaneous, but are the result of contact. The phenomena already described in the Oscillatoriaceæ are presented also in *Beggiatoa mirabilis*. The foulness of the water in which *Beggiatoa* habitually grows causes it to coil up into a ball.

With regard to the nature of the membrane (in *Oscillatoria maxima*), the author finds it to exhibit fine punctations, which he believes to be of the same nature as that in *Glœocapsa*, and to be due to a granular structure.

New Genera of Protococcoideæ.†—Among the results of the first Regnell expedition, Herr K. Bohlin describes the following new genera of Protococcoideæ:—

Echallocystis g. n. Thallus macroscopicus, viridis, stratum efficiens; cellulæ oblongæ, in divisione membrana cellulæ maternæ dehiscens; cellulæ sororiæ ad eam se fingentes excreto mucoso, interstitium conicum cellulorum explente; amylum adest. Placed under Tetrasporeæ.

Pilidiocystis g. n. Alga viridis, cellulis ovoideis, membrana ex maxima parte tenuis, incolorata, sed ad angustiorem partem cellulæ incrassata, umbonem rubellum efficiens, ad partem latiorem cellulæ tuberculo minimo, stipitem unum v. duos ferente, instructa; pyrenoidibus singulis in angustiore parte cellulæ; amylum adest; propagatio 2–4-partitione contentus cellularis; cellulis filiis solutione membranæ totius maternæ, umbone rubello excepto, liberatis. Near *Oocystis* and *Lagerheimia*.

Selenoderma g. n. Alga viridis, thallo mucoso macroscopico, cellulis late lunatis, irregulariter in muco dispositis; chlorophoris singulis parietalibus, pyrenoidibus singulis instructis; propagatio 2–4-partitione cellularum; alii modi propagationis ignoti. Near *Kirchneriella*.

Thermal Algæ.‡—Miss Josephine E. Tilden enumerates the algæ (Schizophyceæ) collected from several warm springs in the United States and in Canada. They include a number of new forms, and two new species, *Microspora Weedii* and *Spirulina caldaria*.

New Plankton-Forms.§ — M. B. Schröder describes in detail the composition of the plankton of the Oder, in which he finds the following

* Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 460–7 (1 pl.). Cf. this Journal, 1897, p. 324.

† Bih. k. Svensk. Vetensk. Akad. Handl., xxiii. (1897) 47 pp. and 2 pls.

‡ Bot. Gazette, xxv. (1898) pp. 89–105 (3 pls.).

§ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 482–92.

new species:—*Reinschiella* (?) *setigera* (Pleurococcaceæ), with the external habit of a *Rhizosolenia; Golenkinia fenestrata*, sometimes in enormous quantities, each colony occasionally consisting of as many as 64 cells; and *Tetrapedia emarginata*.

Reproduction of Diatoms.*—Comte Abbé F. Castracane reviews the recent literature on this subject, confirming his previous view that the normal mode of reproduction of diatoms is by spores or by germs, and that multiplication by division, although very common, is the exception rather than the rule. The evidence of fossil diatoms shows that the siliceous wall is present from the first moment of the existence of the diatom, and that, like other organisms, it is small when first formed, gradually growing to its full size.

Rhizosolenia and Attheya.†—In the plankton of the Plöner See, Dr. O. Zacharias finds representatives of both these genera of diatoms, and argues for their very close affinity, if not identity. In *Rhizosolenia* he records, moreover, the formation of chains.

Cause of Odours and Tastes in Drinking Waters.‡—Mr. D. D. Jackson and Mr. J. W. Ellms point out that while some of the Cyanophyceæ (especially *Anabæna*) produce disagreeable odours in surface waters by the decay of nitrogenous organic matters, the usual cause of unpleasant odours and tastes occurring in potable water is the large numbers of certain microscopical organisms which secrete compounds of the nature of essential oils as a phenomenon of growth. Besides *Anabæna*, an odour of decay is produced by other Cyanophyceæ,—*Rivularia, Clathrocystis, Cœlosphærium, Aphanizomenon*. The organisms enumerated which emit odours of growth are the following:—Diatomaceæ (*Asterionella, Tabellaria, Meridion*); Chlorophyceæ (*Volvox, Pandorina, Eudorina*); Infusoria (*Uroglena, Dinobryon, Synura, Bursaria, Peridinium, Cryptomonas, Mallomonas*). Most of these produce fishy, some of them aromatic smells. The odour of the Cyanophyceæ is produced by the decay of highly nitrogenous organic matter, in which partially decomposed sulphur and phosphorus compounds play the leading part.

Gas-Vacuoles of Gloiotrichia.§—In opposition to the view of Richter, Herr H. Klebahn maintains that the red bodies in *Gloiotrichia echinulata* are gas-vacuoles, though the composition of the contained gas could not be ascertained.

β. Schizomycetes.

Myxobacteriaceæ.‖—Herr H. Zukal has now adopted Thaxter's view § that this group of organisms must be ranked under the Schizomycetes rather than under the Myxomycetes. The structure which he before described as a plasmode is rather a pseudo-plasmode, i.e. it does not result from the coalescence of active swarm-cells, but is rather a collection of swarm-cells in which each retains its individuality and can be again separated from the mass. The Myxobacteriaceæ are charac-

* Ann. de Micrographie, ix. (1897) pp. 473–503.
† Biol. Centralbl., xviii. (1898) pp. 161–6 (4 figs.).
‡ Technology Quarterly, x. (1897) pp. 410–20 (1 pl.).
§ Bot. Ztg., lv. (1897) 2te Abt., p. 349. Cf. this Journal, 1895, p. 345.
‖ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 542–52 (1 pl.) Cf. this Journal, 1897, p. 154.
§ Cf. this Journal, 1897, p. 569.

terised by the formation of a receptacle from this mass of swarm-cells in precisely the same way as that of a Myxomycete from a true plasmode. The pseudo-plasmode is formed by the swarming of true bacteria.

In the case of *Chondromyces* (*Myxobotrys*), the bacterium is a rod, 4–7 μ long, rounded at the ends, often irregularly bent, which possesses the power of swarming under certain conditions, forming a pseudo-plasmode about 1 mm. in diameter, which becomes invested by a gelatinous envelope. Within this the greater part of the bacteria are used up in the formation of spores. Each rodlet increases in length, and divides by septa into from 4 to 6 cells, which round themselves off, invest themselves with a rather thick membrane, and become the spores.

According to the author, Thaxter's generic name *Myxobacter* must give place to *Polyangium*, under which the organism has been described as the egg of an insect. A new species of *Myxococcus*, *M. macrosporus*, is described, growing on the bark of poplars.

Crenothrix and Beggiatoa.*—According to Sig. G. Gasperini, the organisms known as *Crenothrix Kühniana* and *polyspora* must be referred to *Beggiatoa*, a genus which has much more affinity with the lower filamentous Algæ than with Bacteria. *Beggiatoa* will then include all the non-chlorophyllaceous forms which present the morphological and biological characters of the Oscillatoriaceæ. A similar affinity is displayed by the forms included under the genera *Streptothrix*, *Cladothrix*, *Actinomyces*, *Thiothrix*, *Nocardia*, *Kurthia*, *Sphærotilus*, *Leptothrix*, *Leptotrichia*, *Detoniella*, *Hypheothrix*, *Rasmussenia*, and *Phragmidiothrix*.

When passed through iron tubes, *Beggiatoa* (*Crenothrix*) *Kühniana* has the property of depositing iron in the form of a sheath of an organic ferric oxide, or of ferruginous tubercles. The usual colour of the flakes of this organism is ochroleucous or ochraceous, but it varies according to the quantity of iron deposited.

Internal Structure of Micro-organisms.†—Herr V. Růžička states that he has discovered important structural conditions in bacterial cells by means of a special though comparatively simple method. This method consists in fixing the cover-glass films in sublimate, staining with methylen-blue, and decolorising with acidulated water. By this method he has succeeded in demonstrating, in bacteria, fungi, and oidia, granules not hitherto described. The presence and size of the granules appear to depend largely on the age of the culture. In cocci the granules are usually central; in rodlets, polar. Sometimes a rodlet may possess more than two granules; if so, they may be situate at regular distances apart; and if there be a single central one, it imparts the appearance of a nucleus, though it is not suggested that the central granule has a nuclear value.

In fungi and in oidia the granules are more numerous and irregularly distributed. The same method also serves to demonstrate the septa where fission is taking place.

Microbes of Root-Tubercles.‡—M. Mazé, who had previously shown that the fixation of nitrogen by the bacilli of Leguminosæ is a property

* Atti Soc. Tosc. Sci. Nat., xi. (1897, 8) pp. 3–7.

† Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) pp. 305–7 (1 pl.).

‡ Ann. Inst. Pasteur, xii. (1898) pp. 1–25, 128–53 (2 pls.). Cf. this Journal, 1897, p. 158.

of the micro-organisms themselves and not the effect of a symbiosis, in a second memoir studies the physiological aspects of the work of the microbes of these nodosities, viz. the effect of air, the influence of the richness of the media in combined nitrogen and in saccharose on the fixation of free nitrogen, behaviour of the microbe to mineral nitrogen, and the action of the roots of the Leguminosæ on the free forms of the microbes.

In a third memoir the author deals with his observations on the morphology of the microbe. Both under natural conditions and on artificial media the bacilli are very polymorphic, presenting themselves under the forms of coccobacilli, filaments, branching forms, endosporous, and oosporous forms. Sometimes the colonies are composed of motile elements. Mostly, however, they are motionless.

While the bacilli freshly removed from the tubercles appear to possess the power of reproducing new tubercles, yet they lose this property in time; and though one form or variety of the microbe is unable to produce the tubercles, this result may be arrived at by the co-operation of two forms.

Effect of Monochromatic Light on Bacterial Development.* — Herren Beck and Schultz examined the action and effect of monochromatic light on various bacteria, chiefly chromogenic. The bacteria were simultaneously exposed to the action of sunlight and diffused daylight, and were also protected from light. Monochromatic light was not found to possess an inhibitory nor a germicidal action, though occasionally it had some effect on the production of pigment. Diffused daylight was favourable to pigment formation. Direct sunlight was injurious to pigment production and to bacterial growth. Röntgen rays had no influence on the growth or power of forming pigment of the microbes tested.

Production of Sulphuretted Hydrogen, Indol, and Mercaptan by Bacteria.†—Herr M. Morris demonstrated the production of sulphuretted hydrogen by bacteria on a medium composed of agar and sugar of lead, in the proportion of 1 litre of agar to 1 grm. of sugar of lead, or as 1000 to 1. On this lead-agar bacteria grow well; the only precaution necessary is to make a deep puncture, as the surface growth does not show the reaction well owing to oxidation.

The following species were found to form sulphuretted hydrogen very freely:—typhoid, glanders, *Staphylococcus aureus*, *Proteus vulgaris*, and *P. mirabilis*.

The statement of Petri and Maassen, to the effect that almost all bacteria form sulphuretted hydrogen in media containing much pepton, was not confirmed for anthrax, *mycoides*, and *subtilis*. On the whole the author's results agree pretty well with those of Stagnitta-Balistreri.

Indol was copiously produced by mouse septicæmia and by *B. coli anindolicum*; less strongly by typhoid, swine plague, *violaceus*, blue milk, *pyocyaneus*, anthrax, yellow sarcina, and a yeast. Experiments with *B. coli communis* showed that the amount of indol produced was proportionate on the one hand to the time, and on the other to the

* Zeitschr. f. Hygiene u. Infekt., xxiii. (1897) p. 490. See Centralbl. Bakt. u. Par., 2[te] Abt, iii. (1897) p. 603.
† Arch. f. Hygiene, 1897, p. 304. See Bot. Centralbl., lxxiii. (1898) p. 216.

amount of pepton. It follows from these observations that the production of indol by bacteria is more common than is usually supposed.

Only one bacterium, *Proteus vulgaris*, was found to produce mercaptan.

Experimental Production of Amyloid.*—Dr. Davidsohn has produced in animals, by subcutaneous injection of living bouillon-cultures of *Staphylococcus pyogenes aureus*, a substance which, if not identical with the amyloid deposit found in the human subject, belongs to the same class of bodies. The animals were injected at suitable intervals with doses of the culture increased from 0·3 to 25 ccm. In half the cases the amyloid change was found. Rabbits, mice, and fowls gave positive results, guinea-pigs and cats always negative.

Putrefactive Bacteria in Fruit and Vegetables.†—Herr P. Gordan, from an investigation of the causes and conditions of putrefaction in fruit and vegetables, found that in the decomposition of plants there was no evidence of the production of sulphuretted hydrogen. In vegetable decomposition the same bacteria were constantly appearing, the most frequent being *B. coli* Escherich. In rotting apples *B. fluorescens liquefaciens* was found, on potato *B. liquefaciens*, and on red cabbage *B. flavofuscus liquefaciens*. This last, a new species, is merely an accompaniment of the putrefaction set up by the other three, and has not the power by itself to initiate decomposition.

Gummosis of Beetroot.‡—Herr W. Busse endeavoured to isolate the exciting cause of the gumminess of beetroot, a disease which is first seen as a browning or blackening of the vascular bundles. The parenchyma cells then become soft and degenerate, and at the same time is produced a dark brown slime which sets to a sort of gum. Two bacilli were isolated, bacillus α and β. The colonies of α were finely granular and radiately striated, and the organism was capable of exciting a lively fermentation. Unfortunately the cultures were lost before inoculation experiments could be tried.

Bacillus β, isolated from different material, was found to possess similar morphological characters and physiological functions; the author therefore concluded that they were one and the same species, and called it *Bacillus Betæ*. Healthy beets inoculated with *B. Betæ* were found to contain internally evidences of gummosis, though externally there was no difference between the infected and healthy plants. Bacteriological examination showed the presence of *B. Betæ*.

Production of Mucinoid Substance by Bacteria.§—MM. A. Charrin and A. Desgrez find that *Bacillus pyocyaneus* produces a substance having the chemical reactions characteristic of mucinoid compounds. Injected into the animal body it gives rise to the phenomena of pyocyanic intoxication, emaciation, albuminuria, enteritis, and intramuscular hæmorrhages. The authors suggest, in view of their results, that bacteria play an

* Virchow's Arch., cl. (1897) pt. 1. See Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) p. 426.

† Inaug.-Diss. Erlangen, Leipzig, 1897, 18 pp. See Beih. Bot. Centralbl., 1898, p. 322.

‡ Zeitschr. f. Pflanzenkr., 1897, pp. 65–149. See Bot. Centralbl., lxxiii. (1898) p. 153.

§ Comptes Rendus, cxxvi. (1898) pp. 596–7.

important part in inflammatory processes affecting mucous membranes. Besides *B. pyocyaneus*, staphylococcus, colon bacillus, and the cholera vibrio produce the mucinoid substance.

Production of Mucin by a Pathogenic Fluorescing Bacillus.*— M. Ch. Lepierre states that quantities of mucin are produced in meat-pepton cultures, and this even independently of fluorescence. In the latter case the media also contained lactate, malmate, malate, tartronate, isosuccinate, pyrotartrate, ethylmalmate, glycerate, or glycolate.

Fluorescence and mucin were simultaneously produced when citrate, succinate, oxyglutartrate, oxypyrotartrate, or gluturate were present. Liquid media containing asparagin also gave mucin. As this mucin rarely contains any phosphorus, and is split up by acids with the formation of a reducing sugar, it is real mucin, and not a nucleoalbumin.

The author also notes that he has observed the formation of mucinoid substances in liquid cultures of a bacillus which he found to be the pathogenic agent in the production of "sleepiness."

Destruction of Microbes in Hypervaccinated Animals.†—Dr. A. T. Salimbeni's experiments on the destruction of microbes in the subcutaneous tissue of hypervaccinated animals were made on horses treated with (1) diphtheria toxin, (2) living cholera vibrios, (3) living streptococci.

From a general point of view no essential difference was found between the cases of antitoxic and anti-infectious immunity, that is to say, the microbes were got rid of by phagocytosis. Still the experiments showed that phagocytic leucocytes do not all interpose to the same extent, or act in the same way upon the englobed microbes. As regards the bacteria in question, the polynuclear leucocytes are endowed with the most energetic bactericidal properties. In diphtheria the mononuclear leucocyte scarcely interferes at all. With the cholera vibrio the case is much the same. In the case of streptococci, mononuclear leucocytes at first arrive in large numbers, and englobe the majority of the microbes. They soon however perish, and the streptococci thus set at liberty are destroyed by the polynuclear phagocytes.

Nature of the Agglutinated Substance.‡—M. C. Nicolle considers that the bodies of certain microbes, such as *B. coli*, *B. typhosus*, *Vibrio Massowah*, and others, contain an agglutinated or agglutinable substance, to the existence of which the phenomenon of agglutination is due. The reaction is produced only by homologous serum, and the agglutinated substance is an integral part of the microbe. This substance is extremely resistant to heat, cold, sunlight, high pressure, and drying, and the addition of antiseptics does not prevent the production of the phenomenon. It is soluble in water, in acids and alkaline fluids, in ether, and in alcohol. The exact nature of the substance is unknown, and its chemical composition is doubtless very complex. The production of the substance is not related to the virulence or toxicity of the cultures used. It is distinguished from microbic toxins by its solubility in absolute alcohol; hence the presence of the agglutinating power is not a sign of intoxication. The characteristic of the substance is its property of agglome-

* Comptes Rendus, cxxvi. (1898) pp. 761–2.

† Ann. Inst. Pasteur, xii. (1898) pp. 192–209.

‡ Tom. cit., pp. 161–91.

rating and at the same time of causing the agglomeration of the bodies which contain it, or which are suspended in the fluid.

The substance is located in the external layer of the microbe, and agglutination may be defined as being a coagulation and coalescence of the external layers of agglutinable microbes under the influence of agglutinating serum. Agglutination in fact is a purely passive phenomenon. It is not constantly present, for certain microbes are devoid of it. It is not, properly speaking, a sign of infection, for a perfectly non-virulent microbe or a filtered culture may give rise to it.

New Chromogenic Micrococcus.*—Dr. A. Cantani describes a chromogenic coccus which is designated, from the hue of the pigment, *Micrococcus corallinus*. It was obtained from an impure influenza culture. It has no special arrangement; it stains well with anilin dyes, and also by Gram's method. It is an essential aerobe. It was cultivated on agar, in bouillon, and milk, but grew best on blood-agar. The optimum temperature is 20–25°.

The pigment exists only in the cells, the medium not being stained at all. It is only sparsely soluble in water or alcohol, and not at all in ether or chloroform. Though *M. corallinus* does not grow at all at 37°, yet it was found to be pathogenic to guinea-pigs and rabbits, these animals dying in 4–5 days with toxic symptoms accompanied by emaciation.

Violet Bacillus.†—Prof. H. M. Ward describes a violet bacillus which was derived from the Thames. Morphologically it presents itself in the form of rodlets or filaments from 2–3 μ to 60 μ or more in length by about 0·75–0·8 μ broad. It may be quiescent or actively motile, and in old cultures involution forms are found, and the rodlets may be so short as to be almost cocci. Spore-formation was not observed. It is aerobic, liquefies gelatin, grows slowly, its optimum temperature is 20°, it is easily killed by direct sunlight, and is not pathogenic to animals. It was grown on gelatin-agar, potato, or broth and milk. The growth, at first white, develops later a violet pigment which is insoluble in water, but very soluble in alcohol. It is very stable, except in sunlight, is turned bluish-green on adding caustic alkali, the colour nearly returning by excess of acid.

Polymorphic Bacillus from a case of Calculous Nephritis.‡—Sig. G. Grixoni cultivated from the pus of a nephritic abscess a highly polymorphic aerobic bacillus. Its growth on potato was very characteristic, the growth in 18 hours being dark brownish-red, and in a few days quite black. Gelatin was not liquefied. The bacillus is devoid of movement, and stains well by Gram's method. Mice succumb in about 30 hours after intraperitoneal injection. Rabbits, guinea-pigs, and pigeons are refractory.

Coli and Typhoid Bacteria are Uninuclear Cells.§—By means of a special method of staining Dr. A. Wagner claims that he has demonstrated that coli and typhoid bacteria are mononuclear cells. The

* Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) pp. 308–11.
† Ann. of Bot., xii. (1898) pp. 59–74 (1 pl.).
‡ La Riforma Med., 1896, No. 235–7. See Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) p. 421.
§ Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) pp. 433–8, 489–92 (2 pls.).

simple coli or typhoid cell is a round or oval body with central nucleus. The nucleus undergoes the changes of shape and position observed during fission in other cells. Six figures illustrate the author's description; the first of these shows the oval bacterial cell with small central body; the cell elongates, as does also the nucleus; the nucleus shows polar expansions joined by a cord; the cord disappears simultaneously with a constriction of the cell; the cell is now practically two cells with central nuclei, the bodies of the cells being connected by the adjacent part of the investing membrane. Two of the author's photographs show tubes or cylinders containing oval bodies, in the middle of each of which is a central body or nucleus.

Growth of the Typhoid Bacillus in Soil.*—Prof. S. Martin has studied the growth of the typhoid bacillus in soil from its vegetative aspect, and without reference to the pathological or physiological activity of the organism. Two kinds of soil were used: (1) sterilised soil containing a large quantity of organic matter (organically contaminated soil); (2) sterilised virgin soil of sandy peaty nature. In experiments conducted at 37° C. on soil 1, the bacillus was found not only to be able to exist in this particular kind of soil, but to grow and pervade it at this temperature, while at the laboratory temperature (15°–19° C.), and exposed to diffused daylight, the bacilli were still alive and active at the end of 63 days, and had begun to pervade the soil.

From the experiments with the virgin soil the results were negative, both at 37° and at 15°–19°.

The results of these two sets of experiments offer such a marked contrast between the growth of the typhoid bacilli in organically contaminated soil and in virgin soil, as to indicate that the distinction between these soils is one of prime importance.

Experiments with *Bacillus coli communis* under exactly similar conditions gave similar results.

Behaviour of Typhoid Bacilli in Milk.†—Among the results of an investigation made by Dr. E. Cautley to ascertain how long milk infected with typhoid bacilli will retain its infectivity, may be mentioned that the *Bacillus typhosus* will live in milk under the conditions which ordinarily prevail in a household, though there is no evidence that the microbe is capable of multiplication. In naturally or artificially soured milk the bacillus can live, and hence it is quite possible for this microorganism to exist in curd cheeses.

Observations on, and Experiments with, the Plague Bacillus.‡—Dr. E. Klein made experiments on the plague bacillus with material obtained from a case which occurred in London in the autumn of 1896. After sketching the morphological and cultural characters of this bacillus, in the course of which he notes certain characteristic appearances on gelatin, such as atypical angular colonies consisting of minute oval or rod-shaped bacilli singly or, more commonly, in dumb-bells, the author proceeds to the experiments with the plague bacillus. The guinea-pig was found to be extremely susceptible to plague infection, for plague material derived directly from the body affected with plague, or indirectly

* Twenty-sixth Annual Rep. Loc. Govt. Board, 1896–7, Appendix B, pp. 231–42.
† Tom. cit., pp. 243–54. ‡ Tom. cit., pp. 287–308 (6 pls.).

from artificial cultures, produces, after subcutaneous or intraperitoneal injection, morbid appearances which differ from those produced by any other known septicæmic affection of this particular animal. As a rule the animal dies in 48–72 hours; there is then a tumour at the infection site, and the lymphatic glands and spleen are found to be notably enlarged. If death be delayed beyond 72 hours, then there is also focal hæmorrhagic pneumonitis with central areas of necrosis. The blood, lymph, and organs generally are found on examination to reek with bacilli. It was not found practicable to render the guinea-pig immune to plague infection, either by means of sublethal doses of plague blood, or by sterilised cultures of the plague bacillus; hence the blood-serum of the animals treated by these methods failed to exhibit any definite curative or prophylactic property.

Microbe of Cattle Plague.*—MM. M. Nencki, N. Sieber, and W. Wyžnikiewicz describe a microbe which they have found in the blood and tissues in cattle plague. It is 1–3 μ in size, and in shape usually round. It was cultivated on media composed of extract of salivary gland, in pepton-salt solution, and in agar mixed with inorganic salts. In examining the blood, it is necessary to break up the red corpuscles by the addition of an equal bulk of water. Cultures from the bile proved fatal to calves.

Pseudo-Tetanus Bacillus.†—Prof. E. Tavel describes a bacillus, isolated from abscesses in connexion with the intestine, which has some resemblance to the tetanus bacillus. It is about 5–7 μ long and 0·5 μ thick. It forms a terminal oval spore, and possesses several (4–8) flagella. It is easily stained by basic anilin dyes, but only with difficulty by Gram's method. It is an essential anaerobe; it was cultivated in bouillon, agar, and in serum, but not in gelatin. The spores are killed if heated to 80°. It is not pathogenic to mice, rabbits, or guinea-pigs.

Ætiology of Dysentery.‡—Dr. S. Ciechanowski and Dr. J. Nowak made an investigation into twenty-one cases of dysentery for the purpose of ascertaining the ætiology of this disease. The intestinal contents and the mucosa of the colon were thoroughly overhauled. The most prominent and frequent bacteria present were *B. coli commune*, *Streptococcus*, and a vibrio, much like *V. choleræ asiaticus*, but staining well by Gram's method. Amœbæ were put out of court owing to their infrequence. Experiments were made on cats with toxines of the bacteria alluded to, chiefly *B. coli commune* and its variety *B. coli dysentericum*, but no phenomena or symptoms similar to those of dysentery resulted.

The conclusions arrived at are that, with regard to the dysentery of temperate latitudes, neither amœbæ nor any one kind of bacterium stand directly to dysentery as cause to effect. Moreover, there is no proof that it is a mixed infection even; and, in fine, our knowledge of the ætiology of this disease is nil.

Bacillus capsulatus chinensis sp. n.§—Dr. Alice Hamilton describes a bacillus, remarkable for an extraordinarily thick capsule, which was

* Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) pp. 529–37 (3 pls.).
† Tom. cit., pp. 538–41 (1 pl.).
‡ Tom. cit., pp. 445–52, 493–500 (2 pls.).
§ Op. cit., 2te Abt., iv. (1898) pp. 230–5 (1 fig.).

discovered in "Indian ink." Under the Microscope the organisms presented themselves as spherical or oblong forms, in the middle of which lay a bacillus about 0·6 μ broad and 4–8 μ long. Two or three individuals may occupy one capsule. The bacillus did not stain by Gram's method, it was devoid of movement, and spore-formation was not observed. It was easily cultivated on the ordinary media at from 20°–37°. Gelatin was not liquefied. The growth is white. The bacillus is a potential anaerobe. Milk is slowly coagulated. In some media a smell arises, on agar like yeast, in milk like cheese, on potato like trimethylamin and ammonia. The bacillus is extremely pathogenic to mice and guinea-pigs.

A special characteristic of this microbe is that it never loses its capsule, and that the capsule is thicker and finer on some artificial media, such as glycerin-agar or beer-wort agar, than in the animal body. The bacillus has been found not only in liquid and solid Chinese, or rather "Indian, ink," but in samples of China tea.

Tuberculosis and Pseudo-Tuberculosis.*—MM. Bataillon and Terre recount some more examples of the polymorphism of the tubercle bacillus.† In a previous communication, the authors had described two types, A that of Koch, B a variety, adapted to low temperatures. Two secondary types, a and β derived from A, are now mentioned, and details of three series of experiments given. In two there is manifest tuberculosis, but there are no germs in the tuberculous products capable of being stained by the Koch-Ehrlich method. In the third series the results were much the same, except that the bacilli were motile. Thus human tuberculosis, after a short passage through the frog, when transferred to guinea-pigs, renders these animals tuberculous without the demonstrable presence of Koch's bacillus, the form of the bacillus resembling that of pseudo-tuberculosis. In rabbits, the bacillus exists in the blood and viscera, but there is no tuberculous formation or deposit. A converse type, i.e. where rabbits become tuberculous and guinea-pigs do not, is next alluded to. Thus there are two types of pseudo-tuberculosis, originating in two distinct stages of the bacillary cycle.

The inference drawn by the authors is very important. They are convinced that many cases of pseudo-tuberculosis are instances of real tuberculosis, the agent being one of the numerous forms of Koch's bacillus.

Bacillus of Bitter Wine.‡—MM. J. Bordas, Joulin, and Rackowski isolated from a sample of bitter wine, by cultivation in strong yeast water slightly alkalinised with potash and containing glucose, a bacillus which presented itself in the form of filaments of variable length. After a few days the filaments united into bundles made up of short rodlets. The colonies on gelatin were small, yellowish, and did not liquefy the medium.

In Laurent's medium, containing 10 per cent. pepton Collas, the bacillus grows rapidly; in 24 hours the liquid is turbid, and in eight days is distinctly bitter, and at the same time there is gas formation. In this medium, the bacillus presents itself as short rodlets 4–5 μ long

* Comptes Rendus, cxxvi. (1898) pp. 538–41.
† See this Journal, 1897, pp. 571 and 2.
‡ Comptes Rendus, cxxvi. (1898) pp. 598–9.

and 1 μ broad. The rodlets are sometimes motile, and are so arranged as to impart the notion of being ramified. Wine, previously passed through a Chamberland's filter and examined six months after inoculation with this bacillus, was found to be pronouncedly bitter. The wine had become turbid; its colouring matter had been partly precipitated, the deposit being found to contain the characteristic filaments. The alcoholic strength of the wine was undiminished, while the glycerin and glucose were notably less. The acidity was greatly increased. The infected wine had been kept at a temperature of 20°, though artificial cultures were found to do better at 30°. In wine from which the alcohol had been removed by distillation, the disease is quickly effected.

Smegma Bacillus.—Herr H. Laser * succeeded in obtaining, from hard chancres and *condylomata lata*, colonies of Smegma bacilli on blood-agar. The colonies resembled those of *Streptococcus* and diphtheria, and when transferred to blood-serum and glycerin-agar they grew up thereon like dew-drops. No growth occurred in gelatin thrust cultures. On agar, in pepton-water, in bouillon, and on potato, there was scanty or no development, but on grape-sugar bouillon the growth was moderate. The bacilli were stainable with fuchsin and methylen-blue, as well as by Gram's method. Often rodlets were found which were stained only at the ends, thus giving the appearance of cocci. The results from subcutaneous and intraperitoneal injection of mice and guinea-pigs were negative.

Herr Czaplewski † found small colonies of acid-resisting rodlets in some gonococcus cultures on nutrose-serum-agar. Pure cultivations were easily obtained. On Loeffler's serum at 37° yellowish-grey colonies appeared by the second day, and soon became confluent, forming a pretty thick overlay. On glycerin-agar the growth was somewhat similar. The growth on potato was scanty, and of a honey-yellow colour. The rodlets are stainable with the basic anilin dyes, and also by Gram's method; are very resistant to decoloration with 5 per cent. sulphuric acid, 30 per cent. nitric-acid-alcohol, sulphuric-acid-alcohol, and even by hydrochloric-acid-alcohol. The shape of the bacilli is very variable; on nutrose-serum and potato are found the longest forms; on gelatin the rodlets are frequently knobbed or swollen at one end, or very thick. On Loeffler's the rodlets are short. The bacillus is presumed to be identical with that described by Laser.

New Bacillus from a case of Leprosy.‡—Dr. Czaplewski cultivated, from the nasal secretion of a leper, a bacillus belonging to the tubercle bacillus group, and remarkable from being resistant to the action of acids and alcohol. The medium used was glycerinised serum, but cultures were also made with human ascitic fluid on agar, gelatin, and in bouillon. The bacillus stained well with anilin pigments, and also by Gram's method. The resistance to the action of alcohol and of mineral acids, though pronounced, is not so strong as that of the tubercle bacillus. In shape the organism is a straight or slightly bent rodlet, the length and thickness varying a little with the culture medium. The ends may

* München. Med. Wochenschr., 1897, No. 43.
† Ibid. See Beih. Bot. Centralbl., 1898, pp. 389-90.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) pp. 97-107, 189-94 (2 pls.).

be pointed, rounded, or even bulbous. In some preparations the bacilli are found massed together, in others there are club-shaped forms, and in others branched forms.

Experiments on animals were negative.

Septicæmia hæmorrhagica of Cattle.*—Dr. G. Bosso describes a micro-organism which he has discovered in the hæmorrhagic subserous flecks of cattle dying in 24 hours of hæmorrhagic septicæmia. The microbe is $2-2 \cdot 4\ \mu$ long and $0 \cdot 4-0 \cdot 5\ \mu$ broad. It is devoid of motion, and does not form spores. It is easily stained, but not by Gram's method. It does not give the indol reaction. It is a potential aerobe, though when cultivated as an anaerobe it loses its pathogenic properties for guinea-pigs and rabbits. It is easily destroyed by heat and chemical reagents and drying. The effect of its toxin when injected into animals is practically nil. Its virulence is rapidly diminished by continuous cultivation, but by passage through animals it acquires increased pathogenic properties. The microbe is pathogenic to guinea-pigs and rabbits, producing in these animals the morbid appearances of hæmorrhagic septicæmia. Successful cultures were obtained in bouillon, milk, on gelatin, agar, and potato.

Histological examination of cattle, guinea-pigs, and rabbits, shows the presence of large crowds of the specific bacterium in the extravasations in the heart, spleen, and kidneys.

Ætiology of Syphilis.†—Dr. Van Niessen describes a microbe which he has found in the blood and diseased tissues of persons suffering from syphilis. The organism, which is demonstrable by staining reagents and on cultivation, is a pleomorphic bacillus, closely allied to the higher fungi. The disease is transferable and hereditary, not only in man but also in animals (rabbits) inoculated with the bacillus. The organism usually presents itself in the form of streptobacillus. The appearances presented by the blood, as depicted in some of the figures, are so unusual that it excites the doubt whether the drawings were made from recent or old preparations.

Parasites of Cancer and Sarcoma.—M. F. J. Bosc,‡ from an examination of large numbers of malignant growths, is of opinion that there exist in these tumours abnormal structures, foreign to the tissues, which may be grouped under five morphological types:—(1) micrococci or microbes; (2) granulations; (3) cell-forms; (4) encysted-forms; (5) sarcodic forms. All these five types have their seat in the protoplasm of the cancerous cell, occasionally in the nucleus, and sometimes in connective tissue cells and giant cells.

The examinations were made from the fresh juice and tissue, and also from fixed preparations, stained and unstained.

In a later communication § the author discusses the staining reactions, the structure, and the modes of reproduction of the parasites. Even without staining the parasites can be distinguished from the surrounding tissue, but from staining in the first condition remarkable

* Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) pp. 318–23.
† Tom. cit., pp. 49–59, 108–17, 194–205, 258–66 (2 pls.).
‡ Comptes Rendus, cxxvi. (1898) pp. 541–4.
§ Tom. cit., pp. 1161–3.

results are obtained. Sections from fixed tissue are less satisfactory, though they may be made to show the parasite with great clearness. The chief facts relating to structure appear to be the presence of a hyaline zone around the microbic, the granular, and cellular forms, the existence of a nucleus in the cellular forms, and the presence of a doubly contoured capsule around the encysted forms. With regard to reproduction, it seems that the parasites form spores freely, that some are large and some small, that there is a non-sporing cycle with direct division of the nucleus, and that there is a cycle of reproduction by means of microsporozoits or chromatozoits.

The same parasite may also pass through several evolutionary cycles.

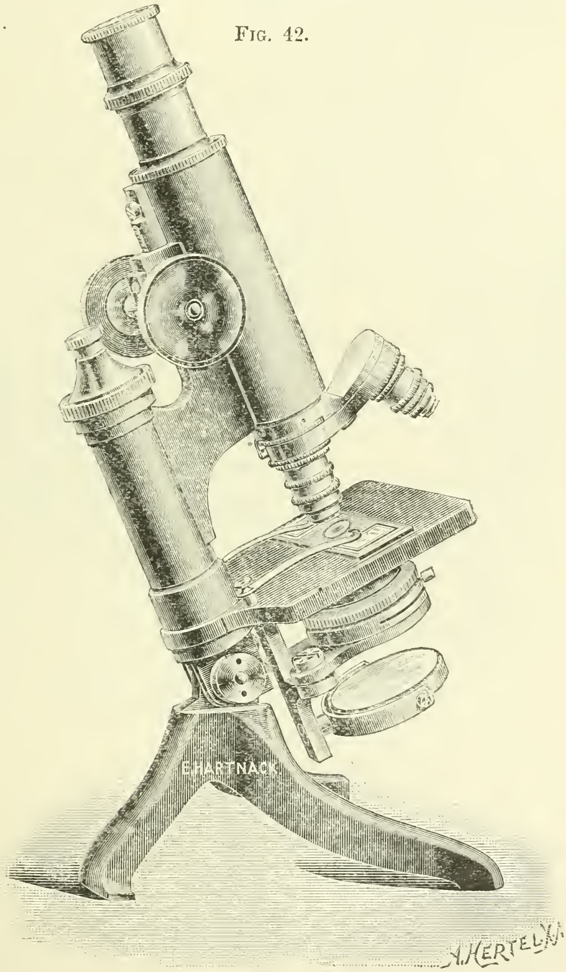
MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

New Hartnack Microscope.—The well-known Potsdam firm have brought out a large model Microscope (numbered iv C in their Catalogue) which is represented in the accompanying figure. It has the novelty of

FIG. 42.



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

an iron tripod foot after the English style, and the illuminating apparatus is worked, not by means of a screw, but by freehand motion. The iris diaphragm is applied by a side movement, and consequently affords a better control of its opening. A movable and rotatory stage can be fitted if desired.

Brugnatelli's Large-size Mineralogical and Petrological Microscope.*—The stand (fig. 43) is 40 cm. in height, is mounted on an iron horse-shoe foot, and possesses perfect stability at all inclinations. The illuminating arrangement can be raised or depressed at will by means of rackwork. The polariser and condenser are centered by two screws and a spring. A large Nicol's prism is mounted in a rotatory tube, completely independent of all other movements; it can be set in all desired orientations, and can be easily removed for cleaning. Immediately below the Nicol is an iris diaphragm, whose movement, regulated by a button, is completely independent of that of the polarising prism, in such a way that the motion of the diaphragm has no effect on the orientation of the prism. A division into degrees and an index gives this orientation; another division allows the opening of the diaphragm to be read in millimetres. This new arrangement is useful for the determination of the indices of refraction after Viola's method. The condenser is composed of three lenses, of which the largest, with very long focus, is united to the mounting of the Nicol, and serves also for observations with parallel light. The means by which parallel light may be exchanged for very convergent illumination is imitated from the Fuess Microscope, but simplified in the sense that the condenser can be easily unshipped without the aid of a special key. The two superior lenses of the condenser, forming a system with large aperture angle, are mounted on a movable arm fixed under the stage. The arrangement for inserting this and taking it away is the same as in the Fuess Microscopes.

The circular stage is 120 mm. in diameter, and bears on its periphery a scale in degrees on argentan (a metal which keeps its white colour). It moves on a conical bronze guide with great precision. Two verniers read to 10′. On the rotatory stage is fixed a micrometric car of very careful construction whose orthogonal displacements are regulated by two micrometric screws each provided with a drum giving, the one, hundredths of a millimetre, the other, 0·04 mm.; two divisions in millimetres give the entire turns. The maximum movement of the car is 20 mm. in each direction. The object-carrier is applied to the car by means of an easily removable clip.

The upper part carrying the tube has been heightened by 4 cm. by means of a massive cylindrical column; this arrangement, coupled with a more extended draw-out of the tube by means of a rack, allows the placing, between the stage and the objective, of accessories of a certain height, such as the stages of Klein, Fedorow, &c. The tube is composed of two parts jointed one within the other. The lower extremity bears a revolver for three objectives, centerable on the rotation axis of the stage. By means of always screwing the same objective on the same arm of the revolver, a perfect centering is obtained. The centering ring of the revolver is pierced by an opening of rectangular section orientated at 45°,

* Bull. Soc. Vaud. Sci. Nat., xxxiii. (1897) pp. 228–30 (1 pl.).

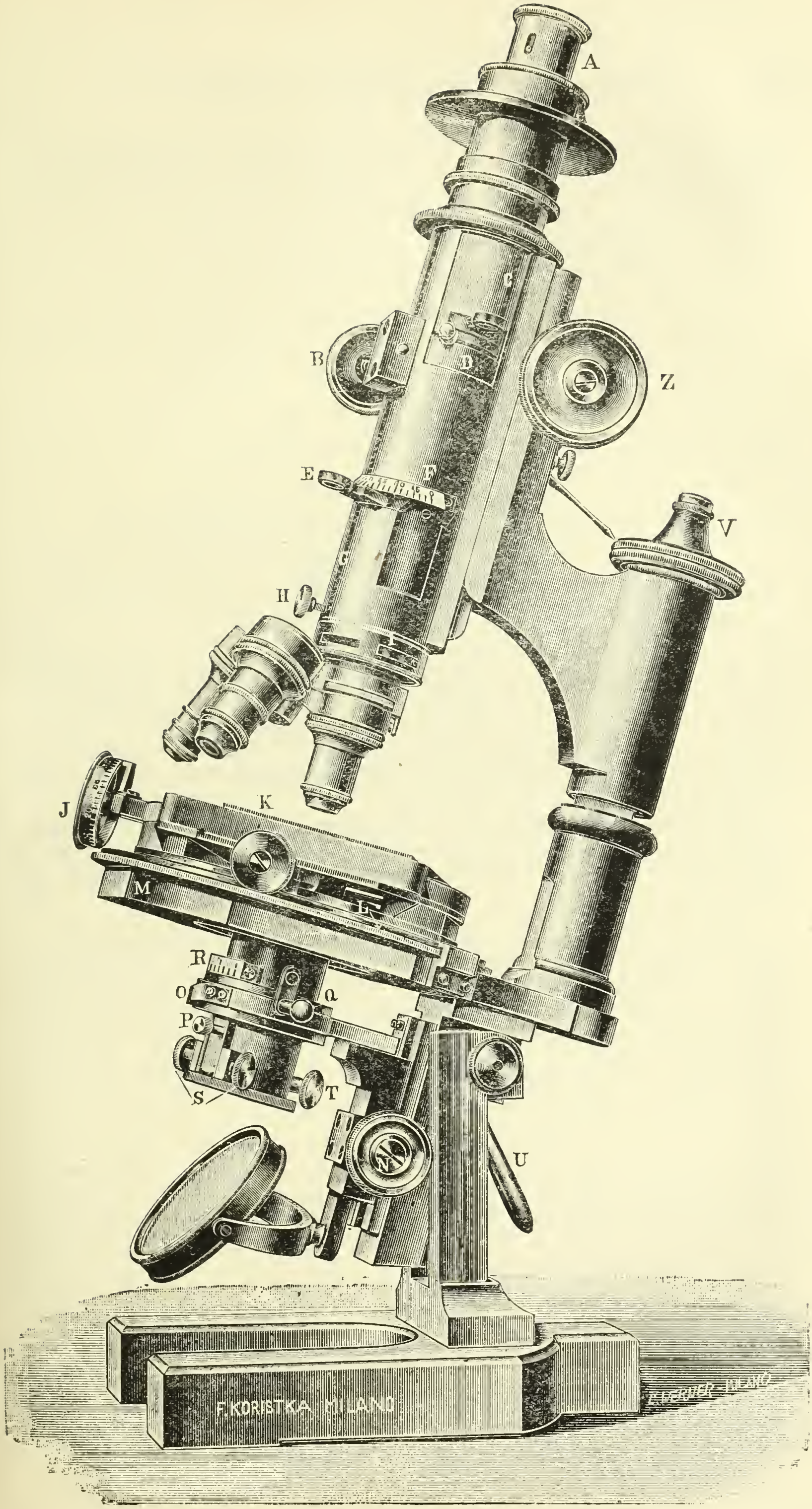


FIG. 43.

and intended to receive the feather edges of gypsum and quartz. This opening can be closed at will by a movable ring. Immediately above this arrangement is a window in the exterior tube, in which slides the analysing Glan-Thompson prism combined with a long focus lens which renders invariable the focal distance of the optical system used with or without the analyser. A new arrangement allows the orientation, by a rotation of 90°, of the analyser; the orientation of the principal section being indicated by an index and a divided dial. All the upper part can be raised or lowered by means of a rack and pinion; the micrometric movement is done by means of a screw whose head is divided into ·005 mm.

In order to use the instrument as a focimeter, a division in millimetres is placed on the lateral part of the rackwork piece, and a vernier below the pinion.

The eye-piece tube is also worked by a rack and pinion, and can be extended about 40 mm. A millimetre scale reads the extension.

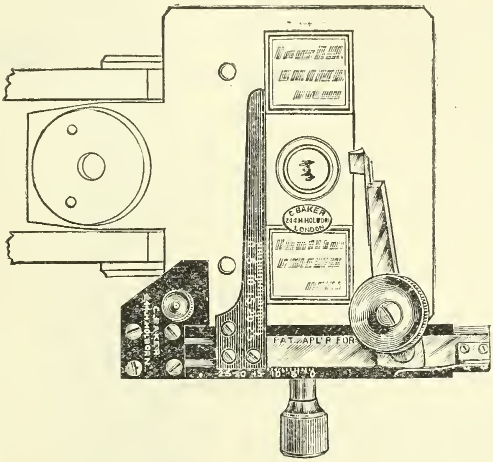
In the lower part of the eye-piece tube is an iris-diaphragm opened and shut by means of a button on the left side; directly over this is a window intended for the Bertrand lens to observe the axial figures of interference.

The upper extremity of the tube carries the analyser with divided circle. The mounting of the Glan-Thompson prism is easily removed to introduce the oculars. These are provided with a reticule and a small screw which ensure the invariable position of the crossed threads in relation to the principal sections of the Nicols. The mounting of the upper analyser is also provided with an opening intended to receive the feather edges.

M. Amann, who describes the Microscope, has been able to assure himself, by actual working, that the instrument possesses qualities of high precision, solidity, and simplicity, which render it an eminently practical instrument.

New Attachable Mechanical Stage.—Fig. 44 is an illustration of Baker's new mechanical stage, designed by Mr. Allen, and exhibited by Mr. C. L. Curties at the meeting of March 16th last. This apparatus can be easily attached to any Microscope that has a rectangular stage, by means of two thumb-screws; one of these, at the lower end, can be seen in the figure, but the one at the top is not shown, as it is below the stage. This attachment at both extremities gives the apparatus great rigidity. Both rectangular movements are performed by means of rack and pinion. The milled head seen at the right hand causes the transverse arm, upon which the slip rests, to move in a vertical direction over the stage; but the principal novelty in this device is the method by which the transverse movement is controlled. Above the slip a transverse arm, fitted with a rank-and-pinion movement, is pivoted to the vertical dovetailed slide, and to its extremity is fixed a small piece of cork, which is kept in pressure against the top of slip by a spring placed on the right-hand side of the pivot. The friction of this cork pressing on the top of the slip is sufficient to impart transverse movement to the slip, when the milled head is turned. To diminish the friction between the bottom edge of the slip and the lower transverse arm, it is so arranged that the slip bears only on two points. Both movements are graduated in millimetres for registration as a "finder," and the mechanical movement in each direction is 1 in. Although the transverse movement is 1 in., the examination of a slip is not confined

FIG. 44.



to this amount, as is the case with most mechanical stages, because in this apparatus no limit is imposed as to the lateral position of the slip, neither is the length of the slip limited to the usual 3 in. The device, therefore, becomes eminently useful for the examination of serial sections.

(2) Eye-pieces and Objectives.

New Hartnack Homogeneous-Immersion Objective.—The Hartnack firm have brought out a 1/10 in. homogeneous-immersion on the same model as their 1/12 in. (No. 1). Greater experience in the construction of immersion lenses allows the new objective to be issued at a much less price than the 1/12 in. (85 marks as against 125). The numerical aperture is 1·25–1·30; the working distance 0·3–0·35; and magnification with suitable eye-pieces from 280 to 1050 diameters.

(3) Illuminating and other Apparatus.

Zeiss' Combined Horizontal and Vertical Camera.—This apparatus fully answers to its name, and secures, at the will of the operator, a horizontal, vertical, or 45° inclination of the camera. These three positions will be readily understood from figs. 45 and 46; the outlined portion of fig. 46 showing the 45° position. The massive triangular cast-iron sole plate F has recessed into it a revolving stage P, which is kept in position by a spring, and is adjustable by three setting screws *i i*, so as to give the Microscope its proper elevation and inclination. The Microscope is placed upon the rotating stage, and is adjusted in such a manner that in its vertical position its axis coincides with the axis of rotation of the revolving stage P. This adjustment need only be made once, as a stop fixed at the front edge of the rotating stage always ensures the correct setting of the Microscope, which is firmly clamped by means of a cross-

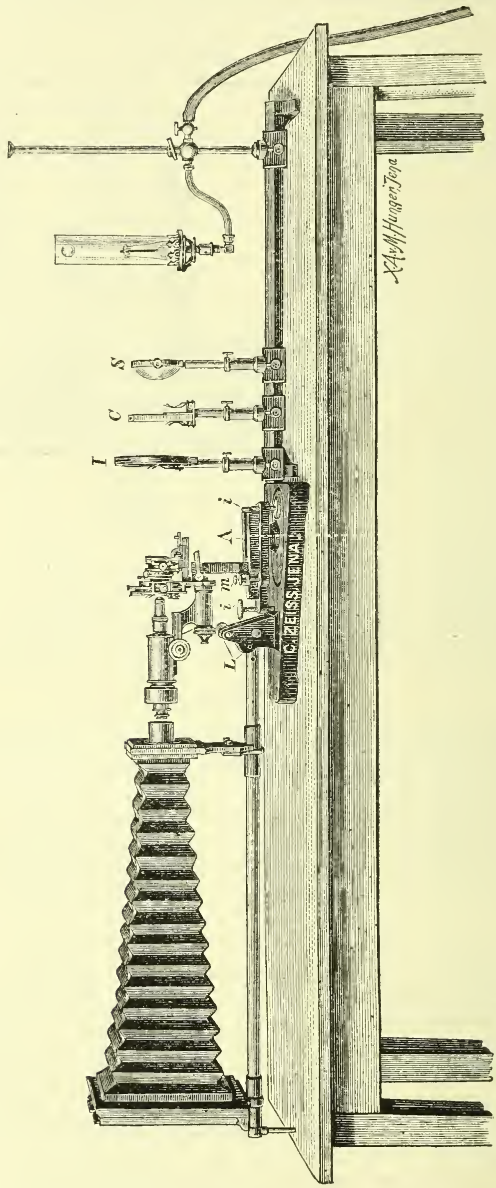
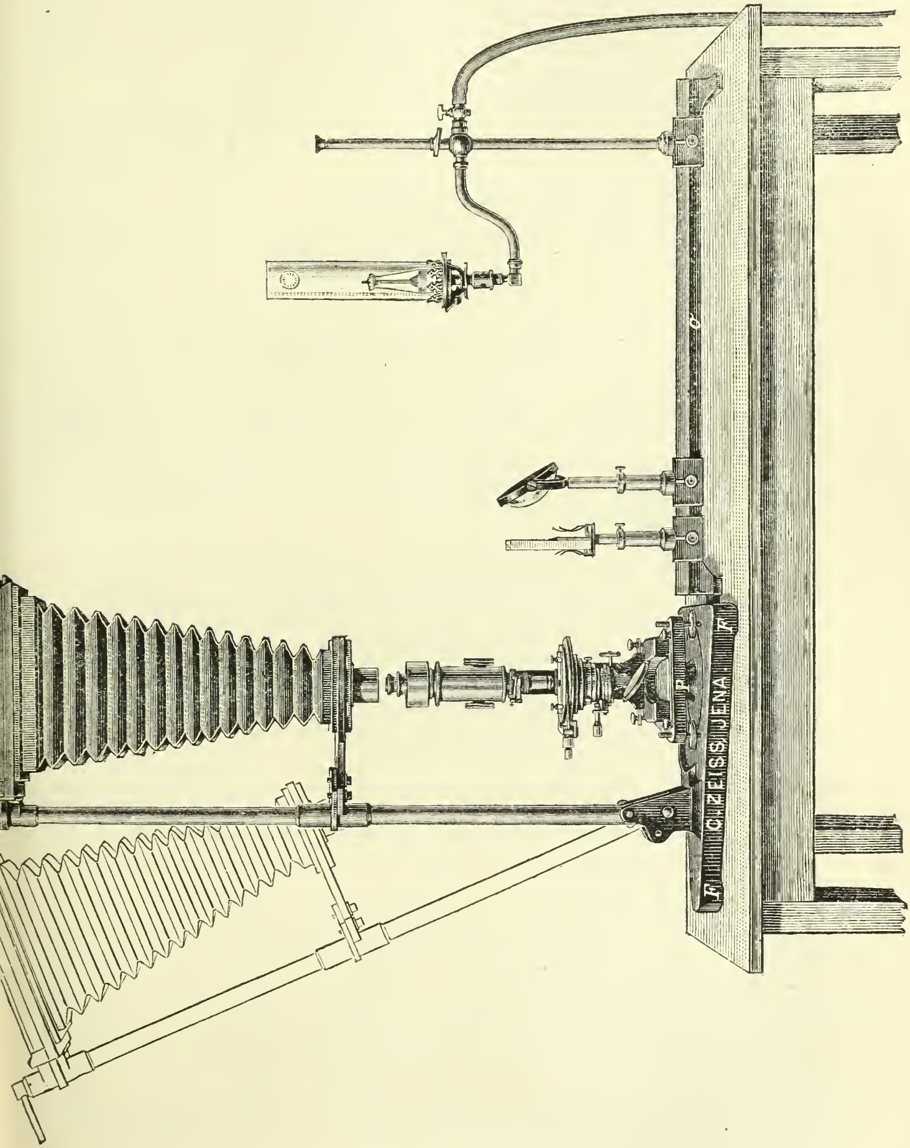


FIG. 45.

bar m passing over the claw at the back of the foot of the Microscope, and capable of being tightened down by means of two screws. The

Microscope, together with the revolving stage, may be rotated through 90° in either direction with respect to the central position. The front



set-screws slide both together in a circular groove recessed into the revolving stage; the back set-screws slide in a separate elevated recess. This arrangement, in conjunction with the spring which binds the revolving stage and the sole plate together, serves in a very efficient manner to adjust the position of the revolving stage and the Microscope in the two principal directions. A cylindrical guide rod, mounted hinge-fashion in a fork at the rear of the sole plate, supports the camera, either end of which is adjustable by sliding sleeves fitted with thumb-screws. These screws enter with their points into a longitudinal groove running along the rod, and thereby keep the camera from turning round.

A prop at the end of the guide rod maintains the camera in a horizontal position; the vertical position is ensured by a stop at the front of the rod, a bolt at L acting as a clamp. A pin passed through the back of the support obtains the 45° position.

An optical bench adapted to the front of the sole plate provides for the reception of the light-source, condensing lenses, and other accessories.

(4) Photomicrography.

Winkel's New Photomicrographic Apparatus.*—Dr. H. R. Gaylord, of Dresden, describes this apparatus, which is based on Zeiss' combined horizontal and vertical camera, and differs from it mainly in securing to the operator *any* inclination of the camera he may desire. This is accomplished by attaching the guide rod to a rail which slides in a groove made in the sole plate. The two ends of the camera are connected by stay-rods, which can be clamped at any angle to a sleeve sliding on the guide rod.

(5) Microscopical Optics and Manipulation.

Aperture as a Factor in Microscopic Vision.† (Plates VII.–X.)—Dr. A. Clifford Mercer, in his presidential address before the American Microscopical Society in 1896, describes a long series of experiments undertaken by him with the view of investigating this subject.

Considered theoretically and independently as a factor in microscopic vision, aperture has been almost ignored; although as an associate factor, associated with diffraction by the finer details of microscopic objects, it has received no little attention. In this latter form it is the basis of the Abbe theory of microscopic vision; but the writer wishes to call attention to some unsatisfactory points in the Professor's theory, and to submit a theory of microscopic vision in harmony with an experimental study of aperture.

He believes that the theory of the effect of aperture should be applicable to all projecting lenses (e.g. telescopes as well as Microscopes), explaining resolving power and its limitation; that the diffraction of light by an object should be considered in the same category with other changes in direction in incident light produced by an object, e.g. those resulting from reflection and refraction; that diffracted and others rays leaving an object in changed directions, as well as rays directly transmitted, when travelling the same paths between an object and an objective, are affected alike by aperture; and that the final effects in the image experimentally studied by Abbe are the result of changes

* Zeitschr. f. wiss. Mikr., xiv. (1898) pp. 313–7 (2 figs.).

† 'An Experimental Study of Aperture as a Factor in Microscopic Vision, Buffalo, 76 pp., 4 pls. and 13 figs.

ABOVE the objective due to aperture, and not to changes BELOW the objective resulting from diffraction by the finer details of an object.

He first made a preliminary experiment by constructing a gigantic Microscope out of a telescope objective, which had a diameter of $2\frac{1}{2}$ in. and a focus of 43 in., and an eye-piece which was supported 60 ft. from the objective. No tube was necessary, as the experiment was done in a dark room. The source of light was an electric arc lamp about 27 ft. from the objective. The object was a series of vertical lines scratched with a fine needle-point through the opaque film of an old dry plate negative supported nearly 46 in. in front of the objective. After focusing so as to show the lines through the eye-piece, a plane was found not far from the eye end of the actual telescope-tube, in which was a central image of the electric arc with a series of diffraction images on each side. These images could be dealt with so as to vary the final image seen through the eye-piece, as one deals with the "spectra" at the back of the Microscope objective to produce change in the final image of the ordinary Microscope.

If a telescope objective behaves in the same way as a microscopic objective in experimenting with these diffraction phenomena and associated image changes, does a reason based on such experiments exist for regarding microscopic vision as *sui generis?*

Not only have microscopists noticed in practice the direct relation of aperture to resolution, but also the fact that isolated lines or particles in an object appear broader through an objective of small aperture, and narrower through an objective of large aperture. This narrowing effect of increasing aperture is due to the contraction of the diffraction pattern. *It is easily understood that the projected image discs of a series of close points in an object (or the projected image bands of a series of close lines) might touch or overlap when projected by a lens of small aperture, and, on the other hand, might be separated or resolved when projected by a lens of sufficiently large aperture.*

The separating or resolving power of the telescope is thus explained.

Simple parallel experiments with the telescope and Microscope show that the actual effects of aperture in both instruments are in harmony with the above explanation.

Dr. Mercer now describes 14 experiments, of which the following seem the most important.

Experiment 1.—The instrument used was a telescope having an aperture of $2\frac{1}{2}$ in. and a focus of 43 in., standing 27 ft. from a window in a darkened room. Outside the window was a mirror reflecting light from a bright sky into the room. Of all the light reflected from the mirror that only reached the telescope which passed through two pinholes in a piece of black paper supported in front of the mirror. The diameters of the pinholes were 1/30 and 1/20 in. respectively, and the distance between them 1/10 in. The iris diaphragm of an Abbe substage condenser was supported centrally in a temporary mounting of wood fitting into the hood of the objective. When the diameter of the iris was 1/16 in., the two pinholes appeared, when seen through the telescope, as one dim hazy disc. When the diameter was 1/8 in., a smaller and more distinct disc was seen. When the diameter was 3/16 in., the disc was still smaller, brighter, and better defined, with a dim, hazy, overlapping disc becoming evident. When the diameter was 3/8 in., both discs were brilliant and well separated, their relative sizes and distance apart approaching truth. When the diameter was 1/2 in., the picture was more brilliant, the larger disc tending to appear star-like with irradiation. With the full aperture of $2\frac{1}{2}$ in. irradiation was marked in both. During these observations thin concentric circles of light were glimpsed.

Experiment 2.—Instrument and all the conditions same as in experiment 1, except that in the hood was fitted a piece of stiff black paper instead of the iris diaphragm, the circular piece of paper allowing no light to enter the objective except that which passed through a slot corresponding with one of its diameters. Thus the objective was made rectangular in shape, with a narrow aperture in one direction, and a long or wide aperture in the other. The discs seen through the telescope appeared stretched out, as it were, into lines always crossing at an angle of 90°, the diameter of the instrument corresponding with the slot. The width of each line was determined by the long aperture; the length by the narrow aperture. A comparison of the width of each line with its length showed the comparative effect of the two apertures in contracting the diffraction pattern.

Experiment 3.—At a distance of 3 ft. in front of a Microscope the same pinholes used in the first two experiments were arranged so as to allow only such light from a lamp flame as passed through them to reach the mirror of the Microscope. The light reaching the mirror was reflected through the substage condenser to an aerial image of the pinhole projected by the condenser in the plane of the Microscope stage. The aerial image of the pinholes was the object observed through the Microscope. Seen with a small diaphragm opening behind the objective, the pinholes appeared as two discs just touching one another. With larger openings the discs became smaller, more brilliant, and separated. The effects of varying aperture (varied by means of diaphragm openings behind the objective) in this experiment with the Microscope were the same as those seen in the first experiment, when aperture was varied by means of diaphragm openings in front of the telescope objective.

Experiment 4.—The instrument and all the conditions were the same as in experiment 3, except that a slot corresponding to one diameter was used instead of the central opening in a diaphragm behind the objective. The aperture of the objective thus became rectangular in shape. The image of the pinholes was observed while the slot was turned so as to lie successively in all diameters of the instrument. The effects were the same as those seen when the corresponding experiment 2 was made with the telescope.

Experiment 5.—The apparatus and its arrangement same as in experiment 3, with two exceptions. First, for the two pinholes three were substituted, and a group of three parallel slits 2 mm. apart; second, for the diaphragms with a single opening at the back of the objective were substituted diaphragms with two slots. The substage condenser projected these as essentially self-luminous aerial dots and lines in the plane of the Microscope stage. The full aperture image is shown in photo 1, and is most like the original object. Projected with five isolated slots, the image shown in photo 5 differs more; while with two isolated slots the pictures shown in photos 3 and 4 differ remarkably from the original object.

Experiment 6.—The general arrangement of the apparatus and the aerial object remained the same as in the last experiment; but, instead of rectangular slots, annular or zonular slots were used at the back of the objective.

When an annular slot exposed emitting points in a circle 2 mm. in diameter, the image discs were surrounded by rings of light. When the circle was 4 mm. in diameter, the discs were surrounded by closer rings, and the tangential union of diffraction rings between the bands (overlapping discs) resulted in intense lines, in comparison with which the semi-rings at the ends of the bands appeared faint.

Now the diffraction pattern is contracted with every increase in diameter, and this is true in all diameters, and we know that with circular lenses an area of diffracted light varies in extent *inversely* with the square of its diameter or aperture. Therefore the light intensity of such an area would vary directly with the square of the aperture, provided the amount of light transmitted by the objective were to remain the same. But the amount of light transmitted by the objective increases with the square of its aperture. This means that, independently of the contraction of the diffraction pattern, an area of light on the projected image varies in intensity with the square of the aperture of the lens. Increase of aperture, then, adds to the intensity of the diffraction pattern in two ways. The increase of intensity gained in one way must be multiplied by that gained in the other to get the total increase. Thus: *The intensity of the diffraction pattern varies with the square of the square of the aperture.*

Experiment 7.—The object of this was to test the conclusion just arrived at. The apparatus and conditions were as in experiment 6, except that for the object was substituted an aerial image of a tiny pinhole, and for two or more slots behind the objective, single slots were substituted.

Photo 8 is a double photomicrograph of the aerial object. E had the first exposure of 15 seconds, with a slot 3 mm. wide. The aerial object was shifted very slightly to the right. F had an exposure of 1215 ($= 15 \times 3^4$) seconds, with a slot 1 mm. wide. Exposed on the same plate and developed the same, the two images were strictly comparable as to their intensities. The exposures were so timed as to show the first diffraction ring in each case. The triple broadening of the disc by the lesser aperture at once attracts attention, and it is clear that the exposures were as 1 to 81 ($= 3^4$). In the negative it was impossible to say that the two rings differed in intensity, but unfortunately the half tone process has failed to reproduce the rings.

With small apertures the visual pictures of finest particles and lines consist chiefly of diffraction spreading. Such diffraction spreading not only contracts with increasing aperture, but gains in intensity rapidly (with the square of the square of the aperture). Thus, increasing aperture narrows and intensifies most noticeably the picture of finest details. In a similar way, increase of aperture causes diffraction-spreading of boundaries of areas to contract and to approach in intensity that of the area, because that of the former increases with the square of the aperture, while that of the latter increases with the square of the square of the aperture.

Experiment 8.—The apparatus was arranged as in experiment 6, but instead of an aerial image of bright lines and areas, an aerial image of dark lines and areas was photographed. The results in photos 19, 20, 21, and 22 correspond with those in photos 1, 2, 3, and 5 respectively.

Experiment 10.—A telescope was arranged as in experiment 2. Instead of the paper diaphragm with a single slot, diaphragms with two or more slots were used in the hood. Emitting points uncovered by pairs of slots (or an isolated zone of aperture) in a telescope behaved as we have seen the corresponding apertures of a Microscope objective behave in the projection of diffracted phenomena.

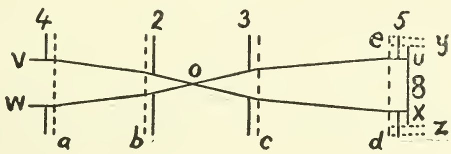
Experiment 11.—Fine and closely ruled lines were observed while diaphragms with minute openings were held between the lines and the eye. The conditions were varied so as to convince one that the dioptric apparatus of the eye projects diffraction phenomena parallel with those previously studied in images projected by the telescope, Microscope, and camera objectives.

Experiment 12.—Photo 32 shows the lines of an Abbe test plate (the same shown inverted in photos 9 and 10), taken when the last emitting surface of the objective used was covered with a diaphragm which had an eccentric opening 1 mm. wide, and transmitted only such rays as had been previously diffracted in the plane of the object by the lines cut through a film of silver. Photo 33 was taken under the same conditions, excepting that the eccentric opening was 2 mm. wide. Photo 34 was taken under the same conditions as photo 32, except that the slot 1 mm. wide transmitted central primary rays. Photo 35 was taken with a slot 2 mm. wide, half central and half excentric, transmitting through its central half primary rays, and through its excentric half diffracted rays. Repetitions of the experiment show that, under parallel conditions, the same aperture gives the same resolution with either diffracted or primary rays. In other words, *Aperture affects diffracted rays from an object as it does primary rays from an object.*

Dr. Mercer now gives at full length his reasons for considering that advantageous reduction in a cone of light between an object and the objective should not exceed, in the case of first-class objectives, one-fourth to one-third (never more than one-half) of the diameter of the cone.

Experiment 13.—The general arrangement of apparatus was the same as in taking photo 1 (experiment 5), but instead of the card-holes an opaque card having a cross-shaped hole cut through it was placed against the bull's-eye condenser. An aerial image of the cross was projected in the plane of the Microscope stage by a 1 in. objective arranged as a substage condenser. This aerial image was then observed through a $1\frac{1}{2}$ in. objective and a 2 in. Huyghenian eye-piece. Let fig. 47 indicate diagrammatically the relative positions of the substage condenser, aerial image, and objective. The dotted line a shows the position of the first lens of the substage condenser, and b the position of its second lens. Let c show the position of the first lens of the objective, and d that of the final lens of the objective. Let 4 represent the Powell and Lealand substage diaphragm with circular opening "4" in use. Let the angular lines V O X and W O U indicate the paths through the lenses which the boundary rays of the light transmitted by the diaphragm opening at 4 travelled. Experimentally it was found that a circular opening 2 mm. in diameter in a diaphragm capping the substage condenser at 2, a circular opening 3 mm. in diameter in a diaphragm capping the objective at 3, and a circular opening 5 mm. in diameter in a diaphragm placed behind the objective at 5, just permitted all the rays transmitted by the diaphragm opening " 4 " to reach the emitting surface at *d*.

Fig. 47.



Then, without otherwise changing the arrangement, for diaphragm 5 with its opening 5 mm. in diameter was substituted diaphragm 8 (shown just behind 5), which had a zonular opening and an opaque central portion 8 mm. in diameter. Diaphragm 8 obstructed all the primary rays emitted by the lens at *d*. The eye-piece was then removed. On looking at the back of the objective, the zone *c d* uncovered by diaphragm 8 was illuminated, and remained illuminated even when the circular opening at 4 was changed to " 1 " of the substage diaphragm. The peripheral zone at the back of the objective was illuminated by rays which must have been separated from the direct axial rays at a previously operative lens-surface.

The 2-in. eye-piece was replaced; the eye-lens of the eye-piece was removed, and a photomicrograph taken, as shown in photo 14.

Diaphragm 5 was then exchanged for diaphragm 8, and the photomicrograph taken with the same camera arrangement is shown in photo 17. Immediately afterwards, while observing the image of the annulus on the ground glass as the camera with its 1-in. objective was pushed slowly towards the Microscope, the annulus was seen to shrink gradually and become the small cross shown in photo 18, which is inverted as to the larger cross in photo 14. There can be no doubt then that the annulus was illuminated by light which in some way was derived from the aerial image of the cross projected in the plane of the stage, and the inversion of the smaller image shows that the excentric rays were conveyed to at least one more focus than the direct axial rays. It is probable that the excentric rays were separated from the direct axial pencil by internal and converging reflection at the emitting surface of the front lens of the objective, and returned to the front surface, thence to be reflected back in an onward direction to and through the emitting surface along excentric paths towards the annulus.

The Abbe " spectra " now claim our attention. We have found that they are not indispensable in some of the images of microscopic vision. " Spectra " are images of an opening in the diaphragm of a substage condenser, or of a source of light, formed above the objective in microscopic vision by diffracted rays originating in the object. Can an image of an opening, or of a source of light formed in the Microscope-tube between the objective and the field lens of the eye-piece by diffracted rays, have any influence on the primary ray-image of microscopic vision formed between the two lenses of the eye-piece? Two widely separated images cannot be seen through the Microscope at the same time. In other words, such images cannot be united to form a joint visual picture.

Dr. Mercer thinks that the Abbe "spectra" are sometimes present as an accident of Microscope projection, and sometimes they are not.

Why do "spectra" when present appear to be of such importance? The "spectra" are so placed in a plane at the back of the objective that when a slotted diaphragm in their plane uncovers the "spectra," the same diaphragm uncovers simultaneously certain emitting points of the projecting lens. If now one of the slots of such a diaphragm be covered, one of the "spectra" disappears, and a corresponding change occurs in the projected image. But this change is due to the loss of the slot and corresponding emitting point of the projecting lens, and not to the loss of one of the "spectra"; because *if the "spectra" were absent in full cone illumination, the covering the slot in the diaphragm would produce the same change in the projected image.*

When the axial illuminating pencil is narrow and the Abbe "spectra" are separated by well-marked intervals of darkness, the Abbe theory ignores the emitting surface of the objective corresponding with the intervals of darkness. In harmony with this partial neglect of aperture, resolution in the Abbe theory may be said to increase by jumps. So long as a central image of the source of light is to be seen at the back of the objective, resolution is not present. The aperture may be increased without change in the contraction of the diffraction pattern and in accompanying resolution, so long as the central image alone is to be seen at the back of the objective. But the moment the increase in aperture is sufficient to uncover or admit one flanking "spectrum" image, resolution is present. With greater aperture no improvement is to be seen until another "spectrum" image is uncovered or admitted.

On the other hand, with full cone illumination, resolution increases continuously, and not by jumps or by periodic accessions. The portions of aperture neglected in the Abbe theory are effective in full cone illumination. They contribute in proportion to their breadth, radially from the principal axis, to the contraction of diffraction patterns. And thus they may resolve additional finer details (experiment 14) in an object, or increase the distinctness of the resolution of details already resolved.

Experiment 14.—A Microscope was arranged to exhibit the lines shown in photos 10 and 35. For the optical part of a Powell and Lealand substage condenser was substituted a Powell and Lealand 1-in. objective. A Powell and Lealand 3-in. objective and a "10 compensating" eye-piece were used. A diaphragm with an opening 10 mm. in diam. was placed at the back of the objective. The revolving diaphragm of the substage condenser was turned so as to bring opening "1" into use. The closer lines of the test plate were resolved. On removing the eye-piece and looking at the back of the objective, a central image of the opening in the diaphragm of the substage condenser was seen, flanked on each side at the limit of the aperture by about half of an Abbe "spectrum" image. The more distant halves of the "spectra" were just outside the limit of the aperture, and could not be seen.

Then, for the diaphragm with an opening 10 mm. in diam. at the back of the objective was substituted a diaphragm having an opening 6 mm. in diam. The latter just covered both halves of the two flanking "spectra," and left on each side of the central image a breadth of darkness corresponding with one portion of the aperture neglected in the Abbe theory. On replacing the eye-piece and again looking at the test plate, the closer lines could not be seen. Resolution failed, because under the conditions present the Abbe theory requires for resolution the admission, by the diaphragm at the back of the objective, of at least a part of one "spectrum" image in addition to the central image of the opening in the diaphragm of the substage condenser. Again the eye-piece was removed. The diaphragm of the substage condenser was turned so as to bring opening "3" into use. This change caused the central image seen at the back of the objective to increase in size until it filled the opening 6 mm. in diam. in the diaphragm at the back of the objective. On replacing the eye-piece and looking at the test plate once more, the closer lines were seen. Resolution returned as a result of the additional light from the larger opening on the diaphragm of the substage condenser reaching and utilising the portions of aperture which were previously dark under the conditions necessary to the Abbe theory.

Dr. Mercer summarises the results of his experiments thus:—

(1) Diffracted rays leaving an object may be considered in the same category with other rays changed in direction by an object.

(2) The diffraction phenomena seen in a projected image are essentially the effect of changes in light *above* the objective due to a function of aperture, and not to changes *below* the objective due to diffraction of light in the plane of the object.

(3) Diffraction in the plane of the object does, under some circumstances, furnish light to certain parts of an aperture from which primary rays are absent, and thus enables aperture to more fully determine the character of the projected image, resulting in a more nearly truthful image, or, on the other hand, in false appearances. This is the gist of the Abbe phenomena of microscopic vision.

(4) But such phenomena are not peculiar to microscopic vision, notwithstanding Prof. Abbe's claim to the contrary.

(5) With any positive lens similar and more brilliant results may be got by utilising corresponding pencils of primary rays, instead of isolated pencils of diffracted rays.

(6) Still more trustworthy results may be got by using continuous apertures three-fourths (in diameter) full of primary rays instead of the isolated pencils of primary rays.

(7) An advantage peculiar to using narrow cone illumination with an objective of wide aperture (the only illumination admissible in the Abbe theory) consists in giving, under suitable conditions, approximately the acme of resolving power simultaneously in each of several diameters. Thus a circular aperture is approximately squared or made rectangular as to resolving power in several of its diameters simultaneously.

(8) Special attention is called to the fact that the Abbe theory deals with complex objects; for only such objects are subject to resolution. Single particles and uniform areas are outside its domain. These latter, however, are microscopic objects, and all objects are essentially different shaped aggregations of points. An isolated point-like particle, no matter what its minuteness, may be seen if it present sufficient contrast with the surrounding microscopic field. The size of the disc image is no less than a limit determined finally by aperture. That limit in size, varying inversely with aperture, determines the limit of resolving power. This is the gist of the theory of microscopic vision which harmonises with our experimental study of aperture.

Microscopic Vision.*—A paper read by Mr. E. M. Nelson under the above title gives an interesting historical sketch of the theory of microscopic vision and its present position.

After glancing at Dr. Goring's experiments on angular aperture in 1837, Mr. Nelson goes rather fully into the history of the controversy initiated by Dr. Pigott in the M. M. J. (July 1870). Amid much error and much high-sounding Greek verbiage, Dr. Pigott had the merit of stating several important truths, viz. :—

(1) That a water-immersion lens can have a greater aperture than any dry lens, and similarly a homogeneous than a water-immersion.

(2) That illuminating power is increased by the use of higher refractive media.

(3) The suggestion of homogeneous immersion.

Possibly Dr. Pigott's lucubrations suggested to Mr. R. B. Tolles the improvements connected with his name; for in 1874 he actually constructed a balsam immersion objective, and in 1873 an apertometer on much the same principle as that now known as Abbe's; moreover, the word "homogeneous" as applied to immersion objectives is probably due to Mr. Tolles.

Mr. Nelson now traces the history of diffraction from Fraunhofer, through Herschel and Nobert, to Dr. Barnard in 1869. Fraunhofer, in studying the well-known equation $\sin \theta = \frac{\lambda}{\delta}$, had thought that the limit of microscopic vision was reached when $\delta = \lambda$ and θ consequently equalled 90°. If Fraunhofer's theory were correct, not even the 9th band of Nobert's 19th band test-plate (56,300 lines per inch) could be resolved in monochromatic yellow light; but Dr. Barnard and Colonel Woodward had resolved up to the 19th (112,600 lines per inch) with a P. and L. water immersion 1/16.

We are now brought to the era when the opinions of Abbe and Helmholtz were made known to this country by Dr. Fripp. Abbe's great idea of using Snell's equation (law of sines) as a standard to which all kinds of aperture might be referred, simplified matters, and put fresh meanings into and enlarged the ideas connected with aperture. Both Pigott and Tolles used Snell's law, $\mu \sin \phi = \mu' \sin \phi'$; but Abbe went further, and said, $\mu \sin \phi = \mu' \sin \phi'$ = numerical aperture.

Among the enlarged ideas put into the word "aperture" by Prof. Abbe, its photometric value stands first. The radiation of light from

* Proc. Bristol Naturalists' Soc., viii. pt. ii. (1896–7) pp. 141–66 (6 figs.)

any surface diminishes in proportion to the cosine of the inclination of the rays to the normal. This means that the amount of light radiating from a point in a homogeneous medium varies as $(\sin u)^2$, where u is the semi-angle of the solid cone. The next point is that the radiation of energy, such as light and heat, in different media, varies as (n^2), where n is the refractive index of the medium. Therefore the total effect of radiation in any medium is proportional to $(n \sin u)^2$, i.e. the square of the numerical aperture.

The Lagrange-Helmholtz-Abbe theorem may be called the Magna Charta of Microscopy. If u and u' be the angles of convergence of any ray on either side of a given system, n and n' the refractive indices of the media on either side, and M the magnifying power, then

Lagrange (1803) showed that $\frac{u}{u'} = M$, the media on both sides of the system being the same, and the aperture small.

Helmholtz (1866) that $\frac{n}{n'}\frac{u}{u'} = M$, the media different, but the aperture small.

Abbe (1873) that $\frac{n \sin u}{n' \sin u'} = M$ for any aperture or media.

Mr. Nelson outlines the proof of the last result, and shows that the following useful formulæ may be obtained:

$$\text{(i.)}\quad \frac{\frac{1}{2}\text{ back lens}}{\text{N.A.}} = f;$$

$$\text{(ii.)}\quad \frac{M \times \frac{1}{2}\text{ back lens}}{\text{distance}} = \text{N.A.}$$

This gives a simple way of measuring the equivalent focus of any objective without an apertometer. The image of a stage micrometer is projected without an eye-piece on a screen, say 2 or 3 ft. from the back lens, and M the magnifying power is measured; this, when multiplied by half the diameter of the back lens, and the product divided by the projection distance, gives the N.A.

In discussing the Abbe theory that coarse structures are imaged according to ordinary dioptric laws, and fine ones according to diffraction phenomena, Mr. Nelson points out that the line of demarcation between coarse and fine was placed at 1/2500 of an in., but that this position is untenable, because the diffraction pencils from gratings such as wire sieves, linen threads, or ruled scales, where the intervals are at least 1/50 in., can be easily seen without any special apparatus. With suitable apparatus the spectra arising from much larger gratings have been made visible.

The following simple but important experiments prove that the Fraunhofer diffraction law applies even to large objects which can be seen without instrumental aid.

(1) When a scale on a carpenter's rule is examined through a diaphragm held close to the eye, the hole being 0·011 in. in diameter, some divisions on the rule can just be perceived at $7\frac{1}{2}$ in. What is the fineness of the divisions?

Let a be the diameter of the hole, and λ the wave-length, say

1/45,000 in., δ being the value of one line and interspace. Then $\frac{a}{7 \cdot 5}$ will be the angle the hole subtends at the distance of the scale. By the Fraunhofer law u, the divergence of the diffraction beams is such that $\sin u = \frac{\lambda}{\delta}$; but, in order that two diffracted beams may just pass through the hole, which is the condition of the limit of visibility of the grating, $\sin u$ must also $= \frac{a}{7 \cdot 5}$; therefore $\frac{\lambda}{\delta} = \frac{a}{7 \cdot 5}$, and $\delta = \frac{7 \cdot 5 \lambda}{\cdot 011} = 1/66$ in. The scale actually had 64 lines per inch.

(2) The converse problem may be treated in a similar way. Looking through a hole in a diaphragm placed close to the eye, a scale of 50 lines to the inch can be just perceived at a distance of 9 in. What is the diameter of the hole?

The hole here subtends an angle of $\frac{a}{9}$ at the scale; this angle must be equal to $\sin u$ if the grating is just resolved. Therefore $\sin u = \frac{\lambda}{\delta} = \frac{a}{9}$; $a = \frac{9 \lambda}{\cdot 02} = \cdot 01$ in. The actual size of the hole by micrometric measurement was $\cdot 011$ in.

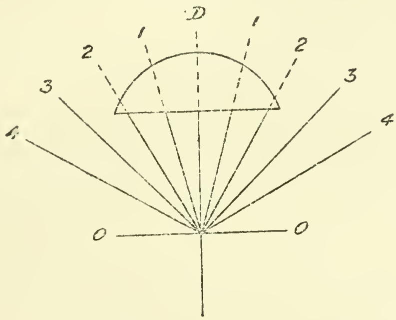
These experiments show that the diffraction limit is at least fifty times greater than that assumed, and the line of demarcation between fine and coarse must be altered to 1/50 in., from which it follows that the only Microscope images to be accepted as truthful are those of objects larger than the 1/50 in., a conclusion which is known to be absurd.

Another dangerous conclusion from the diffraction theory was that, because the image of fine structure depends upon spectra, therefore make spectra. This meant that the spectra should be made as bright as possible by reducing the aperture of the illuminating cone. Reducing the aperture of the illuminating cone is analogous in its effect to reducing the slit of a spectroscope. Narrow the illuminating beam to a mere point, and the spectra from any diatomic structure will become brightly coloured. (So much is this the case that if a spectroscope is not at hand, a coarse diatom, such as a *Pinnularia*, illuminated by a narrow cone when a suitable objective is employed, makes a very good substitute; and a light-filter of any kind can be tested by examining the spectra at the back of the objective.) Prof. Abbe, unfortunately, says that there is not the least ground for supposing that a broad illuminating beam can be expected to give a truer image than a narrow axial illuminating pencil. Apart from the question of the manufacture of false images, this statement renders unnecessary any improvement in the objective—a statement most damaging to the interests of microscopy.

In discussing these questions Mr. Nelson carefully defines his nomenclature. The central white beam, sometimes called the "Central Maximum," will be called the dioptric beam (D); the first coloured spectrum next the dioptric beam the spectrum of the first order (1); the one next to that a spectrum of the second order (2); and so on; see fig. 48.

The law, then, for the manufacture of the simplest form of false image, is the union of a spectrum of the second order with D, when that of the first order is suppressed. In this case the false image will consist of a doubling of line structures, and the insertion of an intercostal in hexagonal and similar structures. To repeat, the cause of the false image is the suppression of (1) and not merely the admission, *per se*, of

FIG. 48.



(2); for if (2) is admitted and combined with the dioptric beam, (1) being also combined with them, there will be no false image. This effect can be obtained by a suitable stop, or by using a narrow cone. When a narrow axial cone is used, spectra of the first order pass through an intermediate zone of the objective aperture, whilst those of the second order pass through an outer zone (fig. 48); then spherical aberration

FIG. 49.

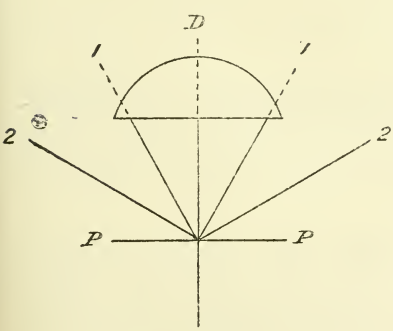
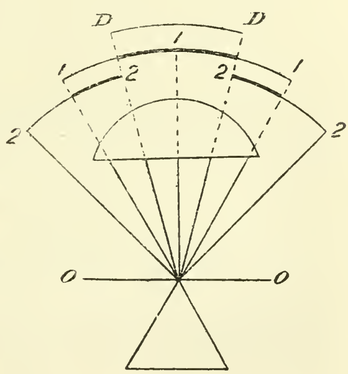


FIG. 50.



(which is always present, even in the best objectives, to a far greater extent than is generally supposed) will cause spectra of the second order to be combined with D, to the exclusion of (1), thereby forming a false image. Putting it in a popular form, it may be said that the eye is quite unable to distinguish whether any given spectra are spectra of the first order arising from a fine structure (P, P, fig. 49), or spectra of the second order from a coarse structure (O, O, fig. 48); so that, if (2) and D are brought into focus together while spherical aberration is causing (1) to be out of focus, the result is that the eye interprets (2) of the coarse structure (O, O, fig. 48) as if they were (1) of fine structure (P, P, fig. 49), consequently a ghost image of fine structure is seen. If therefore the coarse structure (O, O, fig. 48) which in this instance would be the true image, had a certain number of lines or marks to the inch, say 12,000, then the ghost image would have precisely double that quantity, or 24,000 to the inch.

False images of greater complexity may be made by combining (3) with D, when (1) and (2) are excluded, &c.

All these false images are dispelled by means of the wide angled axial cone of illumination (i.e. 3/4 cone), because it causes groups of (1) to pass through the same zone of the objective as those of (2), and unites as well portions of (1) with D (fig. 50), thus rendering their separation impossible.

Fig. 51.

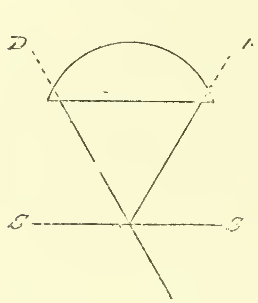
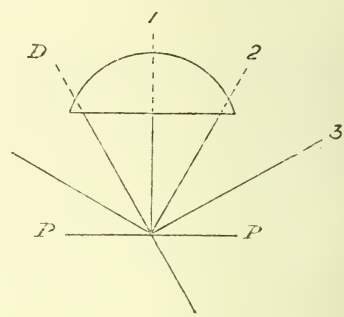


Fig. 52.



In fig. 50, D, (1), and (2) are distinguished by being drawn in steps, the overlapping portions being indicated by thick lines. The structure O, O, is supposed to have 12,000 lines per inch, and to be similar to that in fig. 48. P, P, in figs. 49 and 52, are supposed to have 24,000 lines per inch, while S, S, in fig. 51, have 48,000. In these figures the refraction of the lens has been omitted.

"Oblique illumination" is another form of the small cone, and was probably invented by Dr. Goring in 1826. The dioptric beam passes through a marginal zone on one side; and when S, S, is barely resolved (1) passes through the same zone on the opposite side (fig. 51); duplication is then impossible, and the image will be correct with regard to the fineness (48,000 per inch). If the structure is sufficiently coarse (24,000 per inch) to permit a spectrum of (2) and D to pass through the marginal zone, then a spectrum of (1) will pass through the centre of the objective. Spherical aberration will prevent combination, and therefore an image of double the fineness (48,000 per inch) will be seen.

Tests to determine the reality of the ghosts:—

(1) They usually occur when a small cone of illumination is employed.

(2) They must be an integral multiple of some real structure: thus, if the real structure is 12,000, the ghost may be 24,000, 36,000, 48,000, &c., but it can never be 18,000 or 30,000.

(3) The ghosts invariably have a focus differing from that of the true structure.

The "black and white dot" is a term used to express the fact that when an object—e.g. a siliceous plate—is viewed under the Microscope, its edge assumes either a black or white appearance, according to changes in focus; but when the edge is an inner edge of a hole, and the hole is very minute, the black edge on one side of the hole will meet the black edge on the opposite side, and the hole will appear as a "black dot"; but when the focus is arranged so as to give a white edge, then the hole becomes a white dot. Although primarily applied to diatoms, the term is applicable to all minute microscopical objects, such as bacteria, hairs, flagella, and the edges of objects generally. This phenomenon is found to depend upon the aperture of the objective; for the greater the aperture the easier it is to obtain a black dot. When, however, the hole becomes excessively minute, a black dot is no longer attainable, and we have to content ourselves with the white dot appearance. There is nothing in the theory of microscopic vision, as at present enunciated, to explain why a larger aperture is required to resolve the black than the white dot. In dealing with the limit of microscopic vision, the question arises whether we mean the black or white dot limit, for there must be two limits. Again, which is the more correct picture? Moreover, as these images occur at different foci, which is the correct focus? and as it depends on the adjustment of the objective, which is the correct adjustment?

Another problem awaiting solution relates to dark-ground illumination. This illumination is best obtained by placing an opaque stop at the back of the condenser to stop out an axial cone of greater aperture than that of the objective. It is found in practice that, when the ground is strictly dark, the resolving limit of all objectives is lowered. When the stop at the back of the objective is hardly large enough, the ground assumes a pearly appearance; in this case the resolving limit is at its maximum.

(6) Miscellaneous.

Vessel for Treatment of Paraffin Sections with Staining and other Solutions.*—Dr. L. Buscalioni describes a vessel (figs. 53–57) which is a modification of that devised by D. Caro for the treatment of paraffin sections. The receiver is a rectangular glass jar measuring 8 cm. high, 6·5 cm. broad, and 8·3 cm. long. The lid is made of ebonite and is 8·8 cm. long by 7 cm. broad. In it are twelve openings, each about 4 cm. long, and sufficiently wide to take two slides placed back to back. On the under surface of the lid is a groove for the purpose of fitting the lid on to the receiver. The lid is covered with a cap made of

* Malpighia, xi. (1897) pp. 458–60 (5 figs.). Zeitsch. f. wiss. Mikr., xiv. (1898) pp. 442–4.

tin or iron plate, and is let into a groove on the upper surface of the lid. This cap or cover is about 1 cm. high, 7·7 cm. long, and 6 cm. broad, and its object is to prevent evaporation of the fluid.

FIG. 53.

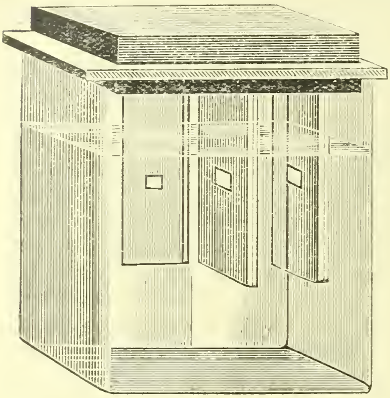


FIG. 54.

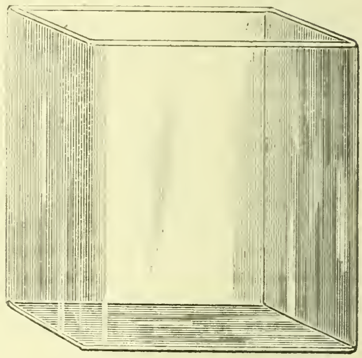


FIG. 55.

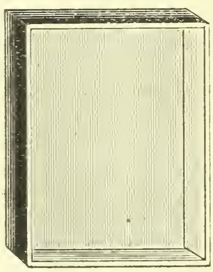


FIG. 56.

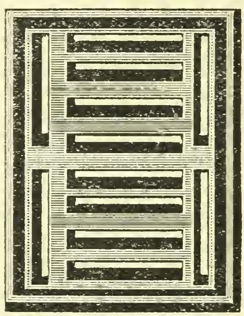
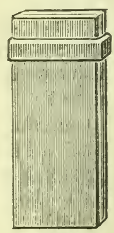


FIG. 57.



The slides are let into the fissures in the lid by placing a couple back to back, and fixing them together by means of a rubber ring. The ring not only holds them together but supports them on the lid.

New Rapid Filter.*—Herr E. Funck has devised an apparatus for rapidly filtering nutrient media such as agar, gelatin, &c. The apparatus is made of copper, and consists of the double filter A (fig. 58), having a side tube E for filling the interspace A with glycerin or paraffin.

The outflow tube is provided with a metal disk F, which serves to prevent dust and impurities from contaminating the filtered fluid, by closing G. The cover B of the hopper is fastened by means of screws C, and rendered air-tight through the intermediation of a rubber or asbestos band. The tube D serves to regulate the pressure of the steam

* Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 200–1 (1 fig.).

and the filtration. Inside the large funnel is a small perforated funnel H which serves to protect the paper filter. The filter may be made of

Fig. 58.

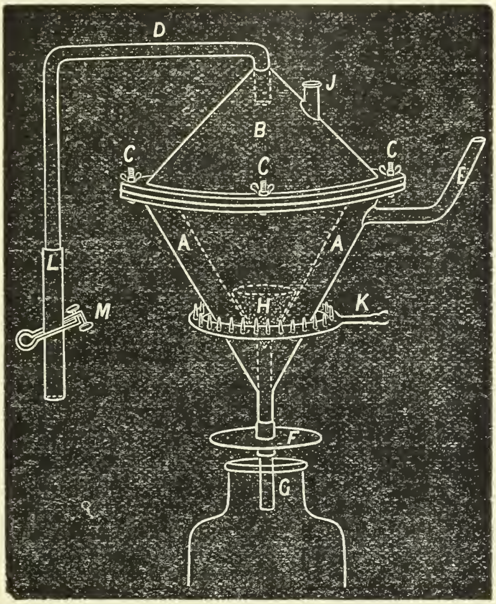


Fig. 59.

thick filter paper or of flannel. The tube J is for the introduction of the fluid to be filtered. The apparatus is supported by the ring K. In order to heat the funnel only a small flame is necessary.

Injection Syringe for Bacteriological Work.*—Dr. A. Cantani describes a syringe he has been using for some time past, with excellent effects. The syringe, which is easily constructed, consists of a nozzle, a glass tube, and a rubber ball, similar to that in Koch's syringe.

As may be seen from fig. 59, the front end of the syringe is narrowed a little, and to this is fastened the nozzle. About two centimetres from the other end is a capillary constriction, beyond which the tube is packed with cotton-wool. The ball is joined to the syringe by a piece of rubber tubing *b*. The instrument is very easily made, easily manipulated, and easily sterilised.

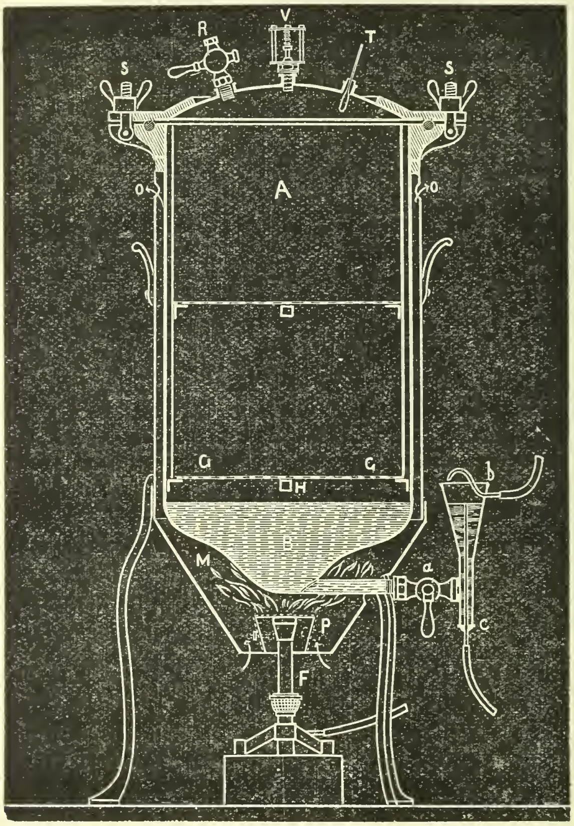
New Autoclave.†—Dr. F. Abba describes an autoclave which he has used for some time with very satisfactory results. It works up to a pressure of 1/2 atmosphere, giving a temperature of 112°. Though

* Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) pp. 217–8 (1 fig.).
† Tom. cit., pp. 462–5 (2 figs.).

very effective, the apparatus is much less costly than most sterilisers, as these are made, most unnecessarily, to withstand a much higher pressure.

The apparatus consists of a copper cylinder or jacket A B (fig. 60) tinned on the inside. The lid is fastened down with the screws S, and the interior rendered air-tight by means of an intervening rubber band. The water-holder B is shaped so as to offer as large a surface as possible to the flame. Inside the jacket is the sterilising chamber, divided into

Fig. 60.



compartments by perforated partitions, and supported on fillets. Its diameter is 27 cm., and its height 46 cm. In the lid are three holes, one for a tap R, another for a safety valve V, and the third for the thermometer T. Connected by a pipe *d*, fitted with a stop-cock *a*, is a funnel *b c*. The jacket is enclosed in a metal case with several openings *o*, for the escape of hot air.

The apparatus can be used for sterilising at 100° or at 112°. If the former temperature be desired, the tap R is kept open If the autoclave is to be worked at 112°, the water-holder is filled up to the level indicated, the tap a is closed, and R left open until the thermometer reaches 98°–99°, a point which indicates that all the air has been driven out of the apparatus. The tap R is then turned, and the temperature soon rises to 112°. Should the temperature and pressure rise above this, the steam escapes through the safety valve.

By a preconcerted adjustment of the tap R, the valve V, and the flame F, a temperatnre constant between 100° and 112° can be maintained.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Aseptic Cultivation of Mycetozoa.†—Dr. C. O. Miller, who described a method for the cultivation of Protozoa,‡ finds that some modifications are necessary for Mycetozoa. They will grow in sterilised dilute hay infusion, or 2 per cent. of milk in water; but for the formation of sporanges it is usually advantageous, and sometimes essential, to furnish the organisms with a mechanical support as a means of getting out of the water. The medium is prepared by putting a handful of hay in a jar and washing it until the water remains colourless. It is then covered with fresh water, and allowed to soak overnight. The following day the water is poured off, filtered, diluted with fresh water until it is of a white wine colour, and 2 per cent. of milk added. It is then filtered, put into a flask and sterilised for future use. The macerated hay is cut, and placed in Erlenmeyer's flasks; the first portion is cut short enough to form a tolerably compact layer at the bottom of the flask to the depth of 1 cm.; the rest is cut sufficiently long to form a very loose layer, reaching about two-thirds the way up the sides of the flask, care being taken not to allow any of the stems to reach the cotton. Sufficient water is placed in the flasks to cover the hay, and they are sterilised for 15 minutes. On the following day fresh water is substituted, and they are again sterilised. The water is once more poured off, and enough of the hay infusion and milk previously prepared is added until it is about 1 cm. deep. The flasks are then sterilised for 10 minutes on three successive days. They are then ready for use.

The cultures are usually transplanted by means of a sterilised pipette.

Peptonised Milk for the Cultivation of Lactic Acid Ferments.§—Herr O. Jensen, who confirms the opinion of Kayser as to the excellence of peptonised milk as a medium for cultivating lactic acid bacteria, gives the following method for its preparation.

After the milk is sterilised, 10 ccm. per litre of pure hydrochloric acid and 2 grm. of pepsin are added, and the mixture incubated at 35°–37°. At first, until the casein is separated and the pepsin dissolved, the flask is to be frequently shaken up, but afterwards this need only be done occasionally.

* 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.

† Quart. Journ. Micr. Sci., xli. (1898) pp. 46–9 (2 pls.).

‡ Cf. this Journal, 1894, p. 744.

§ Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 196–9.

In 36–48 hours it is neutralised, sterilised, and filtered through paper. The reaction should be about neutral to litmus paper, and 5 ccm. of the peptonised milk should, with phenolphthaleïn as indicator, correspond to 1–2 ccm. of 1/10 normal soda solution. It is advisable to take the amphoteric reaction of milk into consideration, otherwise the peptonised milk may be too acid.

If the milk be cloudy it may be cleared by boiling with white of egg and filtering. Gelatin or agar is to be added after the first filtration.

(2) Preparing Objects.

Demonstrating the Tubercle Bacillus in Tissues.*—Dr. G. d'Arrigo and Dr. R. Stampacchia recommend as fixatives of tissues to be examined for tubercle bacilli the two following solutions.

Pyrogallic acid 2 grm., alcohol (95 per cent.) 100 ccm. The solution must be freshly made as occasion requires, and the pieces, having been first washed in water, are immersed therein for four days. The solution is better renewed at the end of two days. After removal the pieces are transferred to 95 per cent. alcohol (changed every 5–6 days) until it is no longer blackened.

The second solution recommended is Hayem's fluid, which is composed of distilled water 100 grm., sodium chloride 0·5 grm., sodium sulphate 2·5 grm., sublimate 0·25 grm. The pieces, which must be small, are left in this solution for 24 hours, and kept in the thermostat at 37°. After removal they are washed in running water for some hours, and then transferred to alcohol to which a little iodine has been added.

The sections are obtained by the paraffin procedure, and are made to adhere to the slide by the distilled water and heat method. The staining solutions recommended are the Ziehl-Neelsen phenol-fuchsin, followed by Gabbet's methylen-blue, the formula for which is, distilled water 100 ccm., sulphuric acid 50 ccm., methylen-blue 2 grm.

It is advisable to allow the phenol-fuchsin solution to act for 20–30 minutes at a temperature of 40°. The preparation should next be washed in a mixture of spirit and water until the stain is no longer given off, after which it is treated with the methylen-blue solution for a few seconds only. The preparation is then washed in water, which is changed until it is no longer stained, and finally mounted in the usual way.

In the case of sputum, especially when this secretion contains few bacilli, it is advised to mix some with 1/3 alcohol and heat the test-tube in a thermostat for 24 hours at 37°, or for three hours at 50°. The mixture should be frequently stirred up in order to allow the spirit to thoroughly penetrate the sputum. Prepared in this way, sputum will keep for a long time, and bacilli can be demonstrated therein after months and even years.

Demonstrating the Structure of Coli and Typhoid Bacilli.†—Dr. A. Wagner has demonstrated the structure of coli and typhoid bacteria by the following method. In 100 grm. of a boiling 1/4 per cent. salt

* Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) pp. 64–7, 123–31.
† Tom. cit., pp. 433–6, 489–92 (2 pls.).

solution, 2 grm. of primulin are dissolved. The solution is filtered and allowed to cool. A cover-glass preparation is floated on the primulin solution in a watch-glass, the latter being placed in water at about 60°, and allowed to remain there for some hours, or indeed all night. The preparation is then washed with water, and stained with Hessian Bordeaux for 1/2–2 minutes. The Bordeaux solution is made by dissolving 1 per cent. of the pigment in boiling water and filtering once or twice. The preparation, after having been washed, is mounted.

The cultures from which the preparations were made were from glycerin-agar media, the coli being 20–24 hours old and the typhoid about 13 hours.

Examining the Nephrostomes of Selachia.*—M. F. Guitel describes a simple procedure for showing the nephrostomes of the kidney of the adult *Acanthias vulgaris.* The body is opened along the ventral middle line, and Flemming's fluid poured in. The solution, which is composed of chromic acid 1 per cent. 15 parts, osmic acid 2 per cent. 4 parts, and glacial acetic acid 1 part, is allowed to act for a minute and a half. The fixative is then poured off, and the ventral cavity quickly and thoroughly washed with water. As the tissue of the nephrostomes fixes the osmic acid more strongly than the surrounding parts, these organs, stained black to chestnut brown, show up well against the dark grey of the adjacent tissues. The reaction attains its maximum in 24 hours. The pieces thus prepared keep well in alcohol or in 2 per thousand carbolic acid.

Microscopical Examination of Viscous Urine.†—Herr G. Michel employs the following method in order to separate the organised deposit in albuminous viscous urines for microscopical examination. 50 ccm. of the urine are shaken several times with 20 ccm. of ether in a cylinder of 100 ccm. capacity and the mixture set aside for some time. The ethereal layer will then contain all the organised elements. It is drawn off with a pipette into watch-glasses, and after evaporation of the ether, the residue is removed to slides for microscopical examination.

New Method of Decalcifying.‡—Dr. E. Rousseau has devised the following method for decalcifying.

The objects to be decalcified, which should not be too large, are imbedded in celloidin in the ordinary way, i.e. after fixation, are dehydrated in alcohol, and then, after having been immersed in a mixture of equal parts of ether and alcohol, are impregnated with celloidin in solutions of increasing strength (4 per cent., 8 per cent., 12 per cent.). When the objects are sufficiently saturated with celloidin, the latter is hardened by slow evaporation, by alcohol or by chloroform. The celloidin blocks containing the objects are next immersed in a mixture of alcohol at 90° and nitric acid, the proportion of the latter being regulated by the amount of calcareous matter to be got rid of. The author uses 10 to 50 parts HNO_3 to 100 of alcohol. The decalcifying fluid should be renewed from time to time, and when decalcification is complete, the excess of acid is removed by washing in water and immersion in 90 p. c. alcohol,

* Arch. Zool. Expér. et Gén., v. (1897) pp. 385–8 (1 pl.).
† Chem. Zeit., xxi. p. 316. See Pharmaceut. Journ., 1898, p. 324.
‡ Bull. Soc. Belge de Microscopie, xxiii. (1896–97) pp. 159–65.

frequently changed, for several days. To the alcohol, carbonate of lime may be added if necessary. When all the acid has been removed, the celloidin block may be sectioned. Now it may happen that, owing to extensive decalcification, there will be large gaps in the objects, which would be a source of considerable inconvenience in making and manipulating the sections. This difficulty is, however, easily got over by filling up the holes with 4 per cent. celloidin, and allowing this to set by evaporation.

This method possesses many advantages; there is no deformity of the animals or tissues, which are observed *in situ*, and it is easy and rapid.

(3) Cutting, including Imbedding and Microtomes.

New Microtome (System Beck-Becker).*—Dr. Arno Beck describes an instrument which is intended to imitate the drawing and pressing motions of hand-cutting, and to improve on the pressing motion of most microtome knives.

Fig. 61.

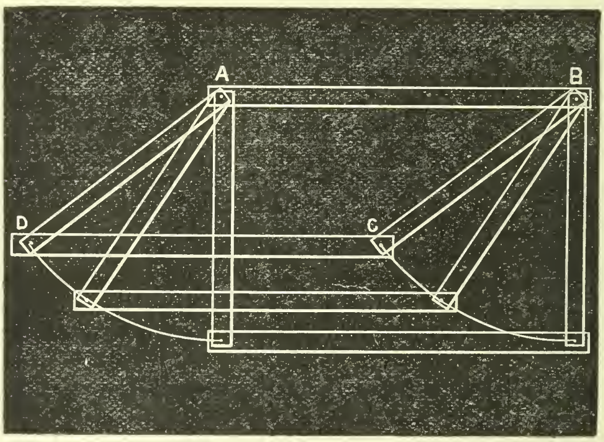


Fig. 61 shows the principle of his knife. A parallelogram of metal rods is jointed at the four corners, and the back edge A B is clamped. D C represents the knife-edge, which, as it is moved forward, imitates the two motions desired. A uniform wear and tear of the knife-edge also results. Regulation of the lengths of the arms also regulates the thickness of the sections; for the more elongated the curve described by the knife-edge, the finer the section. Adjustable screws through A and B determine the pitch of the knife. The guide arms A D and C B are strongly made, and are kept properly placed by strong springs with the intention of preventing the hopping of the knife. A small type of the machine successfully cuts sections of 5 by 7 to 6 by 8 cm.

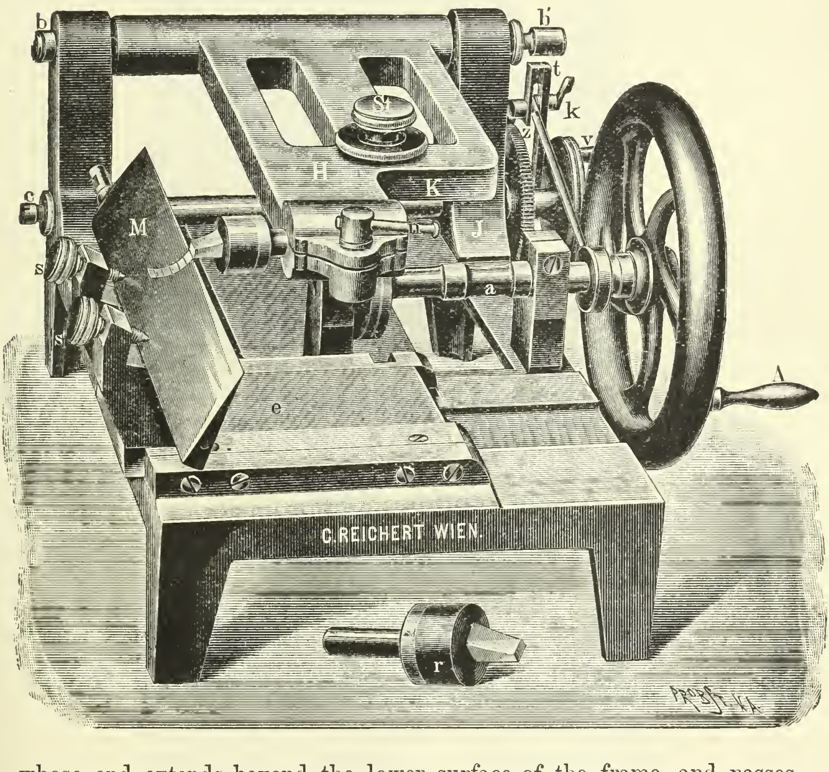
New Microtome by Reichert.†—Dr. J. Nowak, of Cracow, describes this instrument, which resembles the Fromme rocking microtome pre-

* Zeitschr. f. wiss. Mikr., xiv. (1898) pp. 324–31 (5 figs.).
† Tom. cit., pp. 317–24 (3 figs.).

viously described by Schaffer in the same journal,* but possesses a certain modification in the regulation of the movement apparatus by automatic stop and release mechanism, as well as an apparatus for square sections of the paraffin block. These modifications virtually amount to a new instrument, which seems highly ingenious. The view from above is shown in fig. 62, and from below in fig. 63.

A strong cast-iron base (A in fig. 63) bears on its upper side two upright pillars about 5 cm. high. In the pillars lies a horizontal axis on which a frame H (fig. 62) rotates. The frame carries a screw *St*

FIG. 62.



whose end extends beyond the lower surface of the frame, and passes further on into the groove of an excentric mounted beneath the frame. This excentric wheel runs on an axis *a* mounted above the cast-iron base, which axis carries a winch wheel A of 10 cm. diameter on the end extending beyond the frame.

By the rotation of the large winch, and the consequent rotation of the excentric, the frame H is raised and depressed with a kind of pendulum motion. A corresponding movement follows of the object-holder fastened to its end, and therewith of the object to be cut. The object-

* Cf. this Journal, 1896, p. 572.

holder is so fixed that the cutting-plane of the object takes a vertical position.

Fig. 63.

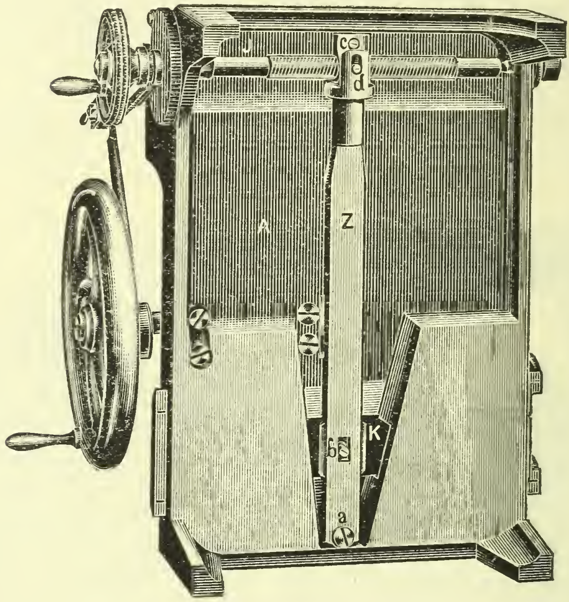
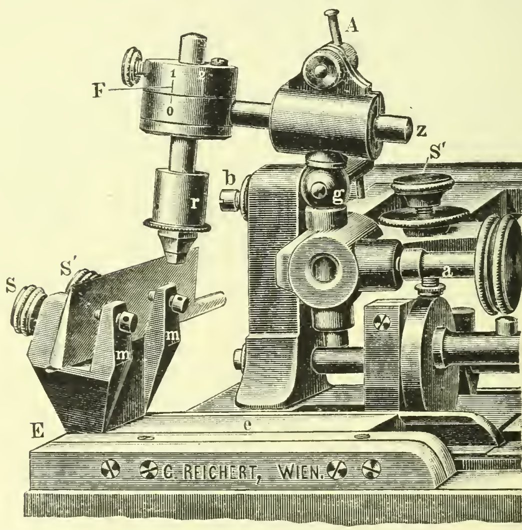


Fig. 64.



The knife moves slowly from left to right without altering its setting; the smaller the knife movement, the thinner the section. The knife is mechanically connected with the winch, whose rotation produces on the one hand a see-saw motion of the paraffin block, and on the other a pushing of the knife. This is accomplished by means of a slide (*e* in fig. 62; K in fig. 63) about 4 by 15 cm., moving in a groove of the cast-iron base. This slide lies exactly under the object-holder, and carries the knife-holder *s s'* at one end. At the further edge of the base is the micrometer screw J (fig. 63), which by means of a three-armed lever is connected with the slider *e* (K).

The lever Z is under the base A, and is at one end connected with a nut *c*, which is fastened to the micrometer-screw at *d*; at the other end there is a small slot *b*, in which a pivot juts out from the knife-slide K. The lever is fastened to the base at *a* by a pin around which it can turn. Thus is formed a three-armed lever with its fulcrum at *a*. When the micrometer (endless) screw J is turned the nut *c* is displaced, a partial rotation of the whole lever round *a* follows, and a corresponding displacement of the slider K is the result. As the arm *a b* is shorter than *a d*, the displacements of K are much less than those of the nut *c*. Thus great nicety of working is ensured.

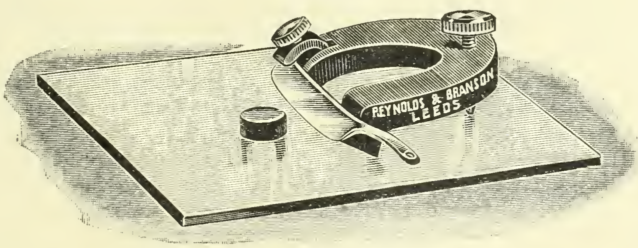
There is a rackwork for adjusting the movements of the knife, whose inclination is regulated by four screws.

Fig. 64 shows an additional piece of apparatus F, by which the smallest paraffin blocks can be arranged for section cutting. The arrangement permits the use of those parts of the knife-edge which are not generally in play, and thereby affords something like uniform wear of the blade.

Dr. Nowak speaks highly of the precision of the machine, and of the ribbon bands of sections.

Student's Microtome.—Messrs Reynolds and Branson, of Leeds, have made a simple form of microtome, devised by Prof. de Burgh Birch, which will be found very useful to students in physiology, botany, &c.

FIG. 65.

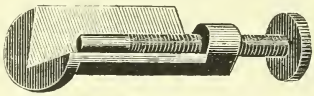


The instrument (fig. 65) is arranged to slide on a glass plate; the substance to be cut is imbedded, and fixed on the glass plate. Sections of any degree of thickness may be cut by raising or lowering the screw, and the microtome is arranged so that any razor may be clamped to it.

Price, with glass plate, without razor	3*s.* 9*d.* each.
Ditto, with roughened plate to secure better attachment of the imbedded substance ..	4*s.* ,,
Razors	1*s.* and 2*s.* ,,

Two very simple Microtomes.*—Mr. E. Pinnock describes two very convenient and cheap forms of microtome. (1) The "handy" has a V-shaped groove for the paraffin imbedded or the naturally hard object, the latter being moved forward by a finely cut screw, the object being held in place by the thumb. There is a flat expansion at the end for the razor, which should preferably be ground flat. (See fig. 66.)

Fig. 66.



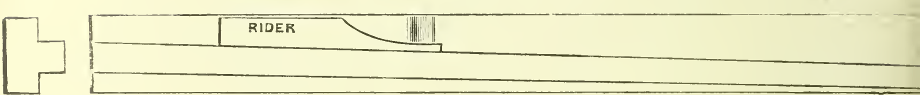


Fig. 67.

(2) Dr. Wetherill's application of the well-known rivet principle to a hand-microtome. It is made of hard wood, with a horizontal portion as a guide for the sweep of the razor, and an incline upon which slides the rider or object-carrier, to which the paraffin imbedded object is attached by melting. In the case of a naturally firm object, the rider may be dispensed with. The object is moved up the incline by the thumb of the hand holding the microtome. (See fig. 67.)

(4) Staining and Injecting.

Contrast-Staining of Bacteria.†—Herr Knaak has devised a method in which the cells are stained with fuchsin, and the bacteria with methylen-blue. After the action of the methylen-blue, the preparation is decolorised with hydric sulphide solution (1–10). By this procedure the pigment is not removed, but merely reduced, and much less so in the bacteria than in the cells and nuclei. In order to prevent reoxidation of the leucomethylen-blue by the atmospheric oxygen, the preparation is treated with saturated tartaric acid solution. It is then contrast-stained with fuchsin (1 part saturated alcoholic solution to 20 parts water) for 5–10 seconds. Instead of sulphuretted hydrogen solution, 1 per cent. solution of argonin may be used for decolorising, but this must be allowed to act for 4 minutes.

Simple Method for Staining Spores.‡—Dr. A. Aujesky has devised the following procedure for staining spores. The cover-glass film, dried in the air, is placed for 3–4 minutes in almost boiling 1/2 per cent. hydrochloric acid. On removal, the cover-glass is washed in water, dried, and then stained with Ziehl's fuchsin solution, after the manner of staining tubercle bacilli in sputum. That is to say, some fuchsin

* Trans. Amer. Micr. Soc., xix. (1897) p. 189 (2 figs.).

† Deutsch. med. Wochenschr., 1897, No. 42. See Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) p. 343.

‡ Centralbl. Bakt. u. Par., xxiii. (1898) pp. 329–31.

solution is dropped on the cover-slip, and the latter heated over a flame until it begins to vaporise. This should be done twice.

The preparation having been allowed to cool for 1–2 minutes, is decolorised in 4–5 per cent. sulphuric acid, and contrast-stained for 1–2 minutes in malachite-green or methylen-blue.

Instead of Ziehl's solution, anilin-oil fuchsin or gentian-violet may be used. In this latter case, Bismarck-brown or vesuvin should be used as contrast stain.

Dahlia as a Stain for Bacteria in Celloidin Sections.*—Mr. R. C. Reed recommends dahlia for staining bacteria in sections prepared by the celloidin method. The formula used is, saturated alcoholic solution of dahlia 20 ccm., distilled water 100 ccm. The sections are overstained (15–30 minutes), and then thoroughly washed with 95 per cent. alcohol, until the celloidin around the section appears colourless. They are then cleared up, for which purpose clove oil is preferred.

This method is not, of course, suitable for bacteria which require special stains or treatment.

Importance of Testing the Reaction of Sputum in Staining for Tubercle Bacilli.†—Dr. N. G. Ward points out the importance of testing the reaction of sputum, and if it be found acid, to render it alkaline before staining it. Any alkali may be used. The reason given by D. B. Kyle, who was the first to call attention to this fact, is that the capsule of the bacillus is permeable by an alkali, but not by an acid. In staining the sediment of urine, pus, or any secretion or fluid for tubercle bacilli, it is equally necessary to make sure it is alkaline before staining.

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

Gelatin as a Fixative.‡—Mr. H. H. Dixon has recently used as a fixative a dilute solution of gelatin in an aqueous solution of bichromate of potash. The solution should be quite fluid at 10° C. The ribbon of paraffin sections is laid on a drop of this solution on the slide. Wrinkles are removed by gently warming the slide. The superfluous fluid is then removed by means of blotting paper, and the gelatin allowed to dry and harden. During this process it should be exposed to a bright light, the action of the light rendering the fixative quite insoluble even in warm water, and so removing all danger of detachment from the slide.

The bichromate has the further advantage of preventing the gelatin, after exposure to the light, from taking up the dyes used as stains.

(6) Miscellaneous.

Paste for Labels.§—A paste for sticking labels on glass, porcelain, and metal, may be made of gummi arab. 15·0 parts, tragacanth pulv. 7·5, glycerini 45·0, thymoli 0·3, alcohol 3·75, water up to 120·0. The gum arabic is dissolved in 15 parts water, and the tragacanth rubbed up

* Trans. Amer. Micr. Soc., xix. (1897) pp. 182–5.
† Microscopical Bulletin, xv. (1898) pp. 1–2.
‡ Ann. of Bot., xii. (1898) pp. 117–8.
§ Photog. Zeitung. See Zeitschr. f. angew. Mikr., iii. (1898) p. 364.

with 30 parts water. The two fluids are then mixed and strained. The glycerin is next added, and finally the thymol dissolved in alcohol.

Test for the Production of Indol by Bacteria.*—Dr. Th. Smith claims that dextrose-free bouillon is the best medium for testing the production of indol by bacteria. It is prepared from beef infusion, by extracting either in the cold or at 60° C., and inoculated the same evening with a culture of an acid-producing bacterium, such as *B. coli*, and placed in the thermostat. Next morning the infusion is boiled, filtered, pepton and salt added, and then neutralised and sterilised.

Method for Splitting up Argillaceous Silicates containing Diatoms.†—Herr G. Marpmann communicates a method for obtaining diatoms from schist and argillaceous earths. It consists in treating the earths or clay with potassium pyrosulphate. The chemical reaction is represented in the following formula.

$$Al_2(SiO_3)^3 + 3K_2S_2O_7 = Al_2(SO_4)^3 + 3K_2SO_4 + 3SiO_2.$$

In this way are formed easily soluble sulphates of aluminium and potassium, while the silicic acid, for the most part in condition of quartz or diatom shells, is not affected, though some of it remains in a soluble state.

In practice the procedure is as follows.

One part of the broken up clay or earth is heated with three parts of the salt, and when melted, one or two parts more of the salt are added. When thoroughly melted, the mass is poured out into a vessel filled with water, and then boiled for a time. If the mass do not thoroughly dissolve, the sediment should be treated with strong hydrochloric acid, and then the diatoms separated by fractional sedimentation.

The salt (pyrosulphate) may be made by heating 87 parts of neutral sulphate of potash in a platinum dish with 49 parts of pure sulphuric acid. When thoroughly melted, the mass should be poured out on to a dry porcelain plate, and, when cold, broken up and preserved in stoppered bottles.

Making Sections of Steel.‡—Mr. F. S. Rice prepares sections of steel for the purpose of demonstrating the microstructural characteristics. The pieces should 3/4 in. in diam. Sections should be 3/16 in. thick, if they are to be heated after cutting in the lathe. The best sections are obtained by carefully grinding off the surface to a plane by hand on an ordinary quick-cutting oil-stone, then on the finest Belgian oil-hone, and finally polishing on a piece of chamois tightly stretched over a block of wood and charged with peroxide of tin. When thoroughly polished, the surface is washed with alcohol followed by a little chloroform. The polished surface is then etched in order to develop the structure.

Though this can be done by means of nitric acid and water, the surest and most delicate results are obtained from a saturated solution of iodine in alcohol diluted with an equal bulk of alcohol, both 95 per cent. Several applications of the iodine solution may be required. After each etching, wash in 95 per cent. alcohol, and dry quickly to

* Journ. Expér. Méd., ii. (1897) pp. 543-7.
† Zeitschr. f. angew. Mikr., iii. (1898) pp. 341-5.
‡ Trans. Amer. Micr. Soc., xix. (1897) pp. 28-42 (3 pls.).

prevent oxidation. Then polish with chamois, mount on a slide without a cover-glass, and examine.

A thin coating of vaselin is the best protection from oxidation.

Old Book on Optics.—The following figures (68–71) from Zahn's 'Oculus Artificialis' (1702), to which Mr. E. M. Nelson referred at the meeting in November last,* have been made from photographs kindly taken for the purpose by Mr. C. L. Curties.

Fig. 68.

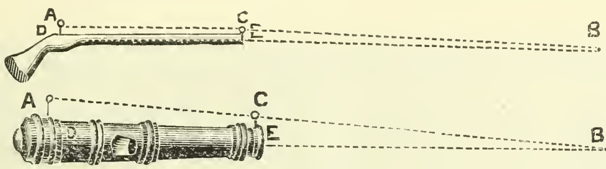


Fig. 68 illustrates a telescope-sight for a musket and a cannon. Zahn says, "Bombardæ et omni generi balistarum ac tormentorum bellicorum tubum opticum sive telescopium aptare, quo visus ad scopum exactè dirigi poterit."

Fig. 69.

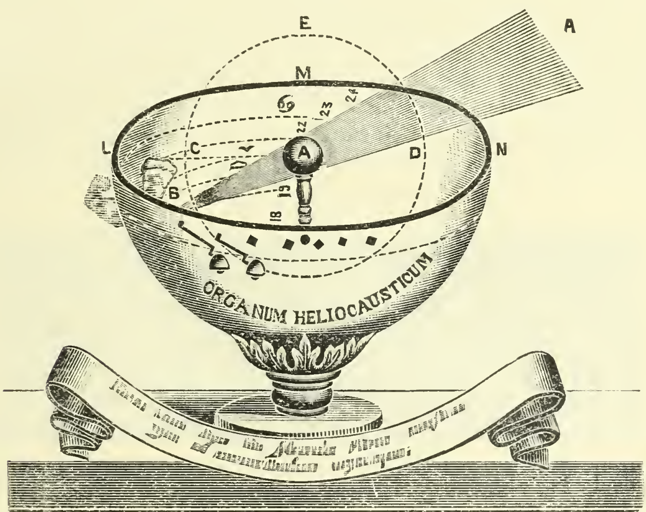


Fig. 69 is the Jordan sunshine recorder. The legend in the ribbon below is

"Horas Luce Sono tibi sphærula Vitrea monstrat,
ignis nil mirum Coelicus urget opus."

The first thing that attracts attention is the converging nature of the sun's rays incident on the sphere! Next, it will be observed that

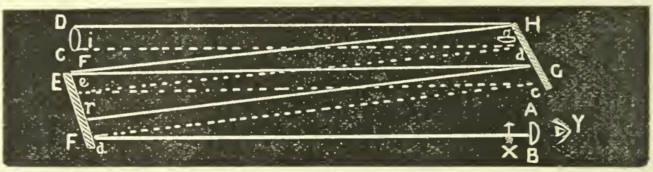
* Journ. R.M.S., 1897, p. 600.

in the figure the principal focus of the glass sphere is about 8 instead of one and a half radii, as it ought to be. An instrument constructed on the proportions as shown in this figure would therefore be useless. This is a strange mistake, because the focus of a sphere is correctly given in another part of the book.

It is intended that at the hours the sun's rays should burn a string to which a bell is attached, thus causing it to ring.

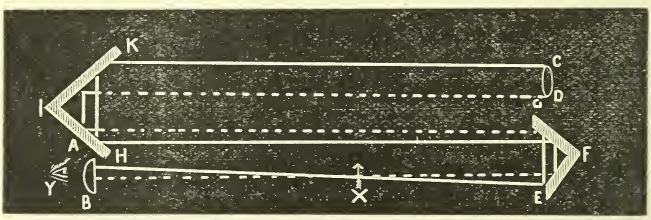
We now come to the most interesting figures, viz. 70 and 71. These are called "Catoptrico dioptrica telescopica," and are two out of a series

Fig. 70.



of seven. In fig. 70, D C is the object-glass of a telescope, and A B its eye-lens; by means of the two mirrors H G and E F the telescope is, as it were, folded up into five. The arrow at X is intended to represent an erect image. It will be noticed that there are two reflections at each mirror. This is the second in the series; the first has not been copied, as the arrangement can easily be understood from fig. 70; the difference between them being that there is only one reflection at each mirror instead of two, so that the telescope is folded into three instead of into five. This leads to fig. 71, which is the third of the series, and shows an arrangement of plane mirrors, by which the path of the rays is diverted

Fig. 71.



in precisely the same manner as by Porro's prisms. This is the principle which underlies the Zeiss patent binoculars. It will be noticed that the eye-lenses in figs. 70 and 71 are plano-convex, and are turned in their proper positions.

The seventh and last of the series has four plane mirrors, and is very ingenious.

The axis of the telescope is supposed to be horizontal; the rays are intercepted just behind the object-glass by a plane mirror placed at an angle of 45°, and are reflected vertically downwards on to the second plane mirror, placed nearly horizontally. This reflects the rays vertically upwards on to the third mirror, also placed horizontally, which reflects them again downwards on to the fourth mirror, placed at an angle of 4°, and this turns them finally into a horizontal direction to the eye-piece.

A telescope of 10 ft. focus thus constructed would, when its axis is horizontal, have a vertical height of about 4½ ft., the distance between the eye-lens and the object-glass being about 1 ft. The object-glass and the eye-lens are in a line with one another, and are placed in the middle of the telescope.

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on April 20th, 1898, at 20 Hanover Square, W., The President, E. M. Nelson, Esq., in the Chair.

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

The Donations to the Society (exclusive of exchanges and reprints) received since the last meeting were announced as follows:—

	From
Three Slides of Botanical Sections..	*Mr. W. T. Suffolk.*
Journal of the Board of Agriculture, vol. iv. No. 4, 1898, 8vo ..	*The Board.*
Report of the British Association, 1897 (London, 1898), 8vo ..	*Mr. F. Crisp.*

The thanks of the Society were voted to the donors.

Mr. Rousselet exhibited a new form of metal lamp chimney made with two openings, enabling white or tinted glass to be used as required by simply turning the lamp partly round. This chimney had been made to a special order by Mr. Pillischer, and happening to see it in the shop, he thought it might interest the meeting as a new idea in the way of Microscope lamp chimneys.

The President exhibited a new monochromatic screen trough which had been handed to him by Mr. Curties. It was of American invention, and consisted of two glasses cemented to a ring. It was very simple in construction, and he had no doubt would be an efficient trough for a light filter.

He also exhibited a dynameter, an instrument designed by Ramsden in 1775 for measuring the diameter of the emergent pencil of a telescope in order to determine the power. This was accomplished by means of a double image, due to the separation of the halves of a divided convex lens.

The idea of a double-image micrometer by means of a divided lens is probably due to Savary,* but the form in which it appears to-day was originated by Dollond in 1754. Mr. Powell, to whom the dynameter had

* Phil. Trans., 1753.

been sent for adjustment, told him that the semi-lenses were moved by a differential screw. The President said that he was under the impression that the differential screw had been invented by his friend the Rev. James Campbell,* but it would appear that it was a much earlier invention.

Mr. Ingpen said he had one of these made by Ramsden some years ago, but gave it away to an oculist. He knew then that it had a differential screw, and he tried at the time to get this introduced for other purposes, but was told it was too complicated and expensive. He also had at the present time a divided lens by Dollond $2\frac{1}{2}$ or $2\frac{3}{4}$ inches in diameter.

The thanks of the Meeting were voted to Mr. Rousselet, Mr. Curties, and the President for bringing these items for exhibition.

Mr. H. G. Madan read a paper "On some Organic Substances of High Refractivity available for mounting specimens for examination under the Microscope." Samples of the various substances were exhibited in illustration.

He said he had sent specimens of three of them to Mr. Nelson, who had handed them to Mr. Morland for him to try their usefulness as media for mounting diatoms, and he hoped to hear something as to the result from Mr. Morland that evening.

Mr. T. C. White said they were greatly indebted to Mr. Madan for the very practical paper he had read. He should like to ask if these media were suitable for histological work; because, although they might do admirably for diatoms or osseous tissue, they might not answer for softer substances.

Mr. Madan said that one or two were as harmless as Canada balsam; some others he could hardly say as much for; but piperine and quinidine had been tried and found harmless, and monobromonaphthalene and phenylthiocarbimide, being neutral substances, were not likely to injure even delicate tissues. Time alone could prove the entire satisfactoriness of these media; but he was inclined to think that the mixture of metacinnamene and phenylthiocarbimide mentioned in the paper approached most nearly to balsam in permanency and neutrality, while it had a much higher refractivity than the latter. It did not, however, harden so completely, hence it should be treated like Farrant's medium.

Mr. T. Comber said that their old friend Dr. Gray had tried experiments with some of the substances mentioned, and gave him some slides mounted with piperine, &c., which were very good at the time, but did not last, except one which was put up in a mixture of piperine and styrax. The styrax was heated, and whilst in this condition crystals of piperine were put into it with the object of increasing the refractive index, and this slide showed no sign of change whatever. He had tried some of these mixtures as media for objects which he wanted to photograph in sunlight, but found they were not particularly adapted for this, because they were affected by the sunlight and rendered dark in colour.

Mr. Madan thought this might be due rather to the heat than to the light of the sun.

* Described at the Q. M. C., 1886.

Mr. Comber said he thought this could hardly be so, because the heat had been taken out of the beam by passing it through water.

Mr. Morland said he had tested what was sent to him only as mounting media, but, being entirely new substances, he did not know their qualities, because the slides had not yet had time to harden, and he was not sure as to the cement used, viz. Hollis's liquid glue, being able to withstand any solvent action these various media might have.

Mr. Madan said that no cement could be better adapted for the purpose than a mixture of good glue (or isinglass) and treacle, such as opticians used for cementing carbon disulphide prisms. This should be applied warm, and in a day or two it would become quite hard and strong. He had a hollow prism with sides cemented thus, and filled with carbon disulphide, which had stood for at least twenty-five years without the slightest leak.

Dr. Dallinger could only, in regard to the present usefulness of mounting media of high refracting power, give the testimony of his experience with slides mounted with these media. He had never mounted with any of them himself, but specimens had been mounted for him by the most competent mounters, and he had possessed and used a very large number of slides mounted in nearly every medium which had been mentioned, and he had at the present time only one slide in all his cabinet which was in good condition. All had changed and ruined most valuable specimens. Nevertheless it was most important that such media should be available, and it was with great pleasure he found that so competent a student as Mr. Madan was working upon so important a matter. There was hope that an efficient and useful medium of high refracting index might yet be found.

The President was very glad to have heard this valuable paper. He had sent the materials he had received from Mr. Madan to Mr. Morland, who had very kindly mounted some diatoms in them so that he might test them. He found that the methylene di-iodide was a very dense substance, and the diatoms stood out well in it, but unfortunately they were injured in some way by it, so that in looking at them the effect was like looking at a dry slide which had gone bad through what was known as sweating. What it was that caused the structure of the diatom to melt off in this way he did not know. In the other materials the diatoms stood out strongly, and the structure was not interfered with. The quinidine was good, but it crystallised. He was, however, very sorry to hear that the experiments with quinidine were not a success, because the diatoms could be so beautifully seen in it. He had not been quite so unfortunate in his experiences as Dr. Dallinger, because he had two slides which were in good condition, but one of these, the finest he had, was he feared, just beginning to show signs of crystallisation. All his piperine slides were still good, and those in Father Thompson's medium were also perfect. The first slide mounted in the dense arsenic medium was still perfect, but some wavy lines were beginning to appear. The curious thing about piperine was that it made the object look as if you had a bad objective; one of the reasons for which was the fact that it had such a high dispersive power. With regard to these co-efficients, he had worked out the comparison of the dispersive powers of these new media with those of some well-known glasses, with the following result.

Refractive Indices and Dispersive Powers of Various Substances, Lines C, D, Hγ.

	μ_D	$\frac{\mu - 1}{\delta \mu}$
Glasses :—		
Chance's light flint	1·574	25·9
" dense "	1·620	22·6
" extra dense flint	1·649	20·9
" double extra dense flint	1·717	18·1
Densest flint in Jena catalogue	1·963	11·8
Mr. Madan's Measurements of New Substances :—		
Methylene di-iodide and phosphorus	1·95	15·8
Quinidine	1·602	14·0
Methylene di-iodide	1·743	12·0
Phenylthiocarbimide	1·654	10·7
Piperine and balsam	1·657	5·1
Piperine	1·681	4·8

From this table we see that while the refractive index of methylene di-iodide and phosphorus is nearly equal to that of the Jena densest flint, it has less dispersive power; but on the other hand quinidine, which has a refractive index between the light and dense flint of Chance, has a dispersive power nearly equal to the double extra dense flint. The next two in the list have high dispersive powers, but they are quite surpassed by piperine.

For example, piperine and balsam has a refractive index very similar to Chance's extra dense flint, but its dispersive power is four times as great. Piperine alone has less refractive index than the double extra dense flint, while its dispersive power is $3\frac{3}{4}$ times as much.

On the motion of the President a hearty vote of thanks was given to Mr. Madan for his very valuable paper, a hope being expressed that something of permanent character might result from what they had heard that evening.

The President said he was sure the Fellows of the Society would feel greatly indebted to Mr. Morland for the beautiful diatoms which he had brought to the meeting for exhibition. The important work he had done in this direction was so remarkable that it was a great pleasure to have an opportunity of seeing such a number of specimens. He hoped Mr. Morland would favour them with some description of what he was exhibiting.

Mr. Morland said it had been suggested to him that he should read a few notes on the specimens exhibited; but on consideration he thought it would be better if he wrote out a short description of each and placed it by the Microscope under which each specimen was shown. These slides were arranged, not with a view to their being test diatoms, but simply to show the various forms which diatoms assumed. He found there was in the whole collection only one of the Naviculoid diatoms. He did not know that he need say any more, but he hoped that the written descriptions would enable the exhibits to speak for themselves. He would, however, take that opportunity of thanking Messrs. Beck for bringing so large a number of Microscopes to the meeting and placing them at his disposal.

The following is compiled from the descriptions referred to.

1. *Actinoptychus annulatus.* — From Whampoa, Canton River. On account of its triangular form this diatom was at first classed amongst the Triceratia, but closer examination has caused its removal to the genus *Actinoptychus,* one striking peculiarity of which is the division of the valve into compartments or segments, by the alternate elevation and depression of the valve round a central "umbilicus." As a rule the *Actinoptychi* are circular, but there are several exceptions to this rule, the present form being a good example. The centre diatom is a frustule placed on edge.

2. *Arachnoidiscus Ehrenbergi.*—Halved valve. This is mounted on edge, and shows the form of the ribs on the inner side of the valve supporting the outer casing, thus economising to a certain extent the amount of silex required.

3. *Arachnoidiscus ornatus.*—*In situ* on coralline, the latter having been decalcified. This slide shows the pill-box form of the diatoms in every conceivable position, some of them being doubled ready for subdivision, as can be seen by viewing them edgewise. Mounted in soft balsam.

4. *Aulacodiscus margaritaceus.*—Believed to be from Pisagua, West Coast of South America. The specimen shown is an abnormal one in regard to its markings. Usually the cells are so crowded together that they become polygonal from mutual pressure, but where they are distinct and isolated they retain their rounded form. Many of the cells are comparatively large, and by a little careful focusing the "eye-spot" to each can be distinctly seen on the under side of the valve.

5. *Aulacodiscus Petersi.* — From shell refuse, Panama. This is shown as a representative of a large and beautiful genus, a monograph of which by Mr. John Rattray was published in the Journal of this Society in June 1888. The diatoms on this slide are very perfect, not one of the processes being broken off.

6. *Aulacodiscus Sturti.*—From the stomachs of tinned oysters sent from Japan to the Fisheries Exhibition. This form can be used as a test object, but is not now shown as such; the finer markings are between the "dots," particularly towards the centre. A portion of a valve highly magnified is illustrated in the last edition of 'Carpenter' by Dr. Dallinger. This diatom is to be found with 3, 4, or 5 processes, 4 being the most common, and 5 rather rare. I here show one with 6 processes, the only one I have ever found, but they are arranged irregularly, and undoubtedly this valve is an abnormal form.

7. *Auliscus oamaruensis.*—From deposit at Oamaru, New Zealand. This is a very fine form of *Auliscus.* The centre frustule shows that the processes of the valve on one side of the frustule alternate with those of the valve on the other side. I find this to be a general rule with all valves having processes.

8. *Auliscus spinosus.*—From borings of an artesian well, 406 feet, Atlantic City, New Jersey. Five valves are arranged together, with a sixth a little below, placed on edge, showing the other view of the processes.

9. *Biddulphia echinata*.—From Vuna Point, Island of Taviuna, Fiji Islands. This diatom was described by Mr. Kitton in the Journal of this Society for June 1888; he therein remarks that "this species seems to be very subject to abnormal development." The slide exhibited shows this very clearly. It will be noticed that the surface is covered with triangular scales or spines.

10. *Ceratulus Smithii*, frustules and valves.—From Sheerness-on-Sea. Examining the centre frustule it will be noted that none of the horns or spines of either valve are opposite to those of the opposite valve; the hoop extends partially over the upper valve, as may be distinctly seen on the edges of the frustule. The valves surrounding the frustule are in pairs, being really two frustules divided into halves by means of a mounted bristle. The upper and lower valves are viewed from the inner side, while those to the right and left are seen from the outside.

11. *Climacosphœnia moniligera*.—From gathering in Japan. This is not a rare form in warm seas, but the slide exhibited was mounted to show the formation of this diatom in its entirety. The diatoms placed third from the ends are front views of complete frustules ready for self-division, the others are valves, or parts of valves, viewed either from within or without.

12. *Coscinodiscus elegans* var. *spinifera*.—From deposit at Oamaru. This slide exhibits both aspects of the valve. The centre valve, on edge, shows the short spines on the circumference as well as the depth of the depression in the centre of the valve.

13. *Cymatopleura elliptica*. — From Weybridge. This is only a very common fresh-water form, but is exhibited as being the first slide I mounted with a view of showing both aspects of the valve or frustule. I scarcely know how I did it, as I only had an ordinary 1-in. simple lens. I now use for this work a Stephenson's binocular with a power of 40 or 50 diameters. A face view of the valve does not give so good an idea of the depth of the furrows as does a front view of the frustule.

14. *Dicladia capreolus*.—From "Cementstein," Sendai, North Japan. This form, which was described as a distinct species by Ehrenberg, is now regarded as being a "spore" of *Chætoceros dicladia*, and is figured *in situ* in Castracane's 'Challenger' diatoms.

15. *Eupodiscus Argus*.—From Tampa Bay, Florida. These diatoms from Tampa Bay appear to have the outer structure less silicified than is usually the case with this form. In all of the outer valves now shown the outside structure is comparatively thin, but the centre valve is a gem, the outside structure being entirely absent with the processes quite perfect. This valve resembles an *Aulacodiscus*, to which genus *Eupodiscus Argus* undoubtedly belongs.

16. *Hemiaulus Kittoni*.—From "Cementstein," Mors Island, Jutland. The centre diatom shows the position of a "spore" within the body of the frustule; the "spores" are also shown entirely isolated. I am unable to give any further information about these "spores" than that the very similar forms *Dicladia capreolus* and *Hercotheca mammilaris*, described by Ehrenberg as distinct genera, are now known to be the somewhat similar spores of *Chætoceros*.

17. *Hercotheca mammilaris*, fossil. — From Howard's Grove, near Richmond, Va. These are "spores" of a species of *Chætoceros*, though

described by Ehrenberg as constituting a distinct species by themselves. These forms are frequently met with in many of the American deposits.

18. *Kittonia elaborata.*—From deposit at Oamaru, N.Z. This is a particularly fine form, and is not very uncommon in this deposit, but when found it is generally more or less broken. I have never found it other than as a single valve, but I have occasionally found smaller valves differing considerably from those now shown. This slide shows the front and side views of this form.

19. *Navicula disciformis.*—From artesian well, Cambridge, Maryland. This is a very curious and small form, not very rare in this deposit, and I was fortunate enough to find a frustule which I have mounted edgewise.

20. *Odontotropis cristata.*—From "Cementstein," Mors Island, Jutland. This diatom is a large one, but I have been unable to mount it as a frustule, because the valves fall away from each other when placed in a drop of water to free them from dirt.

21. *Porodiscus interruptus* and *Craspedoporus elegans.*—From the Oamaru deposit. Described by Messrs. Groves and Sturt in the Journal of the Quekett Club.

22. *Pseudo-rutularia monile.*—From deposit at Oamaru, N.Z. The central pair of valves belong to two opposing frustules; I have never yet found a complete frustule of this form. It is frequently the case that the number of cells on one side of the large central one is one more than the number on the other side. Messrs. Grove and Sturt, as well as Herr Grunow, incline to the belief that this is a species of *Hemiaulus.* There is only a single species in this genus, if it holds good.

23. *Pterotheca aculeifera.*—From "Cementstein," Mors Island, Jutland. This very curious form is regarded by some as belonging to a larger genus, viz. *Pyxilla.* The three central diatoms show the manner in which the valves of opposing frustules were connected by their branched processes.

24. *Rutilaria capitata.*—From "Cementstein," from Sendai, North Japan. The Cementstein from which this diatom was obtained is very rich in new and fine forms. This slide shows how the frustules of this form are connected in chains. The lower diatom is a side view of a valve showing the capitate ends from which the species takes its name.

25. *Stichotiscus californicus* var. *areolata.*—From deposit at Oamaru, N.Z. Showing valves laid flat and a single frustule on edge in the centre.

26. *Syndetoneis amplectans,* fossil.—From Oamaru, N.Z. This is a perfect specimen of a small and curious form from the Oamaru deposit. It is not extremely rare, but is generally damaged more or less. The diatom shown consists of two valves of opposing frustules, each valve having a central rod, at the end of which is an eye, set at right angles to it, the rod of the other valve passing through. These rods slide on each other, and the valves cannot be separated without breaking one of the central rods.

27. *Terpsinoe intermedia.*— From Salt Marshes, near Mobile, Alabama. The upper centre form on this slide is very peculiar; it is the opinion of some that in the process of reproduction the larger frustule, which

is the younger, whilst being formed from the contents of two much smaller frustules, has become silicified and fixed in one of the valves of the smaller frustules before the contents of the valve had quite escaped. I have found many large frustules with *a small valve* attached, but I have never found one with *two small ones* adhering. The small valve cannot be detached without injury either to it or the large frustule or valve.

28. *Triceratium castellatum* var. *fracta*.—From deposit at Oamaru, N.Z. This slide shows a frustule in the centre with four valves surrounding it.

29. Section of "Cementstein" from Mors Island, Jutland, Denmark. The Jutland "Cementstein" is very hard, and is admirably adapted for section purposes. A book by Messrs. Prinz and Van Ermengem gives some information as to what can be seen in sections of this "Cementstein."

30. Diatoms from "Cementstein" from Mors Island, Jutland. This slide gives an idea of the forms to be found in this deposit. There are several species of *Trinacria*, triangular forms with long processes at the corners, the end of each process terminating in a pair of small claws. *Solium exsculpatum* is very similar, but small and square. Many forms in this deposit are sometimes found in rather long chains.

31. Diatoms from Howard's Grove, Richmond, Va., fossil. This slide is principally of interest in showing something of the variations in size of different species. It shows a cast "hoop" of one of the larger *Coscinodisci* with twelve smaller forms, all of different species, arranged within the hoop; they do not touch each other nor the hoop, which is less than 1/112 in. in diameter. This is not an extraordinarily large diatom, for I have found forms as much as 1/40 in. across.

32. Spread-slide of fossil diatoms from Richmond, Va. Among other forms there are many frustules of *Stephanopyxis corona* showing the dissimilarity of the two valves composing it.

33. Type slide of 65 forms from Santa Monica, S. California. This is a sample, by no means complete, of the forms to be found in about a pound weight of this material. When mounting type slides, I arrange the diatoms in squares set diamondwise, thus placing them as close as possible while keeping them in symmetrical order. The slide shown has the diatoms arranged in a square of 8 (64), with a very small one placed in the centre, making 65 in all.

34. Type slide of 121 forms from deposit at Williams' Bluff, Oamaru. This slide shows the great variety of forms in this deposit. The diatoms found in this deposit were described by Messrs. Grove and Sturt in the Journal of the Quekett Club.

35. Type slide of 80 forms of diatoms, with the name of each diatom photographed below it. Mounted by Herr Möller. This is the only slide exhibited by me this evening not mounted by myself.

Mr. J. J. Vezey read a short note by Mr. E. B. Stringer supplementary to his paper on Photomicrography which was read at the Meeting of the Society in December last, and published at pp. 174–9 of the number of the Journal for April 1898.

Mr. T. C. White thought it would be most interesting if Mr. Stringer would show them some specimens of his work upon the screen some evening. Those of the Fellows who had been working at the same thing would no doubt be very much gratified if he would do so.

The President thought Mr. White's suggestion was a very good one, and hoped they should be able to induce Mr. Stringer to come there some evening and show them what he had done.

The President said he would ask the Fellows present, before adjourning the meeting, to pass a very hearty vote of thanks to Messrs. Beck for having lent so large a number of Microscopes for use that evening, and to Mr. Baker and Messrs. Ross for a similar favour conferred upon the Society at their last meeting. Without this valuable assistance it would have been impossible for them to have had the extremely interesting exhibitions of the present and last occasions.

The thanks of the Meeting were voted to these gentlemen with acclamation.

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

The President:—A new Monochromatic Light-Screen Trough, and a Ramsden Dynameter.

Mr. C. Rousselet:—A new form of Metal Lamp Chimney, and *Dendrosoma radians*, alive and mounted.

Mr. Hy. Morland:—About three dozen slides of Diatoms of his own mounting.

New Fellows:—The following were elected *Ordinary* Fellows:—Mr. Thos. J. Barratt, Mr. S. P. Cowardin, Mr. Jacob Pillischer, Rev. Hy. Wadsworth, and Mr. Geo. Winter.

MEETING

Held on the 18th of May, 1898, at 20 Hanover Square, W.
E. M. Nelson, Esq., President, in the Chair.

The Minutes of the Meeting of 20th of April last were read and confirmed, and were signed by the President.

The following Donation was announced:—

	From
Annual Reports of Proceedings under the Diseases of Animals Acts, The Markets and Fairs Acts, &c., &c., for the year 1897. (8vo, London, 1898)	*The Board of Agriculture.*

The thanks of the Society were unanimously voted to the Board of Agriculture for their Donation.

The President exhibited a simple form of microtome, consisting of a plate of glass slightly roughed on one side, and a heavy casting. There was nothing new in the principle, which was the same as the Williams' microtome, and the cutting was done with a razor, but the point of interest and novelty was the cost. Most kinds of microtomes were, as they knew, rather expensive instruments, but the price of this one was 3*s.* 9*d.* post free; or, if with rough plate, 3*d.* extra (see p. 377). The instrument was handed round for inspection by the Fellows present.

The President said they had received three short papers from Mr. Jourdain, which, as the author was not present, he would read to the meeting.

The first of these papers was 'On a new Apochromatic Objective constructed without the use of fluorite.' The lenses were made by the Bausch and Lomb Optical Company, and Mr. Jourdain promised to send a set of them for exhibition at one of the meetings of the Society.

The President remarked, in connection with this paper, that although there was no fluorite used in the manufacture of these lenses, they were a great deal more expensive than those made by Messrs. Zeiss, which had the fluorite in them.

Mr. Jourdain's second and third papers, 'On the Method of Adjusting the Sizes of the Coloured Images yielded by the Cooke Lens,' and 'On the Construction of the "Planar" Lens, and its uses in low-power Photomicrography,' respectively, were also read by the President, who remarked that the optics of photographic lenses had of late years become so specialised that they now formed quite a distinct branch of study, to which he had given too little attention to be able to follow Mr. Jourdain in his account of the Cooke lens. When a subject became specialised, a specialised nomenclature grew up with it; and so rapidly did things progress nowadays, that unless one kept oneself *au fait* with the current literature and modes of expression on any particular subject, in a very little while one became unable to understand the meanings of the terms employed. Therefore, if Mr. Jourdain had been present, he would like to have asked him one or two questions with regard to the foci of the negative and two positives of which the lens was composed. He was sure, however, that the Fellows present would give Mr. Jourdain a hearty vote of thanks, both for sending the Cooke lens there, and for his remarks upon it, as well as for his interesting notice of the apochromatic objective constructed without fluorite.

The thanks of the Society were unanimously voted to Mr. Jourdain for his communications.

Dr. J. Tatham inquired if the President had seen one of the apochromatic lenses described as being made without fluorite?

The President said that he had not yet had an opportunity of seeing one, but he hoped to do so shortly, as Mr. Jourdain had promised to send some up for exhibition.

The President read a note 'On the Optics of Photographic Lenses.'

The President said that Mr. Rousselet had got together for exhibition that evening a most interesting collection of living objects connected with pond-life; he might say that he had never seen a better collection of these objects than that they had in the room before them. He hoped Mr. Rousselet would tell them something about what was being shown.

Mr. Rousselet said he really had nothing to say about them, except that Mr. Parsons had done a great deal towards getting them together.

The President thought that if Mr. Rousselet had nothing to say, the Society had a great deal to say as to their indebtedness to the Members of the Quekett Microscopical Club, and to the Fellows who had contributed to make this exhibition so successful. Messrs. Watson and Son had sent down a large number of Microscopes for use on the occasion, whilst others had been brought by Fellows and friends who were exhibiting specimens. To all these gentlemen their thanks were heartily due, and he had great pleasure in proposing that the thanks of the Society be given to them.

This motion having been put from the chair, was carried unanimously.

The Secretary said there was another paper on the Agenda, viz.:—a 'Report on the Foraminifera of the Malay Archipelago,' by Mr. F. W. Millett. This, though a valuable communication, was so highly technical that he proposed that it be taken as read.

The President said that this paper would appear in the Journal, and would no doubt be referred to with interest by those who studied these organisms.

The thanks of the Society were unanimously voted to the author for his communication.

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

The President:—Student's Microtome, made by Messrs. Reynolds and Branson, Leeds.

Members of the Quekett Microscopical Club and Fellows of the Society:—An exhibition of Microscopic Aquatic Life.

New Fellow.—The following gentleman was elected an *Ordinary* Fellow of the Society:—Mr. Kaufmann I. Marks.

SEP 5 1898

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

AUGUST 1898.

TRANSACTIONS OF THE SOCIETY.

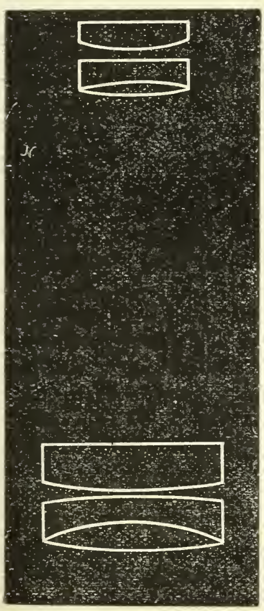
X.—*On a New Apochromatic Objective constructed without the Use of Fluorite.*

By Philip E. Bertrand Jourdain, F.R.M.S.

(*Read 18th May*, 1898.)

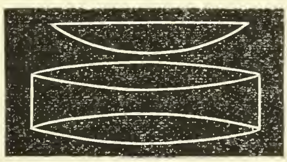
Semi-apochromatic lenses made of hard glass can be produced, as Mr. E. M. Nelson * has pointed out when speaking of some by Leitz,

Fig. 72.



Apochromatic objective; 2/3 in. (×2).

Fig. 73.



Projection ocular (8) (×2).

which are very highly corrected as to colour; in one case such an objective was hardly distinguishable from the earlier apochromats of Zeiss. Apochromatic lenses can also be constructed if the soft glasses of Schott & Co. are used, but their permanency is doubtful.

Prof. Charles S. Hastings recently, however, computed an apochromatic objective without fluorite, which is stated to be of permanent materials. I am able, through the courtesy of the makers, Messrs. Bausch and Lomb, to give a sectional drawing of an objective and projection ocular; but no information

* Journ. Roy. Micr. Soc., 1897, p. 349.

as to the precise nature of the glasses used seems to be forthcoming.

The subject of the permanency of some kinds of Jena glass is of great interest; but while it is highly desirable that all the elements in an objective should be of lasting and untarnishable character, it is nevertheless a fact that much can be done by judicious protection of any doubtful ones. The boro-silicate flint of Schott & Co. tarnishes very rapidly in ordinary air, on account of the presence of minute traces of sulphur compounds. This flint, when enclosed between two other glasses in Dennis Taylor's telescope objective, has been found to show no perceptible alteration after five years' use.

XI.—*On a Method of Adjusting the Sizes of the Coloured Images yielded by the Cooke Lens.*

By Philip E. Bertrand Jourdain, F.R.M.S.

(*Read* 18*th May*, 1898.)

The problems involved in designing objectives for photomicrography in three-colour printing include not only the bringing together to one focus the rays from three different points in the spectrum, so as to correct the outstanding secondary spectrum, but the securing of the same sized image for the same object in three different colours.

The former problem can, of course, be practically solved by the use of special glasses, such as those used by Schott & Co.; the second part of the problem was first explained in detail in the writings of Dr. Schröder.

One of the most interesting points about the Cooke lenses, which Mr. E. M. Nelson kindly showed on my behalf before this Society on March 16th last, is their capability of being adjusted so that the sizes of the coloured images correspond—a capability which is quite exceptional, and has probably been attained in only one other objective, the "Concentric" of Dr. Schröder.

In order to understand the process of adjustment, it is necessary to have a clear idea of the construction of the lens. It is a triplet, composed of two simple positive lenses and a simple or compound negative lens * placed between them; the negative lens or element having a refractive index for the D ray lower than that of the positive lenses. The focal power of the negative lens falls slightly short of the sum of the powers of the two positive lenses, and a small residue of correction against curvature of field and astigmatism is performed by diaphragm corrections.†

In securing coincidence of the coloured images with such an objective, the best results can be practically obtained by the careful adjustment of the air-space between the back and negative lenses, and this end may be attained without sacrificing any other qualities of the lens.

In practice, this adjustment is obtained by treating the photographic or microscopic objective as the objective of a telescope, using as the ocular a high power and carefully corrected achromatic eye-piece.

* In the lenses shown the negative lens was simple and the aperture F/6·5.

† If the refractive indices of the three lenses are about equal, strict application of the principle of construction demands that diaphragm corrections be totally eliminated, so that the burden of correcting curvature of field and marginal astigmatism be thrown on the negative lens, whose power would have to be equal to the combined focal powers of the positive lenses. As this would necessitate thick glasses and deep curves, which tend to produce aberrations of secondary order, the best final results are obtained by the compromise described above.

The image of an artificial star is focussed by means of the latter, and the objective is inclined so that the light passes through it at about twenty to thirty degrees from its axis. If the ocular be then turned slightly out of focus, the objective, unless properly corrected, presents in the eye-piece a series of coloured rings quite apart from any want of chromatic correction.

In the case of a lens under-corrected in this sense, the outer rings are red on both sides of the focus; but if the air-space already referred to be carefully adjusted while the objective is under examination, these rings can be made to coalesce exactly, so that they present a ring of white light.

Finally, I wish to express my deep obligation to Messrs. Taylor, Taylor and Hobson for many interesting details concerning these lenses, and the loan of two of them for testing and experimental purposes.

XII.—*Remarks on the Construction of the Planar Lens and its Use in Low-Power Photomicrography.*

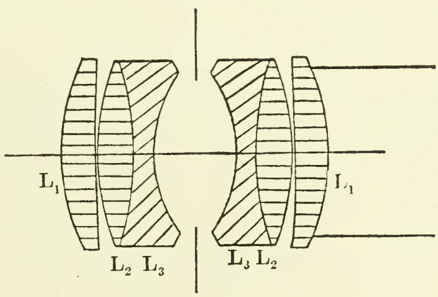
By Philip E. Bertrand Jourdain, F.R.M.S.

(*Read* 18*th May*, 1898.)

The application of short-focus photographic lenses to low-power photomicrographic work has not always been satisfactory, though it is probably true that a short-focus photographic lens is preferable to a low-power microscopic objective for purposes of photography.*

Recently, Dr. Rudolph computed a photographic lens of extremely large aperture, having regard to its astigmatic and spherical corrections, which, in the smaller sizes, is admirably adapted for low-power photomicrography.

Fig. 74.



In construction, the objective is symmetrical; each half consisting of a positive single element L_1, and a negative cemented combination, which, in turn, is made up of a positive biconvex L_2 cemented to a negative biconcave L_3. The refractive indices of L_2 and L_3 are approximately equal, but L_3 has the higher dispersive power.

Spherical aberration is corrected with a large aperture by taking advantage of the principle of Gauss' telescope objective; chromatic aberration is compensated in an entirely new manner; and astigmatism is corrected without the disadvantages of a large separation between the lenses or thickness of the elements.

For photographic work, it is chiefly interesting on account of its great *available* rapidity and wonderfully perfect astigmatic correction; indeed, in this respect it surpasses the other anastigmats calculated by Dr. Rudolph and introduced by Carl Zeiss.

For photomicrographic work, it is interesting to compare it with a

* See Brit. Journ. Phot., xliv. (1897) pp. 706–7.

Zeiss projection lens of the same focus. The "Planar" lenses are quite achromatic, and the chromatic differences of spherical aberration are only very slight. The secondary spectrum is not, however, eliminated to the same extent as it is in the projection lens, and Dr. Rudolph does not think that this will ever be the case. It may be noted, however, that apochromatism is not a great necessity in low-power objectives.

The objectives of 20 and 35 mm. focus may be used with Zeiss' compensating eye-piece No. 18, but with such high magnifications a red border is visible.*

* Further information as to curves and kinds of glass used will be found in the patent specification (No. 27,635 of 1896), price 8*d*., and its reprint in the Brit. Journ. Phot., xliv. (1897) pp. 424–6.

XIII.—*On the Errors to be Corrected in Photographic Lenses.*

By E. M. Nelson, Pres. R.M.S.

(*Read* 18*th May*, 1898.)

As there was no other paper on the Agenda, I thought it would be a good opportunity to put before you a brief and popular account of the errors which need correcting in a photographic lens. This will in no wise clash with the paper we have just heard, as that dealt with corrections that had already been effected in certain lenses. One so often hears and sees in print such erroneous and wild theories regarding photographic lenses, that it may not be amiss to lay before you one or two of the fundamental optical principles, such as are dealt with in the ABC books and primers on the subject. This is now all the more necessary because low-power photomicrography and ordinary camera photography overlap, the same lens being used for both purposes.

The first and principal error to be met with in all dioptric lenses, photographic or otherwise, is that of chromatism; this need not be enlarged upon, as all microscopists are acquainted with it, and its method of correction, by combining a high-power positive lens having low dispersion with a low-power negative lens having high dispersion, the power of the combination being the difference between the powers of its components.

The second error may, like the first, and for the same reason, be dismissed in a word or two. It is of course the spherical aberration of the direct pencil, which in this instance we will restrict to axial parallel rays. This error is due to the spherical form of lenses causing axial parallel rays, passing through a part of a lens remote from the axis, to have a different focus from those passing through the axial portion of the lens. In some lenses the aberration is negative, which means that the marginal rays have a shorter focus than the central; in other lenses it is positive, or the axial rays have a shorter focus than the marginal. Spherical errors are corrected by combining lenses which have equal amounts of positive and negative aberration.

The third error is curvature of image; this means that a real image formed by a lens having a positive focus is curved, presenting its concave aspect to the lens, and the radius of curvature is (approximately) equal to the focal length multiplied by the refractive index. Thus, for example, if we take the refractive index as $1 \cdot 5$, the diameter of the curvature of the image may be estimated as three times the focal length of the lens which formed it; so the image from a 6-in. focus lens would have a diameter of curvature of 18 in., or a radius of curvature of 9 in.

This error is, as far as possible, corrected by reducing the aperture, and by giving to the lens a suitable form. Thus, in a single landscape lens, an inverted meniscus is used. It generally turns out, however, that when an advantage is gained in one direction something is lost in another. In this instance, spherical aberration is introduced by this form of lens, so the correction of the third error is accomplished by introducing the second. In a lens which has a flat field, a want of sharpness may be noticed in images formed by even direct axial pencils.

The fourth error is distortion; this, which is commonly called pincushion and barrel distortion, is caused by the too great refraction of oblique centrical pencils. It is corrected by opposing two lenses of symmetrical form to one another. It should be noted, however, that these lenses may be, and often are, asymmetrical both as to their foci and as to chromatic corrections; all that is necessary is that they should be symmetrical in their outward form or nearly so.

The fifth, the astigmatic error—one most difficult to correct—is caused by the focal lines of oblique and excentrical pencils. The mathematical analysis of this subject is both complicated and prolix. The corrections are obtained by combining glasses possessing relatively high dispersion and low refraction with those of low dispersion and high refraction. This is now rendered possible, owing to the production by the Jena firm of glasses having their ratios of refraction to dispersion different from any hitherto made.

To very briefly explain astigmatism:—When a small oblique pencil is refracted by a lens, the rays are not brought to a focal point, but to a line, and afterwards to another line; these lines are called the primary and secondary focal lines. When a lens has negative aberration, that is, when the lens brings aberrated rays to a focal point situated between the lens and its geometrical focus, then the primary focal line lies between the lens and the secondary focal line; but when the lens has positive aberration, that is, brings aberrated rays to a focal point beyond its geometrical focus, then the secondary focal line lies between the lens and the primary focal line. In general, the circle of least confusion lies half-way between the focal lines.

Now, a plane passing through the axis of the lens and the axis of the small oblique incident pencil, is called the primary plane, and the primary focal line is always perpendicular to this plane; but the secondary focal line lies in it; therefore the focal lines are at right angles to one another. If now points are imaged by lines, it is very easy to see how the image of a lined object in a certain direction would be blotted out. By means of a hole in a card, a small oblique beam of sunlight may be passed excentrically through a hand magnifying glass, and the focal lines be conveniently studied by receiving their images on a piece of paper.

These focal lines have nothing whatever to do with spherical aberration, as some have supposed, for they can be originated by pencils falling obliquely on a plane refracting surface. It is here that we meet one of the differences between reflection and refraction;

a plane refracting surface has a diacaustic, but a plane reflecting surface has no catacaustic.

The sixth and last error is a smaller one, viz. the chromatic error of the secondary spectrum. This is due to irrationality in the dispersion of the media of which a compound achromatic lens is composed.

This error is removed in two ways, viz. (a) by the manufacture of glasses having proportional dispersions; and (β) by combining three different media instead of two; in other words, by making an achromatic triplet of three different media, instead of a doublet of two different media. Of these two methods the first is the better, and great strides have been made in this direction during the past 10 or 15 years.

To sum up, we find that there are no less than six errors to be corrected in a photographic lens, viz.:—

(1) Chromatic aberration, primary spectrum.
(2) Spherical aberration of direct pencil.
(3) Curvature of field.
(4) Spherical aberration of oblique pencil.
(5) Astigmatism arising from focal lines of oblique pencils (caustics).
(6) Chromatic aberration, secondary spectrum.

By these considerations the following question is suggested, viz., what is meant by the term aplanatism?

There can be no doubt that formerly it was applied to a single lens which had only been corrected spherically for a direct pencil, e.g. the aplanatic meniscus. Subsequently it implied the correction of the spherical aberration for parallel axial rays, and at the same time the correction of the chromatic aberration of these rays for the primary spectrum. Now, however, the term has been used more loosely, and it is often applied to a combination in which spherical aberration for axial parallel rays has been intentionally introduced for the purpose of flattening the field.

From what has been said above, we can see the reason of the test applied to photographic lenses mentioned by Mr. Jourdain. The artificial star, one of the most sensitive tests for both spherical aberration and centreing, when the pencils are direct, is also one of the best for searching out focal lines, when the pencils pass through it obliquely, the lens being turned on its axis for that purpose.

We are all, I am sure, greatly indebted to Mr. Jourdain for bringing this interesting subject before us by his account of the correction by lens distance, and also of the method of testing photographic lenses.

In the above note no notice has been taken of this alteration of lens distance, because it is of the nature of a secondary correction of a higher order of error than any we have been considering. This brief article has only been written in order that the "brass and glass" section of our Fellows may have before them a few elementary optical principles connected with photographic lenses and their corrections.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.

*Including Original Communications from Fellows and Others.**

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Theory of the Mesoderm.‡—Dr. T. Garbowski discusses the theory of the mesoderm in the light of *Amphioxus.* His main conclusions are the following. The longitudinal axis of the larva and the dorsoventral axis of the gastrula are not at right angles, but diverge at an angle of about 70°. The gastrula of *Amphioxus* is no archigastrula, nor is the course of development palingenetic. Neither ectoderm alone nor endoderm alone conditions the invagination, all the segmented material is concerned. The closure of the blastopore is not due to a longitudinal concrescence, but to a strong *Nachwachsen,* especially of the dorsal wall. At the posterior margin of the blastopore no primitive mesoderm cells are differentiated. The mitoses are not more crowded at the upper inturned margin of the blastopore than in other parts of the epithelium. The zone of the blastopore margin is, especially above, neither to be reckoned as ectoderm nor as endoderm. The upper wall of the archenteron is quite normal. There is no demonstrable connection between the anterior mesoderm folds and the blastopore. There is in *Amphioxus* no homologue of the "peristomal" mesoderm of Vertebrata. The mesoderm of *Amphioxus* is not genetically continuous with that of the Anamnia, and *Amphioxus* stands apart from other Chordata.

Yolk-Sac of Scyllium.§—Herr Hs. Virchow describes the yolk-sac cleft and its closure; the primary vascular relations (artery, vein, capillaries, and vascular islands); and the transition from the primary to the secondary vascular relations.

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

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

‡ Anat. Anzeig., xiv. (1898) pp. 473–97 (4 figs).

§ SB. Ges. Nat. Freunde Berlin, 1897, pp. 49–59.

In another paper,* the author discusses the yolk-syncytium of Selachians, with its undefined cell-areas and its uniform distribution of nuclei in a single layer. He shows how it differs at different points (marginal, central, &c.) at different times in development, and in different genera.

Morphology of Vertebrate Head.†—Mr. H. V. Neal has studied this problem by investigating the nervous system in *Squalus acanthias*. He is unable to accept Locy's "neural segments" as true segments, for they are irregular in size, inconstant in number, bilaterally asymmetrical, and without definite relation to structures known to be segmental.

In the early stages of *S. acanthias* the neuromeres are local thickenings of the lateral zones, as well as dilatations of all the zones of the medulla.

No structural conditions are presented by the myelomeres which are not reconcilable with the hypothesis that their existence is dependent upon the presence of the mesodermal somites.

There was a primitive correspondence between neuromerism, mesomerism, and branchiomerism.

The eye-muscle-nerves (3, 4, 6) are the serial homologues of ventral spinal nerves; the *ophthalmicus profundus* is a segmental dorsal nerve belonging to metamere ii., while the oculomotor is its ventral root; the trochlear is the ventral nerve of metamere iii., and the *abducens* represents the ventral nerves of metameres iv. to vii.

There are five mesomeres alternating with six neuromeres in the otic and pre-otic regions; probably eleven neuromeres are finally included in the head of *Squalus*.

The author compares the mouth of *Amphioxus* with the left half of the mouth of Craniota, the first pair of permanent visceral clefts in *Amphioxus* with the hyomandibular clefts, and the eight visceral clefts in *Amphioxus* at its "critical stage" with the eight morphological clefts found in some Selachians and Cyclostomes. This report, however, gives only a hint of the scope of this important paper.

Differentiation of Sex-Cells.‡—Dr. v. Hæcker distinguishes, in the development of the germ-cells of *Cyclops*, three differentiating processes:—(*a*) that associated with heterotypic division in the formation of the primitive germ-cells; (*b*) that associated with the separation of paternal and maternal nuclear substance (Rückert); and (*c*) a third process (also seen in the differentiation of the genital rudiment) which seems like a disruption of nucleolar substance.

Crosses between Different Breeds of House-Mouse.§—Herr Georg von Guaita has sought to study the facts of inheritance by crossing different breeds of mouse, characterised by size, colour, markings, dancing power, and temperament. There is a general tendency to results which may be described as reversions to the original type. Thus, if the Japanese dancing mouse be crossed with the albino, the second generation consists of grey mice like the wild form. Continued in-

* Tom. cit., pp. 91–110.
† Bull. Mus. Harvard, xxxi. (1898) pp. 147–294 (9 pls.).
‡ Ber. Nat. Ges. Freiburg, x. (1897) pp. 15–9.
§ Op. cit., x. (1898) pp. 317–32.

breeding among relatives tends gradually to infertility, as Ritzema Bos previously concluded. Some of the detailed results are also of much interest.

Telegony and Maternal Impressions.*—Dr. Otto vom Rath has made an interesting critical study, and some experiments, bearing on these alleged phenomena. It is not easy to sum up the paper, the points of which depend on the criticism of particular cases; but it may be noted that the author thinks biologists are still apt to be "too superstitious." Cases of maternal impression are shown to be "Märchen," and Telegony is still unproved.

Hermaphroditism.†—Dr. J. Fl. Babor directs attention to the phenomena which he has observed in *Limax maximus*. There is in the gonads a succession of sexual states,—female, hermaphrodite, male, hermaphrodite, female. He compares this with what is known in Cymothoidæ, *Apus*, *Stichostemma*, Myzostomata, and *Myxine*. Even in the human testes he has found in old subjects cellular strands which show here and there "primordial ova and primitive follicles." The generalisation suggested is that the indifferent germinal epithelium has the power of producing both kinds of sex-cells in succession.

Studies in Consanguinity.‡—A. L. Herrera refers in a résumé to his studies on "the origin of individuals and the construction of the organism by internal conditions," § and submits a series of tables intended to facilitate the discussion of the facts of inheritance. He refers to successful inbreeding in race-horses, and to the fact that inbreeding of white or whitish rabbits is less successful than that with those of stronger colour. Otherwise, we fail to find anything concrete in his résumé; but we should like to have the original.

Development of Lizard's Skull.‖—Herr E. Gaupp gives a preliminary account of his researches on the development of the Lacertilian skull,—his material consisting of *Lacerta agilis*, *L. vivipara*, *Anguis fragilis*, and *Platydactylus mauritanicus*. The component elements are discussed under four categories:—

(1) The primordial chondrocranium and its ossifications.

(2) The "covering bones," in more or less close relation to (1).

(3) The proper "skin-ossifications" (*lamina supraocularis*, *lamina superciliaris*, &c.).

(4) The supra-orbital bone, which appears very late, and is held to deserve a separate category.

Regeneration of the Lens.¶—Dr. A. Fischel has investigated this in the larvæ of salamanders. He finds that there is no regeneration on the part of epithelial portions of the cornea which have been ruptured or brought into intimate relations with the iris. The regeneration is due to the cells of the inner layer of the *pars iridica retinæ*. The extirpation of the lens may stimulate regenerative processes at several

* Ber. Nat. Ges. Freiburg, x. (1898) pp. 333–59.
† Verh. Zool.-bot. Ges. Wien, xlviii. (1898) pp. 150–3.
‡ Bull. Soc. Zool. France, xxiii. (1898) pp. 78–81.
§ Mém. Soc. Sci. Antonio Alzate.
‖ Ber. Nat. Ges. Freiburg, x. (1898) pp. 302–16.
¶ Anat. Anzeig., xiv. (1898) pp. 373–80.

places, and actually lead to the new formation of more than one lens. Regeneration is effected by the upper portion of the iris, never by the lower. The process may occur in complete darkness, but it is then slower than in the light. Any tearing or dislocation of the iris may serve as the stimulus to lens-regeneration.

Neurenteric Canal.*—Herr Kopsch maintains that in Tunicates the blastopore becomes the neurenteric canal through the appearance of the medullary canal, and that the region of the neurenteric canal is to be regarded as a growth-centre from which the elongation of the embryonic body proceeds.

b. Histology.

Present Position of Some Cell Problems.†—Prof. J. B. Farmer takes a survey of some recent work, discussing the conception of the cell as a structural unit or unit-protoplasmic area, the intercellular continuity of protoplasm, the interrelations of nucleus and cytoplasm, the rôle of the centrosome, the phenomena of nuclear division, the problem of reducing divisions, and so on. The essay may be recommended as a readable and up-to-date statement of the present position of some of the fundamental problems of cytology.

Indirect Division.‡—M. Joannes Chatin has studied direct or amitotic division, especially in *Paludina* affected with cercariæ. The rapid proliferation in the connective tissue is very instructive; some interesting cases of anomalous direct division occur. Chatin refuses to admit the generalisation that indirect division is regenerative, and direct division degenerative. Except in special cases, there is no antithesis between the two modes.

Annular Nuclei.§—Prof. E. Ballowitz discusses the annular and perforate nuclei which have been described in many different kinds of cell. The facts point to the conclusion that these forms are normal and potent, and without evidence of degeneration. Moreover, they multiply, like other nuclei, by mitosis. Ballowitz has studied them especially in the epithelium of *Salpa*.

Superficial Position of Central Corpuscles in Epithelial Cells.‖—Prof. E. Ballowitz brings together a number of cases, observed by himself and others, in which the centrosomes of epithelial cells lay superficially. The hypothesis is suggested that the centrosomes may be peculiarly receptive to external stimuli, and may transmit these to the general protoplasm. In other words, the centrosomes may represent "a kind of sensory, central, primitive organ of the cell." This seems going even further than von Lenhossék's description of the little body as a "kinetic central organ."

Intermediate Body in Cell-Division.¶—Prof. E. Ballowitz gives a critical account of what is known in regard to this little body. Like Flemming, he finds the earliest hints of it in connection with the connecting threads (*Verbindungsfaser*) between the daughter-nuclei. It

* SB. Ges. Nat. Freunde Berlin, 1897, pp. 5–13 (3 figs.).
† Nature, lviii. (1898) pp. 63–7 (11 figs.).
‡ Comptes Rendus, cxxvi. (1898) pp. 1163–6.
§ Biol. Centralbl., xviii. (1898) pp. 286–99.
‖ Anat. Anzeig., xiv. (1898) pp. 369–72.
¶ Tom. cit., pp. 390–405.

appears, however, as thickenings of these threads, not between them as Flemming stated. The author argues that it is not merely an "atavistic reminiscence." It has probably some functional import, and the suggestion is offered that it is an accumulation and condensation of used-up material from the achromatin apparatus, in short, "that it is an excretory product."

Relation of Centrosomes to Cilia.*—Dr. L. F. Henneguy notes several facts which point to a physiological relation between centrosomes and cilia. Thus, in the ciliated cells of Lamellibranch gills, the swelling at the base of each cilium behaves to reagents exactly like a centrosome. The same relation is suggested by the centrosome in spermatozoa. "The centrosomes, which have been hitherto regarded by the majority of biologists simply as organs playing a part as kinetic centres, having to do with the regulation of the movements within the dividing cell, should also be regarded as kinetic centres for the external movements of the cell."

Cuticle and Intercellular Bridges.†—Prof. F. K. Studnička maintains that the cuticle or *Deckplatte*, with its vertical striæ, must be interpreted in relation to the intercellular communications in the epidermis, and that it is primitively due to fine membranes connecting cilia. The septa in the *Deckplatte*, the intercellular connections of epidermic cells, and in part even the cilia, are morphologically equivalent. An ingenious figure in the text illustrates the theory.

Chondrified Fibres in Connective Tissue.‡—Prof. F. K. Studnička found in the lamprey and hag somewhat mysterious chondrified fibres in the connective tissue. They did not, except in rare cases, show any direct connection with cells. What part, if any, they may play in chondrification, remains obscure.

Alimentary Tract of Chelone.§—Prof. L. Plate gives a short account of the alimentary tract of *Chelone mydas*, the minute structure of which does not seem to have been adequately studied as yet. Roundish papillæ in the mouth-cavity often show a central insinking, which C. K. Hoffmann interpreted as the opening of small glands; but sections show no trace of glands. The long horny papillæ of the gullet were interpreted by Owen as assisting the downward passage of the slippery seaweed; but Plate thinks that they must help rather to tear it up.

Enamel of Elasmobranch Fishes.‖—Mr. C. S. Tomes discusses the nature of the hard polished outer layer of the teeth in Elasmobranchs which resembles an enamel in hardness, optical properties, almost entire solubility in weak acids, and tubularity, but contains lacunar spaces and presents a very distinct lamination. Upon the balance of its characters it has much more in common with enamel than with dentine, from which it is sharply marked off by the entire absence of any collagen basis. As to development, it seems to be a joint product of the epiblastic enamel organ and the mesoblastic dentine papilla. On the whole, how-

* Comptes Rendus, cxxvi. (1898) pp. 975–8.
† SB. Böhm. Ges. Wiss., 1897 (ii.) No. lix. 11 pp., 1 pl. and 1 fig.
‡ Op. cit., 1897 (ii.) No. lxv., 7 pp.
§ SB. Ges. Nat. Freunde Berlin, 1897, pp. 85–9.
‖ P. R. Soc., lxiii. (1898) pp. 54–6.

ever, Mr. Tomes gives his authority to the usage which still calls this layer enamel.

Parathyroid Glands.*—Dr. D. A. Welsh has made a critical, anatomical, and experimental study of the parathyroid glands; but of this only the first part is published. It gives a highly useful historical digest of the literature concerning these puzzling bodies.

Minute Structure of Notochord.†—Prof. F. K. Studnička remarks that the tissue of the notochord is usually described as very simple,—a superficial epithelium, and large internal vacuolated elements, the exact nature of which has been often disputed. Ebner, however, rather changed this view by showing that the notochordal tissue was in no way degenerate, but rather the reverse.

Studnička describes the structure in *Petromyzon*, *Myxine*, *Chimæra*, Selachians, several Ganoids and Teleosts, *Ceratodus*, *Protopterus*, and some Amphibians. The cells have no real membrane, nor anything comparable to cartilage. The presence of intercellular connections and fibrillations in the ectoplasm suggests affinity with epidermis and epithelium. At the same time, it must be noticed that the germinal zone (*Keimzone*) of the notochordal tissue—in other words, the epithelium—has here and there the capability of forming cartilage. In many cases, nevertheless, the cartilage described in the notochord is quite extraneous in origin.

c. General.

Light-Limit in Water.‡—Dr. L. Linsbauer is much more cautious than some are in regard to the light-limit in water. We neither know the composition of the light at different depths, nor the limit beyond which light fails to penetrate. It seems certain that a depth of 500 metres does not represent the limit at which chemical rays may be operative. The greatest depth recorded for a plant, not a Thallophyte, is 60 m., at which Forel found a moss (*Thamnium alopecurus*) in Lake Geneva. Algæ occur at much greater depths, though they are certainly very sparse beyond several hundred metres. More exact experiments are necessary before we can speak definitely in regard to a quite light-less (*aphotische*) region. The author has devised an arrangement for testing the colour and intensity of the light at various depths.

Bristle-like Structures on a Shark.§—Prof. A. Brandt observed twenty-seven years ago the presence of numerous bristle-like structures on the snout of a shark, probably *Selache maxima*; and with the assistance of his colleague Prof. W. Reinhard he has now investigated them. They differ conspicuously from Mammalian bristles in the deposition of calcareous corpuscles in the papilla and in the fibrous tissue. The author argues for the consideration of the hypothesis that hairs and teeth may be homologous structures.

Functions of Hypophysis Cerebri.||—E. de Cyon has been led on experimental evidence to regard the hypophysis, like the thyroid, as an

* Proc. Scot. Micr. Soc., ii. (1896–7) pp. 128–43.
† SB. Böhm. Ges. Wiss., 1897 (ii.) No. xlv. 71 pp. (2 pls.).
‡ Verh. K. K. Zool.-Bot. Ges. Wien, xlviii. (1898) pp. 167–70.
§ Biol. Centralbl., xviii. (1898) pp. 257–70 (10 figs.).
|| Comptes Rendus, cxxvi. (1898) pp. 1157–60.

automatic arrangement preventing a dangerous afflux of blood to the brain. When it is stimulated, there is an immediate change of blood-pressure. But it has also a chemical rôle; extracts of hypophysis injected into the veins of an animal produce on heart and blood pressure-effects identical with those which follow electrical or mechanical stimulus of the organ. He compares the action of hypophysine or phosphoro-hypophysine with that of iodothyrine from the thyroid.

Regeneration and Doubling of the Tail in Lizards.*—Dr. G. Tornier finds that the Varanidæ and Helodermatidæ should be excluded from the list which Fr. Werner has given of Lacertilians which do not exhibit tail-regeneration. He notes that those with heterogeneous scaling on the tail are those in which atavistic regeneration might be most reasonably expected; yet this is not the case. This is illustrated in regard to *Pachydactylus capensis* in some detail. Most double tails arise as the result of a notch on the tail,—a secondary tail growing out from the wound. Sometimes, however, they ensue after a bite without any notch. The secondary tail is at first at right angles to the axis of the wound, but the more abundant nutrition of the side towards the head results in bending the extra appendage backwards.

Studies in Variation.†—Mr. W. J. Moenkhaus has studied the darter fishes—*Etheostoma caprodes* and *E. nigrum*—from Turkey Lake and Tippecanoe Lake, Indiana. In the former species the males are more variable than the females (as to rays and spines) in the ratio ·507 : ·468; in the latter species the females are more variable than the males in the ratio of ·402 : ·454. In both species the individuals differ in the two habitats in every structure examined. The differences are apparently environmental modifications. Successive broods differ with the varying conditions of the year in which they are born. The variations in the fins are correlated as follows:—

(*a*) When the dorsal spines increase in number, the dorsal rays decrease in number.

(*b*) When the anal rays increase, the dorsal spines, the dorsal rays, and the sum of the elements in the two dorsals, increase.

In an abstract of a paper on cave-animals, Prof. C. H. Eigenmann criticises current theories, and argues that the Amblyopsidæ were not swept into the caves, but entered them deliberately, and avoided coming out into the light. They were able to establish themselves in caves because they were able to do without light, having simplified eyes and highly developed other sense-organs; they do not possess highly developed sense-organs and degenerate eyes because they were accidentally swept into caves. A short note is given as to the eyes in *Amblyopsis* and *Typhlichthys subterraneus*. The degeneration is not the result of arrested development or of ontogenic retrogression, nor is it primarily due to the cave habitat. The eyes of those species living in the light are prophetic of the eyes of those living in the dark.

Variations and Mutations of the Sparrow's Egg in America.‡—Mr. H. C. Bumpus has compared a large number of sparrow's eggs from

* SB. Ges. Nat. Freunde Berlin, 1897, pp. 59-64.
† Proc. Acad. Sci. Indiana, 1897, pp. 207-31.
‡ Biol. Lectures Marine Lab. Woods Holl in 1896, Boston, 1897, pp. 1-15.

Britain and America, and finds that the American eggs are more variable in ratio of breadth to length, and in colour. "Granting that the sparrow, since its introduction (1850), has been comparatively free from the action of natural selection, we may conclude that the predicted results of Panmixia have been realised." The author discusses this conclusion. He suggests that "English and American birds should be placed in some third locality which combines equally or eliminates the prejudicial environmental conditions of the two countries. Then, and not until then, shall we know to what extent the ontogenic variations in either country have really become phylogenic."

Variability in Fishes.*—Dr. G. Duncker has been engaged in investigating the variability of *Pleuronectes flesus* and *Siphonostoma typhle* L., and makes a short note on some of his results that have a local faunistic interest. The flounders of Plymouth, when compared with those of the Baltic and the south-eastern parts of the North Sea, form a distinct race. The characteristics of this race are:—(1) a high number of fin-rays in the dorsal and anal fin (average, dorsal 61–62, anal 43–44); (2) almost entirely smooth squamation on the blind side. In both respects it is similar to the variety *Pl. italicus* Günther, of the Mediterranean. There are adequate reasons for separating *Syngnathus rostellatus* Nils., and *S. acus* L., both occurring at Plymouth.

Polydactylism and Syndactylism in Mammals.†—Dr. G. Tornier describes some cases of polydactylism in pig and deer. He agrees with Zander that the efficient cause is to be found in the pressure of the amnion-folds. As the result there is atrophy of certain parts and "super-regeneration" of others. Often, but not always, the results appear as if there had been a fusion of parts of a right foot with a normal left, or *vice versâ*; but it seems impossible to make any generalisation. In many cases, too, polydactylism is associated with syndactylism which is the result of some inhibitory action during development, e.g. of pressure from the amnion-folds.

Polydactylism in Swine.‡—Herr J. Werner notes three cases of this, observed during eight weeks at the city slaughter-house in Leipzig. All concerned the fore-feet, and in one case the extra digit exceeded the normal posterior size. He also notes a case in which the soles of the two median digits had coalesced.

Intelligence of Fishes.§—Prof. W. C. McIntosh has a very interesting short paper, which we may be permitted to wish that he would extend, on the memory of fishes. Some of the cases given demand a somewhat wider title. He speaks of 'the behaviour of a large grey skate in its endeavour to escape over a trawl-beam more than 50 feet long which had been arrested in its rise—just above the surface of the sea—by a temporary block in the machinery. The dexterity with which it skimmed to and fro along the beam to find where it dipped sufficiently during the movements of the ship to enable it to glide over was a study. . . . If those who have given a green cod of six or eight

* Journ. Mar. Biol. Ass., v. (1898) pp. 172–5.
† SB. Ges. Nat. Freunde Berlin, 1897, pp. 64–8. ‡ Tom. cit., pp. 47–8.
§ Journ. Mental Sci., April 1898, 4 pp.

inches a particular kind of 'scale-back' (a kind of worm), and noticed, firstly, how eagerly it seized it, then tested it in its pharyngeal region, and soon ejected it, never again taking that species into its mouth, they would be slow to deny that fishes, and even very young fishes, have a memory." A number of very suggestive cases are given, and the author concludes "with regard to the absence of cortex of the brain in fishes, this is probably only a question of degree—easily understood by referring to the descriptions and figures of the brain in the salmon and the wolf-fish. Besides, who has proved that the function of memory depends on the brain-cortex of the human subject? I have seen many a curious case in the pathological room, the history of which would not have led us to this conclusion."

Coloration of Birds.*—Herr Hermann Meerwarth has studied the tail quills of certain Brazilian birds of prey, in connection with the vexed questions of colour change without moult and the phylogeny of markings. Observations on a living specimen of *Heterospizias meridionalis* in captivity convinced him that certain colour changes, especially the breaking up of cross-stripes into spots, do occur without moult. Further, a comparison with the corresponding feathers in *Urubitinga zonura* leads him to believe that similar changes without moult occur in this form, and produce the irregularity of marking already described in young specimens. The author does not seem to have been aware of Schenkling's † recent paper, and does not therefore touch upon the difficulties raised in it.

As to the evolution of markings, the author believes that cross-stripes are the most primitive; that, alike in the phylogeny and ontogeny of the forms discussed, these break up into spots which ultimately arrange themselves in longitudinal rows. A final change gives rise to a feather with pigment arranged in three or four zones. The changes take place first in the central rectrices and later in the lateral ones; they occur more rapidly in the male than in the female; but the tail feathers are not necessarily the first in the body to undergo these changes. The author discusses the relation of these facts to Eimer's "laws."

Hepatic Pigments.‡—MM. A. Dastre and N. Floresco have studied the hepatic pigments, as distinguished from the biliary pigments of Vertebrates. They divide the bodies into two sets according to their solubility:—(*a*) the aqueous pigments (soluble in water after "papainic" digestion, &c.) of which the most important is ferrine; and (*b*) the chloroformic pigments (soluble in chloroform) of which they name one cholechrome, intermediate between lipochromes and biliary pigments.

Adaptations of Respiratory Organs in Aquatic Mammals.§—Herr O. Müller has made a detailed study of this problem. With increasing adaptation to life in water, the ventral bronchi are more and more shunted backwards, and their place is taken anteriorly by the dorsal bronchi, which increase in number. The change in the form of the thorax also brings about a reduction of one of the lobes of the lungs—

* Zool. Jahrb., xi. (1898) pp. 65–88 (3 pls.).
† Biol. Centralbl., xvii. (1897) pp. 65–79.
‡ Comptes Rendus, cxxvi. (1898) pp. 1221–3.
§ Jenaische Zeitschr. Naturwiss., xxxii. (1898) pp. 95–230 (4 pls.).

the infracardiac lobe. Thus the associated *bronchus cardiacus* disappears in whales, and there is only a trace of it in the seal.

Secretion and Absorption of Gas in the Swimming-bladder and Lungs.*—Dr. J. S. Haldane, following up a previous paper, in which he gave an account of the evidence which proves that free oxygen, and in some cases at least nitrogen, is actively secreted by the epithelium of the swimming-bladder, discusses the question whether the exchange of gases between the blood and the air present in the alveoli of the lungs is also brought about by active secretion or absorption. After stating the evidence in favour of the diffusion theory, Dr. Haldane outlines some experimental investigations which seem to show that the diffusion theory of the respiratory exchange in the lungs is insufficient. The majority of these investigations, including those undertaken by himself and Dr. Lorrain Smith, go to prove that the lung epithelium participates actively in the process of respiratory exchange; but there are still too many discrepancies in the results gained by different observers to admit of any certain conclusions being drawn.

Porus Genitalis in Myxinidæ.†—Mr. R. H. Burne has studied this in *Myxine glutinosa* and *Bdellostoma cirrhatum*, and has done much to clear up an obscure point. The main difference between the lampreys and Myxinoids lies in the absence in the latter of the direct communication between the "porus genitalis" and the uro-genital sinus that forms so characteristic a feature in the former. The uro-genital sinus of lampreys is really absent in the Myxinoids; and in the latter the anus, "porus genitalis," and ureters, open into an integumentary cloacal chamber, similar to the cloacal chamber common to anus and uro-genital sinus in the lamprey.

Sensitiveness to Light in Amphioxus.‡—Herr W. Krause criticises Hesse's recent description of what seemed to him like "cup-eyes" on the nerve-cord of the lancelet. In 1888, Krause suggested that the animal was sensitive all along its spinal cord, and he adheres to this without attaching special importance to the grouping of the pigment-granules. Similar groupings around the nucleus are common, and may be seen in the human epidermis. Krause is inclined to believe that the importance of the pigment is not in its disposition, but in its liability to chemical change.

Petromyzont with Large Eyes.§—Prof. L. Plate gives a preliminary account of a Chilian Petromyzont—*Macrophthalmia chilensis* g. et sp. n.—which differs notably from other Cyclostomata in having large Teleostean-like eyes. These and its silvery-white colour point to a free and active life.

Relations between Marine Animal and Vegetable Life ‖—Dr. H. M. Vernon has tackled an interesting problem—how the nitrogenous matter excreted by marine animals into the water is removed, and what

* Sci. Progr., ii. (1898) pp. 237–52.
† Journn. Linn. Soc. (Zool.), xxvi. (1898) pp. 487–95 (1 pl.).
‡ Anat. Anzeig., xiv. (1898) pp. 470–1.
§ SB. Ges. Nat. Freunde Berlin, 1897, pp. 137–41.
‖ Proc. Roy. Soc., lxiii. (1898) pp. 155–61.

parts plants play in the process. Green sea-weeds like *Ulva* rapidly remove the free ammonia, but slowly increase the albuminoid ammonia. Red sea-weeds like *Gelidium* cause a considerable increase in the albuminoid ammonia, and usually in the free ammonia. Percolation through sand has some purifying effect, but this is increased greatly when there are diatoms and other Algæ mixed with the sand, or when bacteria abound in the sand. Vernon worked along three lines, chemical, physiological, and bacteriological. The water was tested physiologically by allowing the fertilised ova of the sea-urchin, *Strongylocentrotus lividus*, to develop in it, and by determining the change produced in the size of the larvæ after eight days' growth under various conditions. The bacterial quality of the water was tested by counting the number of colonies obtained by gelatin plate culture. As yet the results seem rather inconclusive.

Scientific Method in Biology.*—Dr. Elizabeth Blackwell argues that the attainment of truth is the aim of research; that the organic must not be treated as if it were inorganic; that scientific research in biology must be based upon close and extensive observation of the varying forms of animal life, under natural conditions, with post-mortem examination of the records left by health and disease; and so on. The book is a calm and careful statement of what may be called the humanitarian position.

Heredity and Instinct.†—Prof. C. Lloyd Morgan closes an interesting lecture on instinct and intelligence with the following well-weighed paragraph:—"Heredity plays a double part. It provides, through natural selection or otherwise, an outline sketch of relatively definite behaviour, racial in value; it provides also that necessarily indefinite plasticity which enables an animal to acquire and to utilise experience, and thus to reach adaptation to the circumstances of its individual life. It becomes, therefore, a matter of practical inquiry to determine the proportion which the one kind of hereditary legacy bears to the other. Observation seems to show that those organisms in which the environing conditions bear the most uniform relations to a mode of life that is relatively constant, are the ones in which instinct preponderates over intelligent accommodation; while those in which we see the most varied interaction with complex circumstances show more adaptation of the intelligent type. And the growth of individual plasticity of behaviour in race-development would seem to be accompanied by a disintegration of the definiteness of instinctive response; natural selection favouring rather the plastic animal capable of indefinitely varied accommodation than the more rigid type, whose adaptations are congenitally defined."

Litoral Fauna and Pisciculture at Marseilles.‡—Prof. A. F. Marion has made a detailed survey of the fisheries on the coasts of Marseilles, describing the different modes of capture, discussing the question of bait, suggesting possibilities of development, and *inter alia*, taking note of other than utilitarian aspects of the litoral fauna.

* 'Scientific Method in Biology,' London, 1898, 8vo, 80 pp.
† Journ. Roy. Inst. Great Britain, Jan. 1898, 13 pp.
‡ Ann. Mus. d'Hist. Nat. Marseille, v. (1897) 386 pp. (153 figs.).

Bibliotheca Zoologica.*—We have received the fourteenth instalment of Dr. O. Taschenberg's well-known list of zoological publications in periodicals, between 1861 and 1880. It deals with birds and mammals.

Reaction in Zoology.†—Prof. Ernst Hæckel makes a vigorous protest, entitled 'Ascending or Descending Zoology.' It has been provoked by Prof. A. Fleischmann's 'Lehrbuch der Zoologie' (1898), which reverses the evolutionary order of treatment, and seems in other ways distinctly reactionary from the evolutionist's point of view.

Tunicata.

Neural Gland in Cynthia papillosa.‡—Mr. M. M. Metcalf notes that the gland in this species, and in all the Cynthiidæ he has studied, is epineural. The elongation of the gland and its lack of highly developed tubular outgrowths is characteristic of the sub-family Cynthiinæ. Its lumen is full of disintegrating cells from the dorsal wall of the enlarged portion of the duct, and these form the secretion. Another point of interest is that the gland is prolonged backward and downward into the dorsal raphe, i.e. the median portion of the pharyngo-cloacal partition. This rapheal portion of the gland, which is found in many other forms, lies in the place formerly occupied by the trunk region of the larval nerve-tube.

Australian Tunicata.§—Prof. W. A. Herdman gives a preliminary account of the catalogue which he has prepared for the Australian museum at Sydney, and of some forms which are not represented in the museum collection. The list includes 63 species described and figured as new in the catalogue of the said museum; but altogether there are 180 species—a greater number than that (about 176) known from the shores of N.W. Europe. The great abundance of species in the southern seas bears out what the author stated in his 'Challenger' report, that "Ascidians attain their greatest numerical development in southern temperate regions," as Quoy and Gaimard had also maintained. The author adds that the extra-tropical southern species do not show any special relationship to the species of the northern hemisphere, and he does not think that the Tunicata can be said to give any support to a "bipolar" hypothesis.

Development of Double Larva of Diplosomidæ.‖—M. Antoine Pizon confirms some of Salensky's results (1894) on this subject, e.g. as to the origin of a double branchial-intestinal apparatus from one primitive cavity. He shows also that two epicardiac tubes from each branchial sac give origin to pericardium and heart,—a fact which escaped Salensky's notice. Another interesting result is the observation that young buds appear on the twin individuals of the "double larva," even before hatching.

* 'Bibliotheca Zoologica, ii. Verzeichniss der Schriften über Zoologie welche in den periodischen Werken enthalten vom Jahre 1861–1880 selbstständig erschienen sind,' Leipzig, 8vo, Sig. 521–60, pp. 4209–4528.

† Jenaische Zeitschr. Naturwiss., xxiv. (1898) pp. 469–74.

‡ Anat. Anzeig., xiv. (1898) pp. 467–70 (3 figs.).

§ Ann. Nat. Hist., i. (1898) pp. 443–50.

‖ Comptes Rendus, cxxvi. (1898) pp. 848–50.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

Notes on Structure of Sepia.*—Mr. R. H. Burne finds in the male a funnel which seems to be the remains of a former channel of communication between the body-cavity and the peritoneal sac surrounding the genital duct, thus supplying an additional argument in favour of the cœlomic origin of the sac.

He also describes a series of slender rods of cartilage (one to each gill lamella), standing out from the branchial gland and stiffening the free edge of each supporting membrane.

γ. Gastropoda.

Reno-Pericardiac Pore in Ampullaria Urceus.†—Mr. R. H. Burne has been able to find, what von Erlanger suspected, and what Bouvier failed to detect, a pore from the pericardium into the left kidney. "The present features of the pore are sufficiently peculiar to warn one to be cautious in assigning great weight to it in any attempt to determine which kidney of *Ampullaria* is the representative of the single kidney of the monotocards."

Variations and Mutations of Littorina.‡—Mr. H. C. Bumpus makes a third contribution to the study of variation, namely an account of the variations and mutations of the periwinkle, *Littorina littorea*, introduced on the North American shores. He examined 3000 British shells and 10,000 American shells, 1000 shells being considered sufficient to represent any given locality. He concludes, from his measurements, &c. that the periwinkle, subjected to a new environment, and presumably emancipated from many of the restraining influences of natural selection, has become in any and in all of the American localities, more variable in stature, course of growth, weight, and bulk, as also in the limitations and boundaries of the colour patterns. While presenting extremes of variation, the American type, compared with the European type, is more elongated, lighter in weight, more bulky, and with less pronounced colour-markings. These results are in harmony with and fully corroborative of the conclusions reached from the statistical study of the sparrow's egg.§

Gastropods of the Great African Lakes.||—Mr. J. E. S. Moore discusses the various theories as to the origin of the Halolimnic animals of the Great African Lakes. The only way of reaching a satisfactory conclusion is through a minute knowledge of the morphology of the individual members of the Halolimnic group, and of these the Gastropods are most suitable. If it can be shown from the study of their structure that the Halolimnic Gastropods in Tanganyika are most closely related to the freshwater Gastropods at present known, then the theory of the ancient freshwater origin of the Halolimnic group is probably

* Proc. Malacol. Soc., iii. (1898) pp. 53–6 (2 figs.).
† Tom. cit., pp. 49–52 (1 fig.).
‡ Zool. Bulletin, i. (1898) No. 5, pp. 247–59 (14 charts and 2 figs.).
§ Cf. *supra*, p. 410.
|| Quart. Journ. Micr. Sci., xli. (1898) pp. 159–80.

true. But if the relationships discovered are with typical marine genera, then there will be little doubt that the Halolimnic group originated in the lake through marine contamination. Of this, there is no direct evidence; but there is no positive geological objection to the view that it has occurred, and there is at least evidence of great geological instability in the districts concerned. In another paper, the author goes on to consider the structure and affinities of some of the Gastropods.

Typhobia.*—Mr. J. E. S. Moore gives the first anatomical description of this mollusc, "probably the most remarkable freshwater Gastropod at present known." It is fairly abundant in Tanganyika.

The genus, which Fischer referred to the Melanias, must be dissociated from them, at least from all those which have been carefully examined. The nervous system is quite unique; no relation with any other freshwater forms can be made out, but there is some suggestion of *Solarium* and the Scalarids. The Typhobias can hardly be called archaic, but they "appear to be among the survivors of some old, but not geologically ancient, marine types."

Two forms are recognised, *Typhobia Horei* and *Bathanalia Howesi* g. n., and a new family TYPHOBIIDÆ is proposed. They have affinities with and stand in the relation of forerunners to those more modern forms which group themselves about the Strombidæ. They have also some of the characters of the Aporrhaidæ, Xenophoridæ, Cypræidæ, and Ptenoglossa. "Their affinities show that they have without doubt been cut off from an exclusively marine stock at what is, geologically speaking, no very remote period of time."

Peripheral Glandular Organ of Helcion pellucidum.†—Prof. L. Bontan has much that is interesting to say in regard to this beautiful little mollusc, but we must confine our report to what forms the bulk of the paper,—an account of a peripheral glandular organ situated between the mantle and the foot, and interrupted only below the mouth. Like other skin-glands in Molluscs, it consists of a network of supporting cells among which the glandular elements lie. The latter are of enormous size. The organ is formed as a longitudinal groove, the upper margin bounded by tentacles innervated from the pedal ganglia. It is not homologous, in position or innervation, with the epipodial "collerette" of Aspidobranchs; it is homologous with a similar organ in *Nacella*, *Patina*, &c.; and approaches the glandular tract in Chitons. As to function, it is probably at once sensory and defensive.

δ. Lamellibranchiata.

Are there Septibranchiate Bivalves?‡—Herr L. Plate criticises Pelseneer's conclusion that the thick muscular septum which divides the mantle-cavity of *Cuspidaria* and *Poromya* into two chambers arises from the gills, and warrants the term "Septibranchiate." Plate seeks to show that the septum is not morphologically branchial or ctenidial, but rather pallial. He rejects the term "Septibranchiate" as applicable to *Cuspidaria* and *Poromya*, and proposes to call the group Septipalliata.

* Quart. Journ. Micr. Sci., xli. (1898) pp. 181–204 (4 pls.).
† Arch. Zool. Expér., v. (1897) pp. 436–82 (1 pl. and 10 figs.).
‡ SB. Ges. Nat. Freunde Berlin, 1897, pp. 24–8.

Structure of Leda.*—Herr W. Stempell describes the structure of *Leda sulculata* Gould,—especially the peculiar dorsal mantle-processes; the imperfect intersiphonal septum which, indeed, is only hinted at; the tendency to coalescence of the Protobranch gills; the absence of any hypobranchial gland; the distinctly defined œsophageal cavity; the absence of any hint of a jaw-like structure; a narrow duct between the pericardial portion of the kidney-tube and the terminal part of the ureter; and the direct opening of the genital organs into a cloaca. Thus the author shows that there are many divergences between his observations and those of Pelseneer on *Leda pella* L.; and it seems necessary to modify Pelseneer's statement of the general characters of the Nuculidæ.

Phagocytosis in Development.†—Dr. C. De Bruyne finds that in Naiadæ all the epithelial cells of the ovarian follicles contribute, in different degrees, to the building-up of the ova; the successful ovum lives at the expense of the adjacent elements of the follicle.

The emergence of phagocytes and leucocytes from mucous surfaces in *Anodonta* is exaggerated in the incubatory cavity. There is a struggle for existence—in modified form—between the embryo and the maternal leucocytes.

The embryonic cells are nourished by active exploitation of the phagocytes and leucocytes, and also by diffusion of material supplied by the histolysis of the phagocytes and leucocytes. This continues during the sojourn of the embryos within the gill-cavity of the mother. But similar processes of struggle and nutrition occur in the skin of the fish within which the larvæ are temporarily parasitic. The same phenomena, *mutatis mutandis*, are to be seen in other types.

Bryozoa.

Development of Tubulipora.‡—Mr. S. F. Harmer shows that a process of embryonic fission occurs normally in *Tubulipora*, as has already been demonstrated in *Crisia* and *Lichenopora*. His paper also contains an account of the structure of the colony and of the ovicell, a history of the species and genus, with diagnosis of accepted forms (including *T. aperta* sp. n.), a discussion of certain (excretory?) vesicles found in the tentacles and other parts. Then follows a detailed description of the different stages in development, and there is a final chapter on the morphology of the internal parts of the ovicell.

Arthropoda.

Cleavage of the Cuticle in Moulting.§—P. Pantel distinguishes an external dead zone of cuticle from an internal transition area between chitinous and protoplasmic structure. Between these a cleavage occurs in ecdysis or moulting, which the author has studied in *Thrixion* in particular. He describes the slow formation of the replacing cuticle, and the rapid hydraulic process by which the pressure of the liquid secreted by the hypodermis effects detachment of the old husk. Then

* SB. Ges. Nat. Freunde Berlin, 1897, pp. 17–23.
† Arch. Biol., xv. (1898) pp. 181–300 (5 pls.).
‡ Quart. Journ. Micr. Sci., xli. (1898) pp. 73–157 (3 pls.).
§ Comptes Rendus, cxxvi. (1898) pp. 850–3.

follows a special account of the more continuous analogous processes in the history of the antenniform organ of the larval *Thrixion*.

Facetted Eyes of Arthropods.*—Mr. V. L. Kellogg calls attention to Zimmer's recent description of the differentiation of the facetted eyes in the males of *Chloë* and certain other Ephemerids. This is to be compared with the two kinds of eyes which Chun has described in *Stylocheiron* and certain other genera of pelagic Crustacea. The author has found two kinds of facetted eyes in *Blepharocera capitata*, a North American nematocerous Dipteron. The predaceous individuals (both male and female) have facetted eyes of two kinds, while the other form of female which feeds on nectar has only the usual small-facetted strongly pigmented eyes. It seems likely that the differentiation implies a certain adaptability of the vision to various conditions of focus and intensity of light.

α. Insecta.

Hybridising Species of Tephrosia.†—Mr. J. W. Tutt gives an account of recent experiments made by Dr. Riding and Mr. Bacot in hybridising the two allied species *Tephrosia bistortata* Goeze (*crepuscularia* auct.) and *T. crepuscularia* Hb. (*biundularia* auct.). Some of the more important conclusions to which the experiments point are the following:—(1) The intercrossing may result in every possible intermediate stage of fertility from sterility to full fertility. (2) Certain crossings produced almost entirely male offspring. (3) The hybrids are fertile *inter se*, but to a less extent than in the parent stock, i.e. there appears to be a larger proportion of failures. They are also fertile with the parent stock. (4) The direct hereditary influence exerted by the parents is a great one. (5) The phylogenetically older species is more dominant in stamping its characters on the progeny. (6) The sex-condition of the hybrids depends on the predominating influence exerted by one of the parents. (7) A recently formed aberration may be prepotent and dominant over the type from which it has but recently sprung. (8) The re-crossing of a hybrid with one of the parent species produces offspring scarcely differing from the parent species with which the hybrid has been paired. (9) The inbreeding of the same cross produces a large percentage differing much from either parent form. (10) The crossing of the hybrids obtained from original reciprocal crosses tends to produce a mixed progeny, some referable to known forms of the crossed species, others quite unlike anything ever obtained in nature. (11) The darkest, best-marked, largest, and most vigorous specimens are those which remain longest in the pupal state. (12) The hybrids have lost all regularity as to the time of emergence, i.e. hybridity causes continuous-broodedness.

As to sex, Mr. Tutt also notes that the influence of the male parent is less than that of the female. When *T. bistortata* is the male parent the progeny is more vigorous than when *T. crepuscularia* is the male parent. The greater vigour of the male results largely in the production of female offspring. When the male is of the dominant species, females are developed in fair proportion; when the female is of the

* Zool. Anzeig., xxi. (1898) pp. 280-1.
† Trans. Entom. Soc. London, 1898, pp. 17-42.

predominant species, males are largely in excess. It must not be supposed, however, that all these conclusions rest upon equally strong evidence.

Termites.*—Mr. G. D. Haviland describes and figures about ninety species of Termites, including many new ones. His collection was made mainly in South Africa, the Malay Peninsula, and Borneo, and includes specimens from about 1000 different nests. Following Hagen in the matter of genera, he distinguishes *Termes*, *Calotermes*, *Termopsis*, and *Hodotermes*. By far the greater number of his species belong to the large genus *Termes*, and most of his observations were made on species of that genus. The soldier-caste was used for the determination of species, since the imago is often absent from nests. The segments of the antennæ are fewer in the soldier than in the male, but they are generally longer and more cylindrical; those of the female are shorter. The actual length of antennæ is not correlated with the number of segments. Long antennæ go with long legs, and indicate much walking and foraging; soldiers with short, stout legs belong to sluggish species. Blindness is more universal among soldier and worker termites than among ants. The winged insects have an unconquerable desire to leave the nest. They fly feebly, and not one in many thousands survives the dangers of flight. At the time of swarming, males and females pair, the males often clinging to the abdomen of the female, though the sexual organs are not at that stage mature. In most species a single pair can found a nest without assistance. The abdomen of the female becomes different from that of the male at the last moult, by a change in the ventral plates. Great distension takes place later, and in some groups there may be secondary chitinisation in the cuticle in front of the original chitin plates. The function of soldiers is defence only, the chief enemies of the colony being ants. The soldiers in some species secrete a sticky fluid in a sac in the head, which opens into a duct passing down the rostrum. A drop of this fluid is deposited on the antennæ of an invading ant, which is immediately rendered *hors de combat*.

Teeth of Diptera.†—Mr. W. H. Harris describes and figures the teeth present in the proboscis of the house-fly and the common yellow dung-fly. These chitinous processes seem to be used for puncturing, scraping, and probably crushing, and are situated at the base of the lobes of the labium.

Sensory Nerve-Cells of Insects.‡—O. Duboscq has, by the use of Ehrlich's method on *Forficula auricularia*, confirmed vom Rath's account of the sensory neurons in Tracheata. His preparations are the most convincing as yet furnished for insects. He found, however, none of the multipolar cells and rich plexuses described by Viallanes, Monti, and Holmgren; these he regards as connective, not nervous tissue.

Peculiar Gland in Ants.§—M. Charles Janet describes in *Myrmica rubra*, the common red ant, a peculiar integumentary gland lodged in the

* Journ. Linn. Soc. (Zool.), xxvi. (1898) pp. 358–442 (4 pls.).
† Cardiff Nat. Soc, xxix. (1896–7) pp. 59–61 (1 pl.).
‡ Arch. Zool. Expér., l. (1897) pp. 401–16 (1 pl.).
§ Comptes Rendus, cxxvi. (1898) pp. 1168–71 (7 figs.).

inferior aspect of the thorax. It is structurally comparable to the mandibular gland, and has been described by Meinert and by Lubbock in Formicinæ, where however its structure is rather different from that in Myrmicinæ. The cavity into which the gland opens is an almost closed air-chamber. It is probable that the secretion is volatile, and Janet hazards the suggestion that it is the source of the characteristic "recognition-odour."

Heart of Hive-Bee.*—Herr W. J. Pissarew finds in *Apis mellifica* that the "aorta," after bending down to the left side of the gut, shows eighteen well-defined zigzag loops, which become shorter anteriorly, and stop about the beginning of the thorax. There is a hint of these loops in Cheshire's figures. The author inquires as to their possible use, whether they occur in any other insects, and whether the vessel on which they occur should be called "aorta."

Brain of a Cave-Beetle.†—Herr O. Hamann has investigated the central nervous system of *Leptoderus hohenwarti* Schmidt, a blind beetle belonging to the family Silphidæ, and occurring in the recesses of the Adelsberg cave. The supra-œsophageal ganglia show pear-shaped swellings, which are continued into the antennary nerves, but there are no other nerves given off. There is no hint of eyes or optic nerves. A very broad connective round the gullet connects the supra-œsophageal with the sub-œsophageal mass, the latter being very well developed. Herr Hamann notes the superiority of 10 per cent. formol over alcohol for the preservation of such specimens as the above, if histological examination is in view.

Venation of a Typical Insect Wing.‡—Messrs. J. H. Comstock and J. G. Needham point out that the recognition of the features of the wing venation that are common to the various orders of insects has been a matter of slow growth. The names and abbreviations to which the authors adhere are:—Costa, *C*; Subcosta, *Sc*; Radius, *R*; Media, *M*; Cubitus, *Cu*; Anal veins, *A*.

Growth of Butterflies' Wings.§—M. Arnold Pictet describes the growth of the wings in Rhopalocera after emergence from the chrysalis.

Composition of Insect's Head.‖—Herr R. Heymons concludes that in insects the frons, clypeus, labrum, compound eyes, and frequently the whole anterior portion of the occiput, represent parts of the primary *head* segment, while the posterior portion of the occiput and the genæ represent, probably exclusively, the tergites of the jaw-segments.

Chromatin Reduction in Hemiptera.¶—F. C. Paulmier points out that the subject of chromatin reduction in insects is at present in considerable confusion. The four workers who have done most to it—Henking, vom Rath, Wilcox, and Montgomery—have reached quite dissimilar results. He has studied it in a number of species of Hemiptera. *Anasa tristis* de G., *Euchistus variolarius* Pal. Beauv., and others, and the

* Zool. Anzeig., xxi. (1898) pp. 282–3 (1 fig.).
† SB. Ges. Nat. Freunde Berlin, 1897, pp. 1–3.
‡ Amer. Nat., xxxii. (1898) pp. 81–9 (1 fig.).
§ CR. Soc. Phys. Nat. Genève, 1898; Arch. Phys. Nat., v. (1898) pp. 378–81.
‖ SB. Ges. Nat. Freunde Berlin, 1897, pp. 119–23.
¶ Anat. Anzeig., xiv. (1898) pp. 514–20 (19 figs.).

evidence points to the conclusion that the first division is the reducing division, and the second the equation division.

Development of Food-Canal in Lower Insects.*—Dr. R. Heymons contrasts in particular the development of the gut in *Lepisma* and in Orthoptera. In Orthoptera the definitive intestinal epithelium arises from the ectoderm of stomodæum and proctodæum; in *Lepisma* from yolk-cells. In Orthoptera its origin is bipolar; in *Lepisma* multipolar. During development the yolk-cells of Orthoptera disappear; in *Lepisma* the majority remain functional. The yolk-cells represent the true "endoderm" of insects. Heymons has also some notes on the Malpighian tubules. In Apterygota entognatha they are either entirely absent, or they do not occur in their characteristic form. The typical tubular vessels make their first appearance in Apterygota ectognatha (Machilidæ, Lepismatidæ).

β. Myriopoda.

Development of Chilopoda.†—Dr. R. Heymons has studied this in *Scolopendra cingulata* L., and has reached the following conclusions:—

(1) The unpaired gonad and its unpaired (mesodermic) duct are both paired in rudiment.

(2) In adults of both sexes there is a dorsal loop recognisable on the efferent duct, and this corresponds to the left of the two primary genital ducts.

(3) The genital cavity and the lumen of the (mesodermic) efferent duct arise from the cœlom.

(4) As in insects, so in Chilopoda, there is an unpaired ectodermic terminal portion of the genital duct, from which the (two) paired terminal glands seem to be derived.

(5) In Chilopoda (Epimorpha) the genital region consists of two segments, not of one.

δ. Arachnida.

Sarcoptes minor.‡—Dr. M. Carruccio gives a careful description of *Sarcoptes minor* Fürstenberg, the itch mite of the cat, occasionally found on man. There are very clear figures of the external characters.

Heliotaxis of Larval Mites.§—Herr Fr. Thomas has made a number of observations and experiments which go to show that the progressive movements of the larvæ of the gooseberry mite (*Bryobia ribis* Th.) are always positively heliotactic, which appears to be of nutritive advantage.

German Hydrachnidæ.‖—Another instalment of R. Piersig's valuable monograph on the Hydrachnidæ of Germany has reached us.

ε. Crustacea.

Peripheral Nervous System.¶—Herr E. Holmgren recognises the strength of the evidence which Nusbaum and Schreiber have afforded

* SB. Ges. Nat. Freunde Berlin, 1897, pp. 111–9.
† SB. K. Preuss. Akad. Wiss., 1898, pp. 244–51.
‡ Boll. Soc. Rom. Stud. Zool., vi. (1897) pp. 181–90 (1 pl.).
§ SB. Ges. Nat. Freunde Berlin, 1897, pp. 39–45.
‖ Bibliotheca Zool., Heft 22 (1898) pp. 241–320 (9 pls.).
¶ Anat. Anzeig., xiv. (1898) pp. 409–18 (7 figs.).

as to existence of peripheral multipolar nerve-cells. It does not follow that these are the same as the elements described by Bethe in 1896, which Holmgren suspected to be mesenchymatous. There is no doubt, according to Holmgren's observations, as to the multipolar nerve-cells in the skin of caterpillars (*Sphinx ligustri*); and his fresh investigation of *Palæmon*, &c., leads him to believe that the same is true of Crustaceans. The nerve-cells are connected by their dendritic processes with one another, and perhaps also with axis-processes. In caterpillars the state of affairs is clearer, since there are no mesenchymatous elements which could lead to confusion.

Distribution of Deep-Sea Brachyura and Anomura.* — MM. A. Milne-Edwards and E. L. Bouvier comment upon the comparative thoroughness with which the abyssal fauna has been explored in the area limited by the Western Mediterranean, the Canaries, the Azores, and the Gulf of Gascony. Far over a thousand dredgings and the like have been made. Yet the results are in some respects strange. In the later expeditions conducted by the Prince of Monaco only one new form was found—*Sympagurus Grimaldii*, of which only one specimen is known. Of the eight known species of this genus, six were obtained in this area. Many other primitive Paguridæ have been found in the same region, which may perhaps be regarded as one of their head-quarters. At the same time, it is strange that while the first explorations revealed many new forms, so to speak, at each haul of the dredge, the six later explorations have resulted in scarcely anything new. This seems to the authors to suggest that something is wrong with the mechanical methods of capture at present in use.

Fossil Apodidæ.†—Mr. C. Schuchert makes a welcome contribution to our knowledge of fossil Phyllopod genera, describing *Dipeltis* Packard (emend.) which is closely allied to *Apus*, *Diplodiscus carri* sp. n., and the synthetic type *Protocaris* Walcott. He discusses the geological history of the Apodidæ, which he divides into two new sub-families,—Apodinæ (*Protocaris*, *Lepidurus*, *Apus*) and Dipeltinæ (*Dipeltis*).

New Gall-making Copepod.‡—M. Jules Bonnier describes a Copepod, *Pionodesmotes phormosomæ* g. et sp. n., which lives at the expense of a deep-sea Echinoid (*Phormosoma aranus*), and makes galls protruding into the interior of the test of its host. At first sight it suggested the Choniostomatidæ, which are parasitic on Arthrostraca, but it is distinguished by a perfectly developed second antenna, by the absence of a prebuccal sucker, by the single pair of maxillipedes, &c. A new family seems necessary to receive it, probably near *Auliostoma* and other forms described by Canu.

Deep-Sea Crustacea from the South-West of Ireland.§—Mr. W. T. Calman describes a number of new forms, of which the most remarkable is *Bresilia atlantica* g. et sp. n. It seems to require a new family, Bresiliidæ, since it occupies a somewhat isolated position among the Caridea. The following points indicate its primitive character:—

* Comptes Rendus, cxxvi. (1898) pp. 1245–7.
† Proc. U.S. Nat. Mus., xix. (1897) pp. 671–6 (1 pl.).
‡ Comptes Rendus, cxxvi. (1898) pp. 769–71.
§ Trans. R. Irish Acad., xxxi. (1896) received 1898, pp. 1–22 (2 pls.).

(1) mandible not deeply divided, and possessed of a palp; (2) proximal lobe of second maxilla not reduced; (3) second maxilliped, with its terminal joints not expanded nor distorted as in the typical Caridea; (4) exopods present on certain thoracic feet.

Annulata.

Structure of Lug-Worm.*—Messrs. F. W. Gamble and J. H. Ashworth have studied *Arenicola marina*, and have made out the following (among other) new points. On the Lancashire coast, and probably elsewhere, two well-marked varieties of *Arenicola marina* occur, differing in general appearance, habits, structure of gills, and periods of maturity.

The cilia lining the gastric region of the gut are specially arranged (1) on the sides of a ventral groove which is continued to the anus, and (2) on curved shallow grooves running downwards and backwards into the former. The currents carry a stream of mucus and digested food backwards away from the mass of sand in the gut. The ventral groove is morphologically equivalent to the similar structure of *Oligognathus*, and probably to the "siphon" of Capitellids.

Each of the two hearts contains a cardiac body, composed of masses of granular and vacuolated cells, projecting into the ventricle. Functionally they may be regarded as glandular valves preventing reflux into the gastric sinuses.

Both the large pinnately-branching, and the smaller dendritic, types of gill occur in *A. marina*. A *lapsus pennæ* will be noticed in the description of the efferent branchial vessels.

The brain is divided by a narrow cleft throughout the greater part of its length. The anterior cornua supply the prostomium and the buccal papillæ, and give off the œsophageal nerve-connectives. The middle region of the brain supplies the upper part of the prostomium, and the posterior cornua innervate the nuchal organ.

The nuchal organ, though apparently single, shows traces of a double origin. It is probably an olfactory organ, and is developed from the posterior region of the prostomium. The otoliths consist of quartz grains surrounded by a delicate chitinoid film, as Ehlers stated.

The first pair of nephridia are in process of reduction. In adult examples, the terminal portions of the nephridia act as receptacles for the ripe ova or spermatozoa.

"The general analogies of *Arenicola* with certain other limnivorous Chætopods are very startling. With the Sipunculids the Arenicolidæ agree in the chitinous spines tipping the proboscis papillæ, the buccal papillæ, the strong retractors of the 'proboscis,' the capacious and largely unsegmented cœlom, the general character of the musculature, the thin-walled looped alimentary canal with its ciliated ventral groove, the action of the body-wall in producing waves of cœlomic fluid auxiliary to the process of burrowing and defæcation, and lastly, the pigmented nuchal organ. If we acknowledge the many points of agreement, which have for the most part arisen independently, between these two distantly related families under similar conditions of life, the true relationship between *Arenicola* and other genera of Polychæts can only be ascertained

* Quart. Journ. Micr. Sci., xli. (1898) pp. 1–42 (5 pls.).

by exercising the greatest caution in not confusing convergent adaptational characters with true genetic resemblances."

Brain of Glycera.*—M. Ch. Gravier has studied the brain of *Glycera convoluta* and related forms, and finds, as his chief result, that it shows the same general characters as that of other Polychæte Annelids. The division of the prostomium into rings is quite superficial, and only affects the epidermis. It has no relation to segmentation, and there is no essential difference between the prostomium of the Glyceriidæ and that of allied forms.

Elytra of Aphroditidæ.†—G. Darboux fils argues that the elytra are not homologous with dorsal cirri. In segments without elytra the elytrophore has its homologue in a dorsal ridge, sometimes called the gill. The insertion of the cirrus is definitely parapodial. A study of development confirms the conclusion that elytron and cirrus are quite distinct. In some abnormalities, e. g. in *Acholoë astericola* Clpd., an elytron and a dorsal cirrus may occur on the same segment. What are called gills in these worms are not homologous throughout, not even in the same family. In *Acholoë*, for instance, they are homologous with elytrophores; in *Sigalion*, where there are gills even on the segments with elytra, they are evidently not so.

New Species of Litoral Oligochæta.‡—Akira Jizuka describes *Pontodrilus matsushimensis* sp. n., found burrowing in the sand, under half decayed leaves of *Zostera marina*, along the shores of Matsushima Bay, Japan. It tallies well with Beddard's definition of the genus *Pontodrilus*, except that the *vas deferens* opens into one end of the glandular portion of the spermiducal gland, the other end leading to the male pore, whereas in *Pontodrilus* the *vasa deferentia* open "at the junction of the glandular and muscular parts." It is probable, however, the author thinks, that his reference of this new species to the above genus is correct.

Annelids of 'Travailleur' and 'Talisman' Expeditions.§—M. Louis Roule makes a preliminary report on these,—seven already known, and seven new. He establishes two new types—*Aphroditella* and *Letmonicella*—satellites of *Aphrodite* and *Letmonice* respectively, and of considerable systematic interest. The two most abundant species were *Eunice Günneri*, living in commensalism with *Lophohelia prolifera* and *Amphihelia oculata*, and *Hyalinecia tubicola*, living in a tube of its own making. The author makes a few notes on bathymetric and geographical distribution.

Phagocytic Organs in Earthworms.‖—Herr G. Schneider points out that in 1896 he clearly described two indubitably phagocytic organs in *Allolobophora*,—(*a*) a portion of the typhlosole; and (*b*) a region in each nephridial canal. This note is in reference to the fact that Cuénot, in a recent communication on the functions of Oligochæta, says very little about the typhlosole, and seems to have misunderstood Schneider.

* Comptes Rendus, cxxvi. (1898) pp. 972–5. † Tom. cit., pp. 1226–7.
‡ Annot. Zool. Japon., ii. (1898) pp. 21–7 (1 pl.).
§ Comptes Rendus, cxxvi. (1898) pp. 1166–8.
‖ Zool. Anzeig., xxi. (1898) pp. 295–6.

So-called Palolo-Worm.*—Dr. B. Friedlænder has given much attention to the puzzling phenomenon of shoals of "Palolo" at Samoa. As is well known, they appear in immense numbers at regular intervals with astounding punctuality, even to the hour. The water is thick with wriggling *headless* worms, "thick as vermicelli soup," as Agassiz said. It can hardly be doubted that they come from the coral reef, and that they are the liberated posterior ends of worms modified in connection with reproduction. As the author notes, Dr. G. Thilenius has also and independently discovered the Palolo worms on the reefs, and interpreted the swimming portions as reproductive bodies. The riddle remains, however, that they appear in constant relation to the phases of the moon, on the day of the last quarter.

Incubation of the Skate-Leech.†—There is a note in the Journal of the Marine Biological Association on the parental care exhibited by *Pontobdella muricata* L. A specimen was dredged along with a scallop-shell, and was seen to be mounting guard over a group of eggs. It continued to do so in the aquarium for at least 123 days. "For what purpose the skate-leech remains with its eggs during incubation appears uncertain. . . One may presume that their protection is the chief object, whether from active enemies or from the mere accumulation of sand, &c., is doubtful. . . . Hatching is accomplished by the perforation of the membrane of one of the fenestræ. The chitinous part of the shell is not ruptured in any way."

Urns of Sipunculus.‡—MM. J. Kunstler and A. Gruvel have been able to cultivate these remarkable bodies for prolonged periods, and have followed with precision the successive changes by which they pass from relative simplicity to unexpected complexity of structure.

Rotatoria.

Fauna of the Nurmijärvi Lake.§—Mr. K. E. Stenroos has studied by the side of this inland lake of Finland the fauna of its waters. After describing the lake itself and its surroundings, he gives a particular account of the Rotifera, which are represented therein by 157 species. Unfortunately the author has not been able to abstain from describing a number of species as new upon the most slender variations from the published figures and accounts. Twenty-six new species are named, about one-half of which are almost certainly "old friends," and a number of the remainder so ill defined that it will be very difficult to recognise them again. The following are the new names:—*Limnias nymphææ*, *Pseudoecistes rotifer* (this is the variety of *Œ. velatus* figured in Dr. Collin's note-book with two eyes near the edge of the corona), *Conochilus limneticus* (= *C. unicornis*), *Microcodides abbreviatus* (= *M. robustus*), *Notops fennicus* (= *N. minor*), *Notommata monostylæformis* (= *Monostyla bifurca*), *Proales mirabilis*, *Furcularia trihamata* (= *F. forficula*), *F. macrodactyla* (probably = *Diaschiza semiaperta*), *Monom-*

* Biol. Centralbl., xviii. (1898) pp. 337–57.
† Journ. Mar. Biol. Ass., v. (1898) pp. 195–6.
‡ Comptes Rendus, cxxvi. (1898) pp. 970–2. Cf. this Journal, 1897, p. 126.
§ Acta Soc. pro Fauna et Flora Fennica, xvii. 1, Helsingfors, 1898, pp. 1–177 (3 pls.).

mata appendiculata, *Eosphora viridis* (= *E. aurita* with two red specks close to the frontal eyes), *Mastigocerca grandis* (? = *M. elongata*), *M. unidens*, and *M. cuspidata* (probably both = *M. scipio*), *M. rosea* (= *M. bicornis*), *Cœlopus intermedius*, *Dinocharis similis*, *Cathypna flexilis*, *C. brachydactyla*, *C. magna*, *Distyla oxycauda* (= *Diplax ornata*, Daday = *D. ludwigii*), *Monostyla bicornis*, *Metopedia quadricarinata*, *M. dactyliseta*, *M. sulcata*, *Pterodina emarginula* (= (?) *Pt. reflexa*). Young students of the Rotifera might as well make themselves fully acquainted with the known species before burdening science with so many synonyms.

Some little-known Pterodinæ.*—In this paper Mr. C. F. Rousselet fully describes and illustrates the following four species of *Pterodina* which before were scarcely sufficiently defined :—*Pt. reflexa*, *Pt. elliptica*, *Pt. clypeata*, *Pt. cæca*, giving also copies of figures of the following species which are not readily accessible :—*Pt. bidentata*, *Pt. parva*, *Pt. incisa*, *Pt. trilobata*, and *Pt. intermedia*. The male of *Pt. elliptica* is figured and described for the first time.

Development of Asplanchna.†—Dr. Al. Mrázek has studied the development in this genus, especially in *A. Herricki*. There are, as usual, three kinds of eggs,—parthenogenetic ova which become males, parthenogenetic ova which become females, and fertilised eggs which become females (*Dauereier*). The author discusses the oogenesis, the structure of the ova, the early stages of maturation and fertilisation, and the question of the layers.

Nematohelminthes.

New Nematodes from Bismarck Archipelago.‡—Dr. von Linstow describes a collection made by Prof. F. Dahl. It includes some new forms of *Ascaris*, *Filaria*, &c., and a remarkable form, *Cloacina Dahli* g. et sp. n., from *Macropus Browni*. As the author remarks, Australia has often proved itself a land of surprises to the zoologist, and *Cloacina* is in its own way surprising. It is one of the Secernentes, with lateral areas so strongly developed that they are sometimes apposed in the middle. There is an excretory pore; the skin is very peculiar; the musculature is monomyarian; the female opening is confluent with the anus, forming a "female cloaca"—a unique character. The genus belongs to Molin's Acrophalli and to the Strongylidæ.

Excretion in Ascaris.§—Herr S. Metalnikoff has independently reached results similar to those of Nassonow. He injected ammoniacal carmine &c. mixed with perivisceral fluid into living specimens of *Ascaris megalocephala*, and found that particles occur in the walls of the lateral canals and adjacent tissue, and that they are taken up by the four large anterior "excretory cells." The actual ingestion is due to the numerous small "vesicles" on the outgrowths of the four giant-cells.

* Journ. Quekett Micr. Club, vii. (1898) pp. 24–30 (3 pls.).
† SB. Böhm. Ges. Wiss., 1897 (ii.) No. lviii. 11 pp. (1 fig.).
‡ Arch. Naturgesch., lxiii. (1897) pp. 281–91 (2 pls.).
§ Bull. Acad. Sci. St. Pétersbourg, vii. (1897) pp. 419–26 (figs.) (Russian). See Zool. Centralbl., v. (1898) pp. 325–6.

Endo-Parasites of Hyrax.*—Herr N. Nassonow found in *Procavia syriaca* all the endoparasites previously recorded from this host, except *Physaloptera spirula* Ehrb. He discusses *Anoplocephala hyracis* Rud. (*critica* Pag.), *Ascaris* (*Crossophorus*) *tentaculatus*, *Ascaris* (*Crossophorus*) *collaris* Ehrb., *Oxyuris pugio* Ehrb., and *O. flabellum* Ehrb.

Platyhelminthes.

Helminthological Notes.—Dr. M. C. Francaviglia † discusses the familiar *Cysticercus pisiformis* of the rabbit, and its adult form *Tænia serrata* of the dog; *Tænia crassicollis* in the cat; *Dipylidium caninum* in dog and cat; *Filaria quadrispina* Dies. in *Mustela foina*, *M. martes* and *Putorius communis.*

Dr. A. Andreini ‡ describes a case of *Echinococcus* in the heart of a soldier.

Helminths in Vertebrates of East Prussia.§—Herr P. Mühling gives a list of 246 Helminths from East Prussia, and a description of some new and rare species. His memoir begins with an interesting historical essay, showing the important part which the naturalists of Ost-Preussen have had in the development of helminthology.

Adult Tapeworms of Hares and Rabbits.‖—Dr. C. W. Stiles has one of his careful memoirs on this subject, dealing with species of *Davainea*, *Cittotænia*, *Anoplocephala*, *Bertia*, and *Andrya*, found as adults in species of *Lepus*.

Archigetes.¶—Dr. Al. Mrázek gives a full account of the minute structure of *Archigetes appendiculatus* Ratz., with notes on its life-history and systematic position. We regret the absence of a summary in a familiar language.

Dactylocotyle.**—M. Paul Cerfontaine gives a diagnosis of this genus of Trematodes, a description of its reproductive system in particular, and an account of the five well-established species which occur as parasites on fishes.

Merizocotyle.††—M. Paul Cerfontaine describes *M. diaphanum* from *Raja batis*, *M. minus* sp. n. from *R. oxyrhynchus* (?), and discusses the systematic position of the genus, which seems to belong to the Monocotylidæ in the family Tristomeæ of monogenetic Trematodes.

Reproductive Organs of Drepanidotænia venusta.‡‡—Mr. T. B. Rosseter describes the scolex and strobila of this tapeworm, whose life-history he recently discovered. He deals especially with the repro-

* Arbeit. Lab. Zool. Warschau Univ., 1897, pp. 199–216 (2 pls.) (Russian). See Zool. Centralbl., v. (1898) p. 319.
† Boll. Soc. Rom. Stud. Zool., vi. (1897) pp. 206–10.
‡ Tom. cit., pp. 227–33 (1 fig.).
§ Arch. Naturgesch., lxiv. (1898) pp. 1–118 (4 pls.).
‖ Proc. Nat. Mus. U.S., xix. (1897) pp. 145–235 (21 pls.).
¶ SB. Böhm. Ges. Wiss., 1897, No. xxxii., 47 pp. (5 pls.).
** Arch. Biol., xv. (1898) pp. 301–28 (1 pl. and 3 figs.).
†† Tom. cit., pp. 329–66 (2 pls.).
‡‡ Journ. Quekett Micr. Club, vii. (1898) pp. 10–23 (2 pls.).

ductive organs, and gives some account of the eggs and six-hooked oncospheres.

Regeneration in Planarians.*—Miss H. Randolph finds that if *Planaria maculata* Leidy is divided longitudinally or transversely, each part regenerates a new individual. Fragments hardly visible can regenerate a complete whole, except as to pharynx. Double heads, double tails, extra eyes, &c., seem to be readily producible.

Prof. O. Fuhrmann † reached similar results. A posterior half regenerates head and eyes, an anterior half regenerates the posterior part and the pharynx. Each of 10–15 fragments showed itself able to regenerate. Longitudinal division also succeeded; if the cut is oblique, the regenerated part is perpendicular to the plane of the cut. Monstrosities with 2–4 heads and as many tails were produced.

New Planarians.‡—Mr. W. McM. Woodworth describes some new forms from the Great Barrier Reef:—*Pseudoceros devisii* sp. n., of a bright orange-yellow colour and brilliant markings (only one specimen); *Idioplana australiensis* g. et sp. n., differing from other Planoceridæ chiefly as regards the reproductive organs; *Diposthus corallicola* g. et sp. n., with male organs so peculiar that a new family (DIPOSTHIDÆ) is required. The salient feature is the separation of the penis and prostate gland into two distinct organs, both of which are doubtless intromittent.

Incertæ Sedis.

Sexual Conditions of Myzostoma glabrum.§—Dr. J. Beard returns to a subject which he discussed in 1884, and publishes an interesting critical paper on the researches of Nansen, Prouho, and Wheeler, with an account of additional observations of his own. His results, apart from suggestive *obiter dicta* on hermaphroditism and the like, may almost be summed up in the last paragraph of his paper.

"Owing to the various kinds of parasitism presented by the numerous species of the genus, parasitism, which in some cases has tended to the preservation of the males, in others to their extinction, in yet others to their conversion into hermaphrodites, we can, so far as at present known, divide the species up into:—

1. Purely diœcious forms with small males (von Graaff, Prouho). *M. pulvinar* and some cysticolous species.
2. Hermaphrodite forms with true males which remain males (Beard). *M. glabrum.*
3. Hermaphrodite forms with males which, retaining their positions on the hermaphrodites, afterwards become female (Prouho) *M. alatum.*
4. Hermaphrodite forms, in which the males have lost their dorsicolous position, and have either become extinct or converted into protandric hermaphrodites." *M. cirriferum* and others.

* Arch. Entwickmech., v. (1897) pp. 352–72 (10 figs.). See Zool. Centralbl., v. (1898) p. 263.

† CR. Soc. Sci. Nat. Neuchatel, 1898. See Arch. Sci. Phys. et Nat., v. (1898) pp. 478–9.

‡ Bull. Mus. Zool. Harvard, xxxii. (1898) pp. 63–7 (1 pl.).

§ MT. Zool. Stat. Neapel, xiii. (1898) pp. 293–324 (1 pl.).

Echinoderma.

Alimentary Tract of Pelmatozoa.*—Herr O. Jaekel finds that there is a remarkable contrast in the structure and position of the alimentary tract in Crinoidea (Jkl.) on the one hand, and Cladoidea, Cystoidea, and Blastoidea on the other. In the first, the gut is "solar" (following the hands of a watch), and in a simple coil; in the others it is "contrasolar," and apparently always more complicated in its coiling. Thus the Cladoidea are brought further from the Crinoids, and nearer the Cystoids and Blastoids.

Anal Papillæ of Caudina coriacea.†—Prof. A. Dendy finds two kinds of papillæ around the anus of this Holothurian:—(1) There are five blunt radially-placed projections, which contain abundant spicules, and are mere solid processes of the body-wall, without nerves or ambulacral vessels. These are apparently present only in extreme youth, and may represent *anal teeth* in a vestigial condition. (2) There are five radially-disposed groups of *anal tentacles* (doubtless homologous with the tube-feet of typical Holothurians), containing branches of the radial nerves and of the radial ambulacral vessels, with loosely scattered spicules in their walls. The branches of the ambulacral vessels are swollen out to form circumanal ampullæ, the function of which is evidently to assist in protrusion and retraction of the anal tentacles. As it seems probable that *C. coriacea*, like *C. arenata*, often lies buried in the sand, with only the tip of the tail projecting, the development of sensory tentacles is readily intelligible.

Classification of Synaptidæ.‡—Herr Hjalmar Östergren has studied numerous species of Synaptidæ, and finds himself forced to suggest a much more elaborate classification than heretofore.

I. Synaptinæ:—*Euapta* g. n. (6 sp.); *Chondroclœa* g. n. (13 sp.); *Synapta* Eschscholtz (7 sp.); *Lapidoplax* g. n. (5 sp.); *Protankyra* g. n. (20 sp.); *Anapta* Semper (2 sp.).

II. Chiridotinæ:—*Sigmodota* Studer (7 sp.); *Chiridota* Eschscholtz (7 sp.).

III. Myriotrochinæ:—*Myriotrochus* Steenstrup (2 sp.); *Trochoderma* Théel (1 sp.); *Acanthotrochus* Dan. and Cor. (1 sp.).

The splitting up of the genus *Synapta* is mainly based on the peculiarities in the structure of the joint-end of the anchor-plates, but with these other peculiarities are associated.

Synapta vivipara.§—Dr. H. L. Clark has studied the development and structure of this species. The ova seem to pass into the body-cavity by a rupture of the peritoneal epithelium, while the spermatozoa pass outward through the genital duct. Spermatozoa may pass by way of the anus into the body-cavity, or perhaps through the water-pore and stone-canal. A complete blastula is formed in about four hours after fertilisation. The first larval stage is elliptical, about a third of a millimetre in length, with the ventral ectoderm much thicker than the dorsal, without ciliated bands, calcareous particles, or nervous system, a mouth on

* SB. Ges. Nat. Freunde Berlin, 1897, pp. 29–35 (10 figs.).
† Journ. Linn. Soc. (Zool.), xxvi. (1898) pp. 456–64 (1 pl.).
‡ Öfversigt K. Vet. Akad. Förhandl., lv. (1898) pp. 111–20 (8 figs.).
§ Mem. Boston Soc. Nat. Hist., v. (1898) pp. 53–88 (5 pls.).

the anterior ventral surface but no anus, a well-developed cœlomic pouch on each side of the digestive tract, and a hydrocœl with five primary tentacles and five secondary outgrowths opening to the exterior through the dorsal pore, by means of an *adradial* water-canal, upon which may still be seen the vestige of an anterior cœlom. Then follows the development of the pentactula. Its characteristics may be briefly summed up as follows:—Water-vascular system consisting of a closed hydrocœl or circumoral water-tube with five primary tentacles, between which are five very much smaller but equally erect secondary outgrowths; a water-tube in the mid-dorsal interradius connecting the circumoral vessel with the exterior; and a Polian vessel in the left dorsal interradius. Nervous system consisting of a circumoral ring; five tentacle nerves on the inner face of the primary tentacles, the ectoderm of which is considerably thickened, especially on the outer side; five radial nerves bending backward over the secondary outgrowths of the water-ring and over the radial pieces of the calcareous rings, and running to the posterior end of the body; and five pairs of otocysts lying external to the radial nerves, where they bend backward. Digestive system, consisting of a short œsophagus with the mouth opening anteriorly in the centre of the circle of tentacles, a large stomach, a comparatively short intestine with a single loop in it, and usually an anus formed secondarily near or at the aboral pole. Digestive system attached to the wall throughout its whole course by a mesentery, formed by the union of the two walls of the right and left cœlomic pouches. Calcareous ring, consisting of five radial and five interradial pieces with much-branched ends. A few scattered glandular organs of doubtful function in various parts of the ectoderm. The author then traces the development on to the adult, and gives a short account of the structure of the adult. As regards the phylogenetic position of *Synapta*, he agrees on the whole with Ludwig that the Synaptidæ are degenerate pedate Holothurians; as regards general embryological results he agrees closely with Bury.

Protandric Hermaphroditism of Asterina gibbosa.* — Prof. L. Cuénot has made an interesting study of this hermaphrodite species. At Roscoff, the individuals are males for one to two years, and then become females; at Banyuls, the individuals are males for an indefinite number of years, at least two to three, then become females; at Naples, there is remarkable sexual polymorphism, some are wholly male, others wholly female, others hermaphrodite impartially, others transitional.

Cœlentera.

Movements of Hydra.†—Herr W. Zykoff describes the protrusion of fine pointed pseudopodia from the ectodermic cells of the tentacles of *Hydra fusca*, and maintains that these function in attachment and locomotion. He discusses the various views already propounded as to the polyp's movements.

Grafting Experiments on Hydra.‡—Herr G. Wetzel has elaborated his previous experiments. He first describes grafting between indi-

* Zool. Anzeig., xxi. (1898) pp. 273–9 (3 figs.).
† Biol. Centralbl., xviii. (1898) pp. 270–2 (1 fig.).
‡ Arch. Mikr. Anat., lii. (1898) pp. 70–96 (1 pl.).

viduals of the same species (*legitime Transplantation*), which readily succeeds. A modification of Trembley's experiment was effected by fixing an everted polyp (after removal of head and base) to two normal polyps, one at each end. The result corroborated the conclusion reached by Engelmann, Nussbaum, and Ischikawa; a polyp cannot live permanently in this everted state; but it is not easy to state shortly what took place. Union of *Hydra grisea* and *H. fusca* was effected readily, but the experimenter was not successful with *H. viridis* and either of the others.

Dactylometra.*—Prof. A. Agassiz and Mr. A. G. Mayer describe this genus of Pelagidæ. At the present time there are four genera of this family known, and they may be distinguished as follows:—

Pelagia	8 tentacles ..	16 marginal lappets.
Chrysaora	24 ,, .	32 ,,
Dactylometra ..	40 ,, ..	48 ,,
Melanaster ..	24 ,, ..	48 ,,

Like other Pelagidæ, *Dactylometra* has eight marginal sense-organs, four in the primary, four in the secondary radii—modifications of tentacles, as L. Agassiz showed. The mouth has four oral fringes or palps. There are sixteen simple pockets round the stomach, eight leading out into the sense-organs, eight others into the tentacles. The genital products are contained in four radially situated infoldings of the oral wall of the stomach, and their position is marked upon the oral floor of the disc itself by four deeply sunken sub-genital pits. The genital organs are further furnished with numerous gastric cirri, which project inwards into the cavity of the stomach. The authors give a general account of the structure and habits, and the illustrative plates are of unusual excellence.

Keeping Medusæ alive.†—Mr. E. T. Browne finds that the secret of keeping Medusæ alive in an aquarium is to have the water in motion, so that the animals can float about just as they do in the sea, without having constantly to pulsate the umbrella. The intervals of floating are periods of rest. He succeeded by a simple device in keeping a glass plate moving up and down, fairly slowly, inside a bell-jar. This "plunger" arrangement, as he calls it, proved very effective. Thus, to quote one result, three dozen unselected Medusæ were placed in a bell-jar holding about two gallons, and given a good supply of copepods. They were left untouched for ten days, except that copepods were added when the supply became low, and at the end of this period thirty-one were alive, and more than half of them in excellent condition.

Cubomedusæ.‡—The late Dr. F. S. Conant, one of the victims of the Jamaica expedition, had finished before his death a memoir on the structure of the Cubomedusæ, which has been published by his friends, along with a short biographical notice.

The Cubomedusæ are of more than passing interest among jelly-fish, both because of their comparative rarity, and because of the high

* Bull. Mus. Comp. Zool. Harvard, xxxii. (1898) pp. 1–11 (13 pls.).
† Journ. Mar. Biol. Ass., v. (1898) pp. 176–80 (1 fig.).
‡ Mem. Biol. Lab. Johns Hopkins Univ., iv. (1898) xvi. and 61 pp. (8 pls. and 1 fig.).

degree of development attained by their nervous system. Thus there is a cellular lens contained in a pigmented retinal cup, analogous to the vertebrate structure.

The memoir contains a short account of the three families Charybdeidæ, Chirodropidæ, and Tripedalidæ, and a detailed description of the structure of *Charybdea Xaymacana*, with a particular account of the vascular lamellæ and the nervous system.

Some Medusæ from Australia.*—Prof. A. Agassiz and Mr. A. G. Mayer describe *Desmonema rosea* sp. n. and *Crambessa mosaica* Hæckel, obtained on a recent visit to the Great Barrier Reef.

Actiniaria from East Spitzbergen.†—Dr. C. R. Kwietniewski describes *Allantactis parasitica* Danielssen, *Chondractinia digitata* O. F. Müller, *Ch. nodosa* Fabricius, *Actinostola spetsbergensis* Carlgr., *A. walkeri* sp. n., and *Leiotealia spetsbergensis* sp. n.

The discovery of the species of *Leiotealia* is interesting, since it has hitherto been recorded only from the Antarctic, but there are other cases of equally wide range, e. g. *Actinostola callosa*, *Actinauge verrillii* McMurrich, and *A. fastigiata* McMurrich. The author also notes the occurrence of brood pouches in Arctic anemones, as Verrill first pointed out. There are two modes:—in the one case the embryos develop in the gastric cavity of the mother; in the other case there is a special cavity in the body-wall. The need for these pouches is perhaps to be found in the limitations which the ice imposes on the superficial Plankton.

Studies on Madreporaria.‡—Mr. H. M. Bernard maintains that the Madreporarian genus *Alveopora* agrees in all essentials of skeletal structure with the Palæozoic *Favosites*, the little known Cretaceous genus *Koninckia* helping to link them through the long interval of time. The skeleton of *Alveopora* is at a very low level of development—like a survival,—and is far away from that of the Poritidæ with which the genus is usually classed.

"The Madreporarian skeleton may be described as the rigid secretion of the basal portion of the columniform body of a polyp into which the flexible upper portion may be invaginated. In its earliest developments a simple cup, it has become complicated in various ways: primarily, by the development of radial infoldings of the stiff external wall, comparable with the infoldings of the chitinous cuticle of Arthropods; secondarily, (1) by further complications of these infoldings, so as to form an intricate 'internal' skeleton, which may render the primitive external cup unnecessary, and hence lead to its becoming vestigial; (2) by a process of repeated sheddings of the external hard secretions, and the formation of new ones across and among the existing 'internal' skeletal structures (dissepiments and tabulæ)." The growing soft parts may also overflow the primitive rigid cup, and the bagging thus occasioned may reach the substratum and widen the base, or may merely hang down, secreting in so doing a folded rim to the cup ("eutheca" of von Heider). Along the lines suggested by these conclusions, the

* Bull. Mus. Zool. Harvard, xxxii. (1898) pp. 15–9 (3 pls.).
† Zool. Jahrb., xi. (1898) pp. 121–40 (1 pl.).
‡ Journ. Linn. Soc. (Zool.), xxvi. (1898) pp. 495–516 (1 pl.).

author looks forward to "the colossal task of redescribing and rearranging the Madreporaria."

Experiments on Ctenophore Eggs.*—Herr A. Fischel corroborates the results of Chun, Driesch, and Morgan, and has made further experiments on the eggs of *Beroe ovata*. From each of the isolated first two blastomeres, a larva with four ciliated ridges arises. From an isolated blastomere of the 4-cell stage, a larva with two ridges arises; and from a blastomere of the 8-cell stage, a larva with one ridge! Each micromere of the 16-cell stage represents a ridge.

Porifera.

Calcareous Sponges of Spitzbergen.†—Herr L. L. Breitfuss has studied the collection of the Bremer expedition, and describes 10 species, of which *Leucosolenia nanseni*, *Sycetta asconoides*, *Ebnerella kükenthali*, *E. schulzei*, and *Pericharax polejaevi* are new. Of the 17 Calcarea known to occur off Spitzbergen, 5 are cosmopolitan, 4 occur in the Atlantic, 7 are local, and *Amphoriscus glacialis* is also known from Greenland and the Russian Murman coast. No Antarctic occurrence of any of these species is known.

Portuguese Calcarea.‡—Herr L. L. Breitfuss describes 11 species from the Portuguese coast, which has been but slightly investigated. The total number known to occur is 15. The author's studies revealed two new species:—*Leuconia coimbræ* and *L. prava*.

Malayan and Chinese Sponges.§—Herr Nils Gustaf Lindgren has studied a collection of sponges from Java and the Chinese seas, and deals in the present memoir with the Monaxonia and Tetractinellida. Of these there were 54 species, 21 new.

Pacific Sponges.‖—Dr. J. Thiele begins by describing a collection of Japanese Demospongiæ, including many new species and several new genera. So far the memoir is of purely systematic interest.

Position of Sponges.—Prof. Y. Delage¶ discusses this difficult question, and inclines to the view that Sponges stand alone in showing a reversal of the normal direction of invagination. The endoderm comes to the surface to form epidermis, while the ectoderm is intruded to line the digestive cavities. If so, the difference between Sponges and other Metazoa may well be recorded in a term, and the words ENANTIODERMA and ENANTIOZOA are proposed.

Prof. E. Perrier** criticises Delage's proposal to contrast Sponges, under the name Enantioderma (ἐναντίος, contrary), with other Metazoa. Perrier does not object to Sponges being regarded as a distinct series, having himself maintained this since 1881; he contends, however, that a new name is superfluous, that it is difficult to admit that one zoological group can be *opposed* to another, and that the so-called reversal of the

* Arch. Entwickmech., vi. (1897) pp. 109–30 (1 pl.). See Zool. Centralbl., v. (1898) pp. 262–3.
† Zool. Jahrb., xi. (1898) pp. 103–20 (2 pls.).
‡ Tom. cit., pp. 89–102 (1 pl.).
§ Tom. cit., pp. 283–378 (4 pls.).
‖ Bibliotheca Zool. (Leuckart and Chun), Heft 24 (1898) pp. 1–72 (8 pls. and 1 fig.).
¶ Comptes Rendus, cxxvi. (1898) pp. 545–8.
** Tom. cit., pp. 579–83; Ann. Nat. Hist., i. (1898) pp. 408–12.

germinal layers is a misunderstanding. The primitive form of every embryo (except in Arthropods) is a blastula, typically ciliated and bipolar; the more active anterior cells become freed from alimentary reserves (which accumulate posteriorly), and multiply quickly; there are two alternatives:—that the blastula remains free or becomes fixed: if it remains free the posterior region is necessarily invaginated by the more rapid growth of the locomotor anterior region; if it becomes fixed (as in Sponges) the ciliated region is covered by the granular region. But this is not reversal of layers.

Prof. Y. Delage * answers Prof. E. Perrier's criticisms, but maintains that there are only two alternatives. Either the direction of invagination is normal, and the endoderm is disguised as ectoderm, and reciprocally; or the layers retain the histological characters which they have elsewhere, and the direction of invagination has been reversed.

Germinal Layers in Oscarella.†—Dr. O. Maas describes the early development of *Oscarella* and *Halisarca*, and concludes that this is no special type, but that it shows a diploblastic larval stage, with granular cells posteriorly, and flagellate cells anteriorly,—layers which correspond to those in *Sycandra*, *Ascones*, siliceous, and horny sponges. The author then proceeds to discuss the possible interpretations:—(*a*) if we compare the sponge-layers with those in other Metazoa, and (*b*) if we do not. He refrains from any dogmatic conclusion; but his arguments must be considered along with those of Delage and Perrier noticed above.

Protozoa.

Protozoa of the Balaton Lake.‡—Herr R. Francé enumerates 191 Protozoa from the "Balatonsee"; 24 Rhizopods, 13 Heliozoa, 90 Mastigophora, and 64 Infusoria, including several new forms. He thinks that the distribution is affected not so much by climatic and meteorological conditions as by the state of the water and the associated plants.

Modifications in Protozoa.§—J. Künstler discusses the modifications resulting from change of environment, e.g. in a new habitat, but his remarks are confined to generalities.

New Genus of Foraminifera.‖—Mr. F. Chapman describes *Haddonia* g. n. collected by Prof. A. C. Haddon in the Torres Straits. The salient characters of the genus are stated in the following terms:—Test calcareo-arenaceous, adherent, and sinuous; the commencement sometimes straight, sometimes spiral. Chambers imperfectly septate or openly labyrinthic. Shell-wall coarsely porous. Thirty-one distinct specimens were attached to a piece of rock measuring about 5 by 4 in. The specific name given is *H. torresiensis*, and the genus is referred to the labyrinthic group of the sub-family Lituolinæ.

* Comptes Rendus, cxxvi. (1898) pp. 767–9.
† Zeitschr. f. wiss. Zool., lxiii. (1898) pp. 665–79 (1 pl.).
‡ Resultate d. wiss. Erforschung d. Balatonsees. Bd. ii. Theil i. Die Fauna des Balatonsees. 1897, pp. 1–64 (figs.). See Zool. Centralbl., v. (1898) pp. 322–3.
§ Comptes Rendus, cxxvi. (1898) pp. 765–7.
‖ Journ. Linn. Soc. (Zool.), xxvi. (1898) pp. 452–6 (1 pl. and 1 fig.).

New Sporozoon from Limnodrilus.*—Herr Al. Mrázek describes an interesting new parasite from *Limnodrilus claparedianus* R. One of its most remarkable features is that the ectoplasm is thickly beset with short processes like cilia, resembling those known to occur in *Myxidium Lieberkühni* and *Chloromyxum leydigii.* In many ways it suggests Sarcosporidia; but these are hitherto known only in Vertebrate hosts, and are always cell-parasites to start with, whereas the form under discussion may occur floating freely in the body-cavity. The name proposed is *Myxocystis ciliata* g. et sp. n.

* SB. Böhm. Ges., 1897, No. viii. 5 pp. (1 pl.).

BOTANY.

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

α. Anatomy.

(1) Cell-structure and Protoplasm.

Development of the Achromatic Nuclear-division Figure in Vegetative and Reproductive Tissues.*—Dr. B. Němec insists on the importance of the difference in the phenomena of division of the nucleus exhibited by the vegetative and reproductive (sporogenous) tissues in the higher plants, especially in connection with the uniformity of the phenomena associated with the reproductive processes in animals and plants. The (hypochromatic) reduction of chromatin characteristic of reproductive cells occurs only in exceptional and pathological conditions of vegetative cells. But the stage of the mother-cell nucleus known as synapsis, in which the chromatin threads on one side of the nuclear space (usually surrounding the nucleole) appear contracted on one side, is, in the opinion of the author, not confined to reproductive cells. It occurs occasionally in vegetative cells, where the development of the chromatin-threads can be followed out to a form identical with the synapsis stage.

A further difference is exhibited in the development of the achromatic nuclear-division figure. In the vegetative cells (apex of the stem and root of *Equisetum*), the bipolar structure can be recognised from the commencement of the division of the nucleus; while in the formation of the spore-mother-cells it is only a later and secondary phenomenon. In the vegetative tissue of *Allium* the achromatic figures are also bipolar from the first.

Multinucleated Vascular Elements in the Dioscoreaceæ.†—Sig. R. Pirotta and Dr. L. Buscalioni describe the occurrence, which they believe has not previously been noted, of vessels with a large number of nuclei in the species of Dioscoreaceæ examined—*Tamus communis*, and several species of *Dioscorea*. The stem, the leaves, and the root, but not the tubers, are distinguished by the presence, in the vascular bundles, of a few vessels of a much larger size than the rest. These larger vessels originate from rows of cells which are at first rectangular in longitudinal section, but which soon greatly exceed the others in length by intercalary growth. At the same time the karyokinetic multiplication of the nucleus commences, and proceeds with such rapidity that the nuclei in a single cell may amount to one hundred. As in other similar cases, all the nuclei in one cell divide simultaneously. The ordinary process of karyokinesis is naturally somewhat modified by taking place at the same time in so many nuclei crowded into a small space. It is only after this that true vessels are formed by the coalescence of the cells.

Protoplasm and Active Albumen.‡—Prof. O. Loew defends his previous conclusions against unfavourable criticism by Pfeffer in his

* Bot. Centralbl., lxxiv. (1898) pp. 1–4 (8 figs.). Cf. this Journal, *ante*, p. 316.
† Atti R. Accad. Lincei, vii. (1898) pp. 141–5.
‡ Bot. Centralbl., lxxiv. (1898) pp. 5–13.

'Handbuch der Pflanzenphysiologie,' and sums up the evidence in favour of the view, advanced by Bokorny and himself, of the distinction between passive and active albumen. Active albumen coagulates in all those conditions in which protoplasm dies.

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

Chlorophyll and its Derivatives.*—Herr F. G. Kohl communicates a number of fresh observations on the absorption-spectra of the various constituents of chlorophyll. Among other points he considers it as established that phylloxanthin cannot be a derivative of chlorophyll.

Calcium Malate and Malophosphate in Plants.†—M. M. Mirande states that although malic acid occurs most commonly in plants in the free state, $C_4H_6O_5$, it is also met with in combination with calcium as neutral calcium malate $(C_4H_5O_5)_2Ca$, or as calcium malophosphate. It was studied especially in *Nolana paradoxa*, from which it can be precipitated by the action of alcohol in the form of sphero-crystals of neutral calcium malate, of the orthorhombic type ; and as two forms of calcium malophosphate, the one consisting of sphero-crystals of needles, with excess of phosphoric acid, the other in the form of orthorhombic prisms, in which malic acid predominates. The quantity of malophosphate generally exceeds that of malate.

Gum of Canna.‡—According to M. L. Lutz, the gum of *Canna* is formed in a lysigenous, and not in a schizogenous manner, as might be supposed from a cursory examination. It forms in a thick layer in the interior of the cell, and, gradually condensing, forces the cytoplasm and its contents into the centre. The protoplasm and the thickened membrane surrounding it finally blend into a mucilaginous mass.

Gum in Elm-galls.§—Sig. N. Passerini finds, in galls on *Ulmus campestris*, produced by the attacks of an aphis, *Schizoneura ulmi*, a gum differing in its properties from other gums—arabin, cerasin, &c.—and from mucilage, dextrin, and other carbohydrates found in vegetable tissues. The solid portion consists chiefly of a gummy substance precipitated by alcohol, the precipitate being amorphous, yellowish, tasteless, very soluble in water, presenting the appearance of gum arabic, but differing from that substance in several properties. It is strongly dextrogyrous, and has an energetic reducing effect on cupric salts.

(3) Structure of Tissues.

Central Cylinder of Vascular Plants.‖—According to Mr. E. C. Jeffrey, there are three main types of fibro-vascular arrangement in plant axes, viz. (1) a single so-called concentric aggregation ; (2) several such aggregations, commonly but not always grouped in a circle ; (3) a ring of so-called collateral or bicollateral bundles. The author points out the primitive development of the tubular arrangement, which occurs in many Pteridophyta and Equisetaceæ. In the latter family the primitive

* Bot. Centralbl., lxxiii. (1898) pp. 417–26 (1 fig.).
† Journ. de Bot. (Morot), xii. (1898) pp. 6–12, 32–42, 58–60 (6 figs.).
‡ Bot. Gazette, xxv. (1898) pp. 280–1.
§ Bull. Soc. Bot. Ital., 1898, pp. 70–1.
‖ Rep. Brit. Ass. Toronto, 1897 (1898) pp. 869–70.

stelar arrangement is a closed tube with external and internal endoderm, but no internal phloem.

Origin of the Vascular Elements in the Growing Point of the Root of Monocotyledons.* —Sig. R. Pirotta and Dr. L. Buscalioni point out that in the root of Monocotyledons the plerome is always well differentiated from the other elements of the growing point, and gives birth to the central cylinder of the root and to the ground tissue, which becomes differentiated into peripheral pericambium and central parenchyme. Within the mass of ground tissue stand the vascular elements, either isolated or united into groups or series, generally simple sieve- and vascular bundles, arranged in a circle towards the periphery of the central cylinder. These vascular elements always originate directly from the differentiation of one or more cells of the meristem of the plerome, thus constituting another important histological difference between Monocotyledons and Dicotyledons.

Vascular Bundles in the Receptacle of the Labiatæ.†—M. L. Vidal has studied the course of the fibrovascular bundles in the receptacle of *Lamium maculatum*. The position of the abortive posterior stamen is clearly marked in the vascular plane of the flower, and may be represented by a phloem-bundle. The vascular system of the carpels is perfectly symmetrical in reference to the median plane of the flower. It is composed, for each carpel, of a median bundle proceeding from two primitive bundles situated right and left of the median plane, either in the cauline vascular ring (*Lamium*), or in the pith (*Phlomis*), and of two placental bundles, each of which is from the first fused with its homologue of the other carpel and with that of a lateral stamen.

Formation of Sieve-Tubes in the Roots of Monocotyledons.‡—From observations on a large number of species of Monocotyledons, M. G. Chauveaud arrives at the following general conclusions:—In all the examples studied, primary sieve-tubes are formed, which may be replaced by others, or may themselves persist. These first sieve-tubes are formed by the septation of a mother-cell, which gives rise to the sieve-tube and to its sister-cell. The sieve-tube is lozenge-shaped (Gramineæ, Cyperaceæ, &c.) or pentagonal (*Naias*, *Potamogeton*, *Vallisneria*, &c.), according to the inclination of this septum to the plane passing through the axis of the sieve-tube. When the first sieve-tube is replaced by others, these latter are usually formed directly at the expense of those previously existing. There may be only one of these directly formed sieve-tubes (*Avena*, *Triticum*, &c.), or there may be several. In this case either all the cells composing the phloem-island develop into sieve-tubes (*Zea Mays*, *Scilla italica*, *Narcissus poeticus*, &c.); or a certain number only, the remainder persisting in the state of phloem-cells (*Anthurium crystallinum*, *Monstera deliciosa*, &c.). When the primary sieve-tubes are not supplanted by others, either the phloem-bundle is reduced to this primary sieve-tube and to three or four cells adjacent to it (*Juncus balticus*, *Pontederia cordata*, *Hydrocharis morsus-ranæ*), or to the primary sieve-tube and its sister-cell (*Naias*, *Potamogeton*, *Vallisneria*).

* Atti R. Accad. Lincei, vii. (1898) pp. 60–2.
† Journ. de Bot. (Morot), xii. (1898) pp. 46–52.
‡ Ann. Sci. Nat. (Bot.), iv. (1897) pp. 307–81 (6 pls.).

In another article * M. Chauveaud reviews the various theories that have prevailed with regard to the function of sieve-tubes, and sums up in favour of the view that their primary function is that of the transport of food-material.

Laticiferous Tubes and Sieve-Tubes of Cuscuta.†—The laticiferous tubes and sieve-tubes of the monogynous species of *Cuscuta* have been made a subject of study by M. M. Mirande, *Cuscuta monogyna* and *japonica* having been the species especially examined. The laticiferous tubes are situated in the cortical parenchyme and in the pericycle, and are never connected by anastomoses. Those in the cortex are long superposed cells; those of the pericycle occupy the whole length of the internodes, and have thickened walls. They contain oily matters, tannin, and a resinous substance. The sieve-tubes are remarkable from the diversity of their structure, and from their large size. The transverse walls are horizontal or oblique, and are sieve-plates; the longitudinal walls also containing sieve-plates or punctations of various sizes, or both. The sieve-tubes (in *C. japonica*) do not contain starch, but an amylaceous substance stained red by iodine.

Mucilage-Cells of the Malvaceæ.‡—Dr. A. Nestler describes the mucilage-cells in the leaves of various species of Malvaceæ, which he regards as organs for the absorption and retention of water. They are epidermal cells, the cuticle of which projects into the interior of the cell in the form of a conical or funnel-shaped mass, giving the cuticle the appearance from the outside of being perforated. The nucleus is situated near the mouth of the funnel. It is the inner and lateral walls of these cells which become converted into mucilage. The author finds hæmatoxylin (Böhmer's) to be the best reagent for demonstrating the mucilage-cells, imparting to them a deep blue colour.

Mucilage-Cells of Opuntia.§—Sig. Longo has made a study of the mucilage-cells in *Opuntia*, and states that they are distributed through the fundamental parenchyme of all parts of the plant. The mucilage does not result from a transformation of the cell-wall, but is a direct product of the cell-protoplasm. Their function is that of a water-tissue. Cells containing crystals occur in the branches and fruit of *Platopuntia*, but are absent from *Cylindropuntia*.

(4) Structure of Organs.

Flower of Deherainia.‖—Dr. G. Fatta has made a study of the flowers of *Deherainia smaragdina*, a shrub belonging to the Myrsineæ, from Mexico. The flowers remain expanded for a period reaching to 20 days, and are strongly proterandrous, the pollination being effected by carrion flies. The petals remain green and coriaceous during the whole time of flowering, and apparently take no part in assisting pollination. They contain chlorophyll, but this chlorophyll appears to have entirely lost its power of forming starch and of assimilating. On the

* Rev. Gén. de Bot. (Bonnier), ix. (1897) pp. 427–30.
† Journ. de Bot. (Morot), xii. (1898) pp. 70–90 (8 figs.).
‡ Oesterr. Bot. Zeitschr., xlviii. (1898) pp. 94–9 (1 pl.).
§ Ann. R. Ist. Bot. Roma, vii. pp. 44–57 (1 pl.). See Amer. Naturalist, xxxii. (1898) p. 214.
‖ Nuov. Giorn. Bot. Ital., v. (1898) pp. 145–57 (1 pl.).

contrary, the green petals absorb oxygen and give off carbonic acid. The author inclines to support Pringsheim's theory of the protective function of chlorophyll.

Epiphyllous Flowers of Chirita hamosa.*—Herr C. E. Boldt has studied the peculiar phenomenon in this plant, belonging to the Cyrtandreæ, and concludes that it results from the complete coalescence of a compound inflorescence with the tissue of the leaf. The similar epiphyllous inflorescence of *Streptocarpus* and other genera of Cyrtandreæ is certainly axillary and not adventitious.

Pistil and Fruit of the Caprifoliaceæ.†—M. L. Vidal describes in detail the difference of the structure of the pistil and the fruit in the two tribes of this order, the Sambuceæ and the Lonicereæ. In the Sambuceæ the ovary is only partially inferior, the style is short, with a large canal, the stigma is lobed, and the fruit a drupe. In the Lonicereæ the ovary is completely inferior, the style long, and the canal obliterated, the stigma entire, or nearly so, the fruit a berry, capsule, or drupe. He further proposes the division of the Sambuceæ into two groups, the Eusambuceæ (*Sambucus*, *Adoxa*), and the Viburneæ (*Viburnum*), which presents an approach to the Lonicereæ; also of the Lonicereæ into two groups, the Eulonicereæ, in which the fruit is a berry, or a capsule with multiovular loculi, and the Linnæeæ, in which the fruit is a drupe, either uniovular or multiovular.

Dichroism in Plants.‡—Prof. F. Delpino records a number of examples of a variation of colour in the same species unaccompanied by any anatomical difference:—*Euphorbia Peplis*, stem and leaves red or yellow; *Anagallis arvensis*, flower scarlet (var. *phœnicea*) or blue (var. *cœrulea*); a similar variation in *A. collina*; in the colour of the flower in *Orchis provincialis* (Liguria), *O. sambucina*, *Erica arborea* (Tuscany), and *Thalictrum aquilegifolium*; *Solanum nigrum*, berries black or yellow (*S. miniatum*), &c. In some cases the difference is probably connected with the promotion of cross-pollination.

Adaptation of Land-Plants to existence in Water.§—Dr. R. Keller describes the changes in external habit, and in the structure of its tissues, undergone by *Myosotis palustris* when growing submerged in water. The lower stem-nodes produce roots, the lowermost of which branch, but there are no root-hairs; the stem becomes nearly round; the leaves are narrower and thinner. This is accompanied by differences also in the anatomical structure:—the conducting system is reduced; the epiderm and cuticle are reduced in thickness.

Extra-Floral Nectaries.‖—Herr V. A. Poulsen describes several fresh examples of these structures from Java. In *Excœcaria biglandulosa* there are on the leaf-stalks two conical projections, hypodermal

* Vidensk. Medd. Naturhist. Foren. Kjöbenhavn, 1897 (10 figs.). See Bot. Centralbl., lxxiv. (1898) p. 128.

† Ann. Univ. Grenoble, 1897, 19 pp. and 3 figs. See Bull. Soc. Bot. France, xliv. (1898) p. 522.

‡ Rend. R. Accad. Sci. Napoli, 1897, 6 pp. See Bot. Centralbl., lxxiv. (1898) p. 51.

§ Biol. Centralbl., xviii. (1898) pp. 241–5 (6 figs.).

‖ Vidensk. Medd. Naturhist. Foren. Kjöbenhavn, 1897, pp. 356–71 (3 pls.). See Bot. Centralbl., lxxiii. (1898) p. 454.

emergences, from which a fluid is excreted. *Fagræa littoralis* has a number of light-coloured spots on the leaf, consisting of a solid small-celled tissue, which excretes a sweet fluid through a pore. *Vaccinium Teysmanni* has extra-floral nectaries at the point of junction of the petiole with the lamina. In *Shorea stenoptera* there are on both sides of the leaves spots which exude nectar.

Leaf and Stem.*—Herr H. Potonié traces back all the organs of the higher plants to a single morphological fundamental organ, a forking thallose structure. The leaves of the higher plants have, in the course of generations, sprung from portions of a thallus, the forked branch being outgrown, and the lateral branches becoming leaves.

Assimilating Organs of the Asparageæ.†—Herr J. Reinke describes in detail the structure of the assimilating organs in the various genera of the Asparageæ—*Asparagus*, *Ruscus*, *Danae*, *Semele*—in all of which the leaves are either greatly reduced, or are replaced by cladodes. The form of the leaves on seedling plants of *Semele androgyna* and *Danae racemosa* renders it probable that these genera and *Ruscus* are most nearly allied to *Cordyline* among Liliaceæ, while *Asparagus* is more probably descended from the Convallarieæ. Whether the development of cladodes in the Asparageæ rendered the leaves superfluous, or whether they made their appearance to compensate the reduction in the leaf-surface, we have no evidence.

Floating Leaves.‡—Herr E. Wollenweber notes the following peculiarities of floating leaves. The margin is almost always entire. The growth of the petiole or of the leaf-bearing stem is regulated by the depth of the water. The epiderm has a thick cuticle, furnished with a coating of wax. The assimilating tissue always consists of a well-developed palisade-parenchyme; there is no spongy parenchyme, the system of air-chambers being located in the lower part of the lamina. With very few exceptions, stomates are wanting on submerged leaves; in floating leaves they occur almost exclusively on the upper surface. The stomates are very rarely depressed; the pore forms a kind of funnel to the air-cavity, a contrivance probably for preventing the capillary stoppage of the stomate by water. The author classifies floating plants under various groups, according as submerged leaves or aerial leaves are occasionally developed in addition to the floating leaves.

Lodicules of Grasses.§—Dr. W. W. Rowlee argues that the lodicules of grasses correspond to a reduced perianth. The three lodicules in the flower of *Arundinaria* alternate on the axis with the stamens, and may therefore be considered the inner whorl or petals. The stamens are directly opposite the midribs of the carpels, and indicate that the inner whorl of stamens, present in some bamboos, is suppressed in *Arundinaria*.

Chimney-shaped Stomates.‖—On *Holacantha Emoryi*, a prickly leafless shrub, native of the arid regions of Southern Arizona, Prof. C. E.

* SB. Gesell. Naturf. Freunde Berlin, 1897, pp. 183–91.
† Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxi. (1898) pp. 207–72 (26 figs.).
‡ Vergleich. Anat. d. Schwimmblätter, Bonn, 1897, 319 pp. See Bot. Centralbl., lxxiv. (1898) p. 184.
§ Bot. Gazette, xxv. (1898) pp. 199–203 (2 figs.).
‖ Rep. Brit. Ass. Toronto, 1897 (1898) p. 861.

Bessey finds stomates of peculiar form. The epiderm is of extraordinary thickness, and the stomates have long narrow chimney-shaped openings above them, terminating in hollow papillæ which project some distance above the surface.

Pyrola aphylla.*—Mr. T. Holm has made a detailed study of the structure of this plant, and asserts, in opposition to the statement of previous observers, that it is not leafless, and is neither a parasite nor a saprophyte. It produces underground shoots, after the manner of other species of the genus, which bear rosettes of leaves at their apex, of quite a normal structure, with chlorophyll tissue. The root has no haustoria. The plant possesses a remarkable facility of propagating itself by means of axillary buds developed on the underground stems, and of adventitious buds produced on the roots.

β. Physiology.

(1) Reproduction and Embryology.

Embryology of Compositæ.†—Mdlle. M. Goldflus finds that, in the species of Compositæ examined, the antipodals play an important part in the early stages of the maturing of the fertilised ovule. They become superposed, and frequently multiply by division. They remain in communication with the base of the embryo-sac by an axial row of elongated cells which performs the function of a pseudo-chalaza connecting the termination of the periovular bundles with the antipodal conducting apparatus. Their position, structure, and contents show that they perform an active part in the digestion of the pseudo-nucellus (the interior portion of the integument), similar to that of the epithelial cells. This interior layer of cells of the integument can no longer be regarded as a protective layer.

In some genera (*Aster*, *Chrysanthemum*, *Leucanthemum*) the terminal antipodal is swollen to a club-shaped form, a kind of pseudopode which projects into the tissues of the ovule. The size of the embryo-sac in proportion to that of the ovule varies greatly, as also does the structure of the digestive epithelial layer. In *Helianthus* the antipodals are of remarkable size, exceeding that of the remainder of the embryo-sac before impregnation, and even during the early stages of the development of the ovule. The antipodals are more cyanophilous than the epithelial cells, whilst the rest of the active cells of the embryo-sac are erythrophilous.

Development of the Embryo in Lilæa subulata.‡—Prof. D. H. Campbell finds the development of the embryo in this plant to correspond with that which occurs in other lowly organised Monocotyledons.§ The sporogenous tissue of the stamen is not hypodermal in its origin, but arises from the plerome, as in *Naias* and *Zannichellia*. The ripe pollen-spore has two cells; the generative nucleus remains undivided in the ripe spore. The archespore of the ovule is hypodermal, and a tapetal cell is cut off from it. The primary sporogenous cell of the ovule

* Bot. Gazette, xxv. (1898) pp. 246–54 (1 pl.).
† Arch. Sci. Phys. et Nat., v. (1898) pp. 390–2.
‡ Bot. Gazette, xxv. (1898) pp. 1–28 (3 pls.).
§ Cf. this Journal, *ante*, p. 322.

divides usually into three, of which the middle one becomes the embryo-sac. The embryo-sac usually develops in the manner typical of Angiosperms, but there may be a suppression of a normal egg-apparatus, and a formation of cellular tissue in the upper part of the embryo-sac before fertilisation. This is probably accompanied by an increase in the number of nuclei. The first division of the embryo is the typical one into two cells, a basal suspensor cell which remains permanently undivided, and a terminal embryo-cell. The cotyledon is derived entirely from the terminal one of the primary segments into which the embryo-cell first divides. The stem probably always originates from the second embryonal segment; its position is strongly lateral. The root is of lateral origin, differing in this respect from other Monocotyledons which have been studied.

Polyembryony in Opuntia.*—Mr. W. F. Ganong describes the process of the formation of numerous embryos in *Opuntia vulgaris.* The embryos originate within the embryo-sac; in half-ripe seeds there is frequently one springing from the micropylar end, and several from the walls. A careful examination shows that in both cases the embryos arise from the nucellus. When the pollen-tube reaches the micropylar region of the nucellus, no oosphere can be detected. It probably disappears early in the development of the ovule. Both the micropylar and the parietal embryos result from the budding of cells of the nucellus near the pollen-tube which are rich in protoplasm. In the course of its development the ovule assumes a campylotropous form, and becomes completely surrounded by the funicle.

Centrosome-like Body in the Pollen-tube of Cycadeæ.†—Referring to the "centrosome-like bodies" found by Webber in the pollen-tube of *Zamia*, and the "rounded nuclei" observed by Belajeff in the spermatogenous cells of Characeæ, Filicineæ, and Equisetaceæ, Prof. S. Ikeno comes to the conclusion, based on a comparison with similar structures in the animal kingdom, that the organs in question are true centrosomes which have become enormously distended, and serve as a surface of attachment for the cilia.

Cross-Pollination and Self-Pollination.—Herr O. Ekstam ‡ names the insect visitors of a number of species, natives of Nova Zembla, together with the relative time of maturity of the stamens and stigma.

Dr. P. Knuth § describes the contrivances for attracting insects in *Leucojum vernum* and *Galanthus nivalis.* In both plants, all the parts of the perianth, receptacle, and style which are not green contain honey.

From observations and experiments on American species of *Eupatorium*, Dr. Laura B. Cross ‖ concludes that self-pollination is very rare; and even when it does occur, the resulting fruits are of weak germinating capacity. When cross-pollination by hand is effected, a slight increase is obtained in the production of good fruits; but when covered

* Bot. Gazette, xxv. (1898) pp. 221–8 (1 pl.).

† Flora, lxxxv. (1898) pp. 15–8. Cf. this Journal, *ante*, p. 99.

‡ Aftr. Tromsö Mus. Arsk., xviii. (1897) pp. 109–98. See Bot. Centralbl., lxxiii. (1898) p. 14.

§ Bot. Centralbl., lxxiv. (1898) pp. 161–5 (1 fig.).

‖ Contrib. Bot. Lab. Univ. Pennsylvania, i. (1897) pp. 260–9 (1 pl.).

flowers are cross-pollinated, the increase is very striking, and decidedly points to the conclusion that insect-visits are the main agency for pollination in winter.

Mr. C. Robertson's * most recent contribution to the literature of this subject comprises an account of the mode of pollination, and the insect visitors in species of *Actæa*, *Lespedeza* (Leguminosæ), *Cornus*, *Viburnum*, *Lonicera* (in which one species *L. sempervirens* is pollinated by birds), and *Helianthus*.

Experiments on Hybridising.†—Mr. W. Saunders gives an account of the results achieved by experiments conducted by him during the past 25 years, in the "cross-fertilising" of plants, trees, and shrubs. Among the more interesting hybrids produced were the following:—One between the black currant as male and the gooseberry as female. A cross was obtained between a form of the wild grape *Vitis cordifolia* and a variety of *V. vinifera*. A number of varieties of dark purple raspberries were produced between the black-cap raspberry *Rubus occidentalis* and the red raspberry *R. strigosus*. *Pyrus baccata* was also fertilised by a Russian apple, and *Prunus pumila* by *P. americana*. A striking hybrid was obtained between *Berberis Thunbergii* and *B. vulgaris purpurea*. A number of promising new varieties of wheat were also obtained.

Hybridisation of Willows.‡—Mr. E. T. Linton has succeeded in producing, by artificial pollination, hybrid willows, apparently entirely resembling forms which occur in nature. The different species of *Salix* present, however, very different capacities for hybridisation; some cross with great readiness; others with reluctance; others again obstinately refuse to enter into any alliance at all.

Hybrid between Lychnis diurna and L. vespertina.§—M. F. Gagnepain has obtained artificially hybrids between these two nearly allied species,—both between *L. diurna* ♂ and *L. vespertina* ♀, and between *L. vespertina* ♂ and *L. diurna* ♀, and gives details of the characters in which they combine the structure of the male and of the female parent. Subsequently he found both these hybrids growing wild, produced by the agency of insect-pollination.

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

Action of the Röntgen Rays on the Protoplasm of the Living Cell.‖—According to Sig. G. Lopriore, the X-rays exercise an accelerating influence on the current of protoplasm in the cells of *Vallisneria spiralis*; but this influence does not last long, and, if continued for a longer period, the effect is injurious. The action of the rays completely suspends the germination of pollen-grains.

* Bot. Gazette, xxv. (1898) pp. 229–45.
† Rep. Brit. Ass. Toronto, 1897 (1898) pp. 867–8.
‡ Journ. of Bot., xxxvi. (1898) pp. 122–4.
§ Bull. Soc. Bot. France, xlii. (1896) pp. 129–39; xliv. (1898) pp. 441–9.
‖ Nuova Rassegna, Catania, 1897. See Bot. Centralbl., lxxiii. (1898) p. 451.

Nitrogenous Nutrition of Plants.* — According to M. L. Lutz, flowering plants can derive the nitrogen necessary for their nutrition from amines without the previous transformation of these substances into ammoniacal salts or nitrates. The elimination of nitrogen takes place in the gaseous state.

Germination of Seeds.†—From a series of experiments, made chiefly on peas, M. F. V. Jodin concludes that the first stages of germination, resulting in the production of a rootlet 2–3 times the diameter of the seed, can take place without the intervention of an appreciable amount of oxygen. Subsequently oxygen is necessary, and this must be supplied in the uncombined state; it is not available in the form either of nitrate or of hydrogen peroxide. Any reduction of nitrates which takes place during germination must be due to the action of microbes.

Influence of Electricity on Germination.‡—Further researches on this subject by Sig. G. Tolomei lead him to the conclusion that there is no difference in their absorbing power for water of seeds subjected to an electric current and of those not so treated. It does, however, somewhat accelerate the process.

Germination of the Seeds of Aquatic Plants.§—According to a series of experiments made by Dr. H. B. Guppy, the germination of seeds may, in the case of many aquatic plants, be deferred to the third, fourth, or fifth year. The seeds of the water-lilies decay rapidly when dried, but retain their vitality if kept moist. Immersion in sea-water favours, rather than retards, their germination. In the case of the majority of aquatic plants, darkness has a decidedly repressive effect on their germination; in other cases it is indifferent; while seeds of *Potamogeton natans* germinated more freely in the dark.

Germination of Lathræa.‖—Herr E. Heinricher finds the phenomena of germination in *Lathræa clandestina* to be repeated also in *L. squamaria*. The first pair of leaves which succeeds the cotyledons possesses the hollow cavities characteristic of the rhizome-scales of *Lathræa*. They are wanting in the cotyledons.

Effects of Water at Different Temperatures on the Germination of the Olive.¶—According to Sig. N. Passerini, seeds of the olive which have been immersed for 10 minutes in water at from 40°–50° C. germinate more rapidly than those not so treated; immersion in water at 60°–70° increases the proportion that germinate; while a temperature of 90° destroys their power of germinating. Under ordinary circumstances it is common for not more than 20 per cent. of olive-seeds to germinate.

Functions of Stomates.**—From a comparative examination of the structure of stomates in terrestrial aerial, and aquatic plants, Prof. C. E.

* Comptes Rendus, cxxvi. (1898) pp. 1227–9.

† Ann. Agron., xxviii. (1897) pp. 433–71. See Journ. Chem. Soc., 1898, Abstr. p. 129.

‡ Atti R. Accad. Lincei, vii. (1898) pp. 177–83. Cf. this Journal, 1897, p. 142.

§ Proc. R. Phys. Soc. Edinburgh, 1897, pp. 344–59.

‖ Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 2–5 (1 fig.). Cf. this Journal, 1895, p. 335.

¶ Bull. Soc. Bot. Ital., 1898, pp. 71–3.

** Rep. Brit. Ass. Toronto, 1897 (1898) pp. 861–2.

Bessey concludes that the normal function of stomates is respiration, and that the loss of water through them is incidental and secondary.

Transpiration in a Moist Tropical Climate.*—Replying to the criticisms of Stahl, Burgerstein, and Giltay,† on his conclusions on this subject, Herr G. Haberlandt adduces the result of fresh experiments in support of his previous contention that in a moist tropical climate the amount of transpiration is considerably less than in the climate of Central Europe. Saturation of the air with moisture greatly diminishes transpiration, even in direct sunlight.

(3) Irritability.

Movements of the Sensitive Plant in Water.‡—M. G. Bonnier has observed the following phenomena in plants of *Mimosa pudica* developed entirely under water:—They continue to display the alternate movements of sleep and waking, and those of irritation, but the waking period is longer than in the case of plants under normal conditions. The extent of these movements is less, and they are transmitted less rapidly. They present no important modification in their tissues, except in the development of the vascular bundles, in the size of the vessels, and in the development of the motor cushions, all of which are greatly reduced. These facts confirm the view that the organs which play the greatest part both in producing and in transmitting the movements of the sensitive plant are the vascular bundles.

Sensitive Cushions of Phaseolus and Oxalis.§—From experiments on *Phaseolus multiflorus* and on several species of *Oxalis*, Prof. S. Schwendener is able to affirm the existence of the same phenomena in the sensitive cushions of these genera as in those of *Mimosa*, viz. that the upper and lower halves of the cushions react in opposite ways towards changes in the light. Darkness causes an increase of turgor in the upper, a decrease in the lower half of the cushion.

Relationship of Secondary Roots to the Vertical.‖—From observations on the seedlings of various plants—*Phaseolus multiflorus*, *Pisum sativum*, *Vicia Faba*, *Lupinus luteus*, *Cucurbita Pepo*—Herr A. Schober confirms the statement of Czapek that secondary roots do not, as a rule, retain their vertical direction of growth; but he does not regard this as a tendency towards an upward growth; it is simply a curvature from the vertical.

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

Ripening of Fleshy Fruits.¶—M. C. Gerber discusses in great detail the chemical changes which take place in the maturing of fleshy fruits. At certain phases of their development they disengage a volume of

* Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxi. (1897) pp. 273–88. Cf. this Journal, 1897, p. 312.

† Cf. this Journal, 1897, p. 556.

‡ Comptes Rendus, cxxvi. (1898) pp. 1001–7.

§ SB. K. Preuss. Akad. Wiss. Berlin, 1898, pp. 176–81 (1 pl.) Cf. this Journal, 1897, p. 558.

‖ Bot. Ztg., lvi. (1898) 1te Abt., pp. 1–8 (1 pl.).

¶ Ann. Sci. Nat. (Bot.), iv. (1897) pp. 1–280 (2 pls.).

carbon dioxide greater than the volume of oxygen absorbed in the same time; in other words, the respiratory quotient is higher than unity. This respiratory quotient has a different origin, and pursues a different course, according to the degree of ripeness of the fruit, and its chemical constitution. Two kinds of respiratory quotient higher than unity may be distinguished, one due to the presence of acids, the other to fermentation. The acid quotient occurs whenever fruits which contain an acid —citric, malic, tartaric, &c.—are exposed to a high temperature; for fruits containing citric or tartaric acid, about 30° C.; for those containing malic acid, about 15°. The fermenting quotient is produced whenever the oxygen of the air does not reach the cells in sufficient quantity to furnish the energy necessary for vital activity. This deficiency of oxygen is due to the production of pectin. The fermenting quotient differs from that of acids in the period at which it appears; in the lower temperature at which it is manifested; in its higher value (often above 3); and in the corresponding intensity of respiration.

Among the chemical changes which take place in the ripening of fleshy fruits are the following:—The acids are partially used up in the production of carbohydrates. The tannin disappears by complete oxidation without forming carbohydrates; the starch is transformed into sugars, which are partially oxidised.

Formation of Wood from Reserve-Material.*—Herr A. Wieler attributes the nourishment of the cambium in woody plants to three factors,—the supply of water, of mineral substances, and of organic substances. Treating especially of the third of these sources, as the result of observations on a number of different trees, he comes to the conclusion that the spring-wood is essentially a product of the reserve-substances in the stem, the breadth of the zone being proportional to the amount of these substances stored up.

Formation of Cane-Sugar out of Dextrose.†—From observations made on a material composed of a very large number (2000) of embryos of barley, Herr J. Grüss asserts that, in the process of germination, cane-sugar is formed in the cell out of dextrose; cellulose and starch out of cane-sugar. In the formation of starch and cellulose, no substance belonging to the group of aldehyds is set free in the molecules of sugar.

Yeast and Alcoholic Fermentation.‡—After a historical survey of the different views which have prevailed regarding the nature of fermentation, Prof. J. R. Green thus concludes an admirable and succinct article. The great advances made in the study of fermentation under the action of soluble enzymes has drawn attention to the possibility of the secretion of an alcohol-producing enzyme by the yeast-cell. The idea of an enzyme does not necessarily involve a new view as to the nature of fermentation; the secreted enzyme is merely substituted for the protoplasm of the cell as the active agent in the process. This idea is not new, having been advanced by Berthelot, Moritz Traube, and Hoppe-Seyler.

The enzyme has been prepared by Buchner,§ and this discovery

* Tharander forstl. Jahrb., xlvii. 76 pp. and 4 pls. See Bot. Ztg., lvi. 2te Abth., p. 39.

† Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 17–20.

‡ Nature, lvii. (1898) pp. 591–4.

§ Cf. this Journal, 1897, pp. 222 and 414.

deals a heavy blow to the vibration theories of Liebig and Naegeli. Their views are only tenable on the theory that most, if not all, of the action takes place in the liquid outside the cells. But if the work be done by an enzyme, it must necessarily be intracellular; for enzymes show no tendency to diffuse through such a membrane as the cell-wall. It also militates against Pasteur's theory of intramolecular respiration, which demands the idea of the decomposition being brought about by chemical action between the protoplasm and the body from which it obtains its oxygen.

Formation of Holes in Emmenthal Cheese.* — According to Herr O. Jensen, the normal holes in Emmenthal cheese are not formed by special agents, by yeasts or by anaerobic bacteria, but by the normal agents of cheese ripening, among which must be considered the lactic acid ferments. The gases to which the normal holes are due are not formed at the expense of the milk-sugar, but at that of the nitrogenous substances. The lactic acid ferments of cheese may under certain conditions form traces of CO_2 from nitrogenous substances; and these traces of CO_2 are the cause of the normal hole formation in Emmenthal cheese.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Leaves of Selaginella.†—M. F. Cornaille describes the structure and arrangement of the leaves in 24 species of *Selaginella*, reviewing the classification proposed by Harvey Gibson. Starting from an ideal group, comprising nearly or quite glabrous species, destitute of fibres, without cuticular ornamentations, and with the epidermal cells not palisade-like, all the species may be arranged in two parallel series, glabrous and hairy. In each of these series secondary groups are established, dependent on the form of the epidermal cells, the presence or absence of palisade tissue, and of epidermal fibres more or less ornamented.

Selaginella spinulosa.‡—According to Herr H. Bruchmann, this species differs in several important points from the rest of the genus. The primary hypocotyledonary shoot remains for a time in the condition of an erect filiform basal member of the plant; the roots springing from its base only, and not, as in other creeping species, from the forks of the stem. They owe their origin to a peculiar persistent cushion of meristem. The primary shoot at first branches dichotomously, but the apices of the system soon pass into the condition of fertile spikes; each then produces two lateral shoots, and acquires a sympodial character. The stem never has a single apical cell; the apex consists of a uniform meristem not differentiated into layers; and this is true also of the apex of the root.

Ferns of Multiple Parentage.—Mr. E. J. Lowe § records the results of experiments on crossing *Asplenium Trichomanes* with both *A. marinum*

* Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 217-22, 265-75, 325-31.
† CR. Soc. R. Bot. Belgique, xxxvi. (1898) pp. 100-18 (3 pls.). Cf. this Journal, 1897, p. 223.
‡ 'Unters. üb. *Selaginella spinulosa*,' Gotha, 1897, 64 pp. and 3 pls. See Bot. Ztg., lvi. (1898) 2te Abth., p. 109.
§ Rep. Brit. Ass. Toronto, 1897 (1898) pp. 866-7.

and *Athyrium filix-femina*. The resulting hybrid partook more of the character of the latter than of the former male parent, and was abundantly fertile.

In another paper * the same author notes the development of more than one sporophyte from a prothallus in the cases of an *Athyrium* and a *Scolopendrium*.

Pits in the Cyatheaceæ and Marattiaceæ.†—From an examination of the pits (*Staubgrübchen*) in the stem and leaf-stalk of various species in these two orders of Filices, Herr E. Hannig comes to the following conclusions. The stem- and leaf-pits of the Cyatheaceæ are, in their structure and development, equivalent organs. They act for a time as pneumathodes, but may be compared with lenticels in their structure and origin. They have no relationship to the streaks (*Male*) on the leaf-cushions of *Lepidodendron*. The pits on the stipules and leaf-stalks of the Marattiaceæ are also equivalent in their origin and structure; they furnish a special contrivance for promoting an active interchange of gas during the development of the bud, and close when the lamina is able itself to assimilate after the full development of the leaf. The stomatic openings on which they arise in the Cyatheaceæ and Marattiaceæ are independent organs, forming a highly differentiated state of contrivances for respiration. The stomates on the stipules of *Marattia Verschaffeltii* furnish an example of very great reduction. The portion of the cortex of the stipules of the Marattiaceæ hitherto styled the periderm differs completely in its chemical character, structure, and mode of renewal, from all cork structures hitherto examined.

Muscineæ.

New Genera of Musci.—Under the name *Nadeaudia schistostegiella* g. et sp. n., M. E. Bescherelle ‡ describes a moss from Tahiti. The following is the diagnosis of the genus, which he places near to *Hymenodon*: —Dioica; habitus schistostegiaceus; caules simplices, inferne nudi, superne frondiformes; folia erecto-patentia, suprema erecta, cellulis quadratis viridibus areolata, integerrima, costa cum apice finiente; perichætium terminale; capsula (?) pedicello longo basi geniculato lævi.

In a subsequent paper § M. Bescherelle sinks the genus *Nadeaudia* in *Calomnion*.

The following new genus from Australia, belonging to the Phascaceæ, is described by Herr C. Müller,‖ in addition to a large number of new species. *Beckettia*:—Habitus *Bruchiæ*; folia pottiacea, marginata, e cellulis pottiaceis granulosis reticulata, aristato-nervosa, apice acute dentata; capsula phascacea, minuta; calyptra majuscula, pyramidati-campanulata, basin versus angustata, fere calymperacea.

On *Leskea Austini* Sull. Mr. G. N. Best ¶ founds a new genus *Fabroleskea*, which he regards as an outlying genus of the Fabroniaceæ.

* Rep. Brit. Ass. Toronto, 1897 (1898) p. 867.
† Bot. Ztg., lvi. (1898) 1te Abth., pp. 9–33 (1 pl.).
‡ Rev. Bryol., xxv. (1898) p. 11. § Tom. cit., p. 49.
‖ Hedwigia, xxxvii. (1898) p. 77.
¶ Bull. Torrey Bot. Club, xxv. (1898) pp. 108–9.

New Genera of Hepaticæ.*—Among material from the interior of China, Dr. C. Massalongo describes two new genera of Hepaticæ:—

Ascidiota g. n. Habitus sp. gen. *Madothecæ* simulans; caulis pinnatim ramosus; folia incuba, ovato-subreniformia, subtus in lobulum conduplicato-appendiculata; lobulus folio multo minor, oblongus, ad plicam inferne scrotiformis saccatus, ejusdem margine interno ad basim juxta caulem in auriculam inflatam revoluto; areolatio speciosa, scilicet e cellulis utraque superficie folii eleganter subhemispherico-prominentibus; foliola oblonga, optime evoluta, utrinque ad insertionem turgide-auriculata; perichætium 1–2-jugum, terminale; bracteæ et bracteolæ inter se liberæ; flores fem. oligogyni.

Hariotella Besch. et Mass. (*Lepidolænæ* subgen. Hariotella Schiff.). Habitus sp. gen. *Polyoti*; caulis pinnatim ramosus; folia incuba, imbricata, subtus auricula prædita; foliola bidentata, dentibus saepe in auriculas transformatis; perichætium polyjugum, in ramulo brevi laterali; bracteis et bracteolis imbricatis, subobovato-oblongis fluentibus, interioribus in sacculum colesulæformem oblongum liberum et inflatum connectis; flores fem. 9–12-gyni; calyptra e basi ad medium cum sacculo colesulæformi accreta.

Systematic Position of Monoclea.†—Prof. D. H. Campbell advocates the removal of *Monoclea* from the Jungermanniaceæ, and placing it among the Marchantiaceæ. The form of the thallus and the character of the apical cell correspond with those of *Marchantia*; the most important divergence from the Marchantiaceæ being the absence of the ventral scales, which are, however, represented by short-lived papillate hairs. Unlike the Jungermanniaceæ, *Monoclea* has two kinds of root-hair, thin-walled and thick-walled. The structure and arrangement of the sexual organs is altogether that of the Marchantiaceæ, among which it presents the greatest affinity with the Targionieæ. There are six rows of neck-cells, in contrast with the five of the typical Jungermanniaceæ.

Retrogression in Metzgeria.‡—Among normal plants of *Metzgeria furcata* Prof. K. Goebel finds others in an enfeebled condition owing to unfavourable vital surroundings. This condition has been described as the var. ulvula. These plants have a strong tendency to revert to a "young condition" in which there is an apical cell which does not further divide. In certain cases, the reversion may even proceed further, and the thallus be reduced to a single row of cells. These degraded structures produce adventitious shoots, resembling the parent shoot, which is never the case with the normal *Metzgeria* thallus.

Algæ.

Influence of Algæ on the Purity of Water.§—From experiments made on the drinking-water of Hamburg, Herr O. Strohmeyer concludes that the green algæ—*Spirogyra*, *Cladophora*, *Enteromorpha*, *Stichococcus*

* Nuov. Giorn. Bot. Ital., v. (1898) pp. 255–60.
† Bot. Gazette, xxv. (1898) pp. 272–4.
‡ Flora, lxxxv. (1898) pp. 69–74 (5 figs.).
§ 'Die Algenflora d. Hamburger Wasserwerkes,' Leipzig, 1897, 48 pp. See Bot. Centralbl., 1898, Beih., p. 406.

—have a very powerful effect in purifying water by the destruction of bacteria by the oxygen which they give out. Those algæ which are enveloped in mucilage, especially diatoms, have a very prejudicial influence on drinking-water, by stopping the filters through which it passes.

Vickersia, a new Genus of Florideæ.*—Among a collection of seaweeds from the Canary Islands, Mdlle. N. Karsakoff finds one which she regards as a new type of Ceramiaceæ, with the following diagnosis:—*Vickersia.* Frons tota articulata, monosiphonia, ecorticata, repens, radiculis apice scutellatim expansis affixa; fila primaria cylindrica, inferne irregulariter ramosa; ramis erectis, ad genicula opposite aut verticillatim ramulosis; ramuli vegetativi simplices, sæpius ex articulo unico crassius-inflato, nunc ad basim ramorum articulis pluribus cylindricis constantes; ramuli tetrasporiferi biarticulati, articulo inferiore tetrasporas numerosas circumcirca prægnante; tetrasporæ sphæricæ, triangule divisæ, sessiles. Cystocarpia et antheridia desiderantur. Until the cystocarps have been found, the genus is placed provisionally near to *Griffithsia.*

New Freshwater Floridea.†—Under the name *Delesseria zanzibariensis*, Prof. K. Goebel describes what he regards as an addition to the very small number of freshwater Florideæ at present known, from Zanzibar.

Miss E. S. Barton ‡ regards the alga as probably identical with *Caloglossa Leprieurii.*

Reproduction of Coleochæte.—Herr F. Oltmanns § confirms, in the main, in the case of *Coleochæte pulvinata*, the correctness of Pringsheim's description of the mode of sexual reproduction in this genus; but he does not assign to it so high a position among Algæ as has generally been done. It is probably most nearly allied to the Œdogoniaceæ; the resemblance to the Florideæ is more apparent than real. The zoosporanges, antherids, and oogones are perfectly homologous organs; the oogones are but a slight modification of the zoosporanges. During winter the resting oosperm remains without change; it always contains a parietal nucleus, a large central vacuole, and eight chloroplasts, each with its own pyrenoid. On germinating the oosperm divides, by a vertical wall, into two cells, each with a nucleus and four chlorophyll-bodies; after two further divisions, each of the eight cells has a single chlorophyll-disc.

Observations made by Prof. R. Chodat ‖ on the mode of reproduction of *Coleochæte* confirm his previous view that there is in this genus of Algæ no true alternation of generations. The fertilised oosphere does not give birth directly to the thallus, but to two groups of cells more or less adherent, which finally become liberated like many spores. These latter germinate directly into a small rudimentary thallus. The so-called sporogone is formed by the concrescence of the products of the division of the ovum within the cortical tissue.

* Ann. Sci. Nat. (Bot.), iv. (1897) pp. 281–91 (1 pl.).
† Flora, lxxxv. (1898) pp. 65–8 (6 figs.).
‡ Journ. of Bot., xxxvi. (1898) pp. 195–7.
§ Flora, lxxxv. (1898) pp. 1–14 (2 pls.).
‖ Arch. Sci. Phys. et Nat., v. (1898) pp. 100–1.

Economical Product from Seaweeds.*—Herr A. Kreftling describes the production from the Fucaceæ of a non-nitrogenous substance which he calls "tangic acid" (*Tangsäure*). It appears to be related to the carbohydrates, although its empirical formula $C_{13}H_{20}O_{14}$ does not indicate this. It is not dissolved by any medium with which it does not form a chemical combination. The alkali-salts are strongly viscid, and form a substance well adapted for gumming paper and other materials. The broad-leaved *Laminariæ* are especially applicable for the manufacture of this substance.

Polymorphy of Cutleria multifida.†—Mr. A. H. Church confirms the current statement of the genetic connection of *Cutleria* and *Aglaozonia*, the former being a sexual, the latter a non-sexual condition. There is no doubt that the oospheres of *Cutleria* develope parthenogenetically, and this development takes place in the latter part of the summer. There seems to be no difference whatever between the mode of germination of the sexually and that of the parthenogenetically produced spores. Under certain conditions the zoospores of *Aglaozonia* give rise to what may be called a protonematoid stage of *Cutleria*. The polymorphy of *Cutleria multifida* has nothing in common with a true alternation of generations. In the opinion of the author the phenomena point to a gradual loss of sexual function rather than to an imperfectly differentiated or incipient sexuality.

Conjugatæ.‡—Messrs. W. and G. W. West maintain their classsification of the Conjugatæ into three families, the Zygnemaceæ, Temnogametaceæ, § and Desmidiaceæ, including the Mesocarpeæ as a sub-family in the Zygnemaceæ. Many of the Desmidiaceæ exhibit a tendency for the separate cells to unite into filaments. The authors state that in all the Conjugatæ, the individual is surrounded by a definite mucilaginous envelope, though the thickness and substance of this envelope vary greatly. Contrary to the assertion of Ewart, they state that these algæ can resist a very low temperature, although the formation of zygosperms is prevented. Direct sunlight greatly promotes their growth as long as they remain in normal conditions; a bright light being apparently necessary for the process of conjugation.

The Zygnemaceæ are made up of the Mesocarpeæ, Pyxisporeæ, and Zygnemeæ. The Mesocarpeæ are composed of two genera only, *Mougeotia* (including *Mesocarpus*, *Craterospermum*, *Plagiospermum*, and *Staurospermum*); the Pyxisporeæ of the single genus *Pyxispora*; the Zygnemeæ of *Zygnema*, *Pleurodiscus*, *Spirogyra*, *Sirogonium*, and *Debarya*. Cross-conjugation—i.e. conjugation in both directions—is almost unknown in the Zygnemeæ. The occurrence of lateral conjugation implies that the sexual differentiation is sometimes manifested, not in the entire filament, but in the different cells of the same filament. The formation of parthenospores without conjugation is not uncommon in the Zygnemeæ; these non-sexually produced spores are aplanospores. The authors think that the Mesocarpeæ have probably been developed along a different line of descent from the rest of the Conjugatæ.

* Chemische Industrie, 1897. See Bot. Centralbl., 1898, Beih., p. 519.
† Ann. of Bot., xii. (1898) pp. 74–109 (3 pls.).
‡ Tom. cit., pp. 29–58 (2 pls.). § Cf. this Journal, 1897, p. 317.

Karyokinetic Nuclear Division in Spirogyra.*—Herr L. Mitzkewitsch gives the following account of the division of the nucleus in *Spirogyra subæqua* and *jugalis*. The large nucleus has a quadrangular form; within it is a dense nucleole-like body which furnishes the material for the karyokinetic figures. While the nucleus becomes gradually round, this body forms filiform prolongations towards the periphery of the nucleus, where they combine with external achromatic filaments. At the same time chromatin bodies make their appearance in the previously homogeneous substance, surrounded by a light border. While the entire chromatin body becomes flattened into a disk which stands vertically to the filament, the sharp outline of the nucleus disappears, and it is no longer distinctly differentiated from the outer protoplasm. The chromatin bodies at the same time arrange themselves in a disk, from which proceed the achromatin-filaments. Each chromatin body now divides into two, and two parallel disks are formed, which gradually separate from one another. These daughter-plates acquire a more or less spherical form; the coloured mass becomes again homogeneous; and two daughter-nuclei resembling the parent nucleus take its place.

Chemical Physiology of Spirogyra.†—A series of chemical analyses of the ash of *Spirogyra nitida*, grown under various conditions, have yielded to Dr. Mary E. Pennington the following results:—Chlorine and sodium are present in about the same proportion as in marine algæ. Conjugating cells show a chemical composition which differs in almost every essential from that of the vegetative cell; the behaviour of the tannin, and its marked increase in quantity, is striking. Under coloured screens the chemical composition of the algæ differs according to the rays of light received; starch was not formed under exclusive blue or yellow rays; under red rays the growth was even more rapid than in white light.

Dissociation of the Cells of Spirogyra.‡—M. Devaux calls attention to the fact that when the cells of a *Spirogyra* separate from one another, as they do with great ease, the ends remain rounded; but that there is, in addition, a membrane in the form of a collar, forming a belt at the base of each terminal hemisphere. This shows that the cells are isolated by the gelification of the middle lamella, followed by a dissolution and rounding off of each half-membrane, accompanied by a disintegration of the outer lamella, which then forms the collar. The process of dissociation is due to a deficiency of oxygen in the water, and has nothing in common with the formation of thick-walled cysts.

Arboreal Algæ.§—In addition to those already described, Herr W. Schmidle finds the following species of algæ growing on trees in Ecuador:—*Cephaleuros Lagerheimii* sp. n., *C. Karsteni*, *C. pulvinatus*, and *C. candelabrum*, the last forming a connecting link between the genera *Cephaleuros* and *Phycopeltis*.

* Warsaw, 1897 (1 pl.) (Russian). See Bot. Centralbl., 1898, Beih., p. 401.
† Contrib. Bot. Lab. Univ. Pennsylvania, i. (1897) pp. 203–59.
‡ P.V. Séances Soc. Sci. Phys. et Nat. Bordeaux, 1897, pp. 34–6.
§ Hedwigia, xxxvii. (1898) pp. 61–75. Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 456–9 (6 pls.). Cf. this Journal, 1897, p. 562.

Plankton-Algæ of the Freshwater Lakes of Norway.*—Under the name *Elakatothrix gelatinosa* g. et sp. n., Prof. N. Wille describes a new plankton-form from the lakes of Western Norway. The cells before division are fusiform, arranged originally in a row, and are surrounded by a gelatinous sheath. The cells divide only by transverse septa, and contain a small nucleus. The chromatophore, which occupies almost the entire cell with the exception of the ends, is parietal, and contains a large pyrenoid; no swarm-cells were observed. Related to *Actinastrum*. Also a new species, *Crucigenia irregularis*.

Fungi.

Impregnation and Development of the Oosphere in Peronosporeæ.†—Prof. A. N. Berlese has turned his attention chiefly to *Cystopus Portulacæ*, *Peronospora Ficariæ*, *P. effusa*, *P. Alsinearum*, and *P. parasitica*. He was able to follow the act of impregnation, and the complete course of development of the oogone and oosperm, the following being the most noteworthy observations made on these and on other species.

The Peronosporeæ possess distinct sexual organs, the antherid and oogone; and the act of impregnation does not consist in the osmotic mingling of their contents, but in the fusion of a male and female nucleus. The embryonal nucleus divides frequently until the oosperm is mature. In each daughter-nucleus the number of chromosomes is double that of the separate sexual nuclei. A reduction first takes place on the entrance of the oosperm into the germinating period, and the number of chromosomes is then reduced by one-half in the nuclei, and each of the daughter-nuclei becomes a zoospore. In several species the wall of the oogone remains permanently thin; and then the periplasm becomes differentiated into a "perinium" (in Strasburger's sense), with a more or less complicated structure. Even in those cases where they are well differentiated, the exospore and endospore cannot be regarded as analogous to those organs in other fungi; the exospore corresponding rather to the "perinium" of certain Pteridophyta, and the so-called "endospore" to a true exospore. In other cases the wall of the oogone becomes thickened at the expense of the periplasm, and often forms a stout yellow or yellow-brown membrane. When there is no perinium, this wall serves as a protection to the oosperm during ripening and germination.

Parasitic Fungi.—Herr von Derschau ‡ describes the life-history of *Exoascus deformans*, and the changes produced in the flowers and tissues of the peach.

Mr. B. M. Duggar § details the life-history, appearance, and remedies of the following diseases of the pear:—leaf-spot, due to *Septoria pyricola*; leaf-blight, to *Entomosporium maculatum*; and pear-scab, to *Fusicladium pirinum*; also the bacterial disease pear-blight, due to *Bacillus amylivorus*.

* Mittheil. Biol. Gesell. Christiania, Oct. 17, 1895. See Biol. Centralbl. xviii. (1898) pp. 302.
† Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxi. (1897) pp. 159–96 (4 pls.).
‡ Landwirth. Jahrb., 1897, p. 897. See Bot. Centralbl., lxxiv. (1898) p. 112.
§ Cornell Univ. Agric. Exp. Stat., Bot. Div., Bull. No. 145, 31 pp. and 15 figs.

Herr F. Bubák * establishes the genetic connection of *Puccinia Scirpi*, found on *Scirpus lacustris*, with the æcidioform, *Æcidium nymphæoidis*, parasitic on *Limnanthemum nymphæoides*.

Herr M. Woronin † suggests that *Monilia fructigena*, an epidemic parasite on the cherry-tree, is probably the conidial form of *Sclerotinia Cerasi*.

Sig. F. Cavara ‡ finds plantations of the silver-fir greatly injured by the attacks of *Cucurbitaria pityophila*. The mycele induces a strong hypertrophy of the cortical tissue, accompanied by a splitting and scaling off of the periderm. A fresh interior periderm is thus formed, with a fresh phellogen and cortical parenchyme, provided with large resin-passages and sclerenchyme cells.

M. P. Nypels § gives the results of the enquiries of a committee on vegetable pathology presented to the Botanical Society of Belgium. The following comprise the maladies attributed to the attacks of parasitic fungi:—Potato-mould and scurf; probably frequently due primarily to the attacks of bacteria. The rust of flax, caused by the attacks of *Melampsora Lini*. The burning (*brûlure*) of flax, probably caused by parasitic bacteria. A disease of flax caused by *Phoma herbarum*. Another disease of flax due to *Fusicladium Lini*. A malady of the celery produced by *Septoria Petroselini* var. Apii. A destructive disease of pinks, apparently attributable to the attacks of an undescribed fungus. The mildew of the vine caused by *Plasmopara viticola*. A malady of grapes due to *Sphærella Rathayi* sp. n. The cancer of *Populus canadensis*, attributed to the attacks of *Hyalopus Populi* sp. n. In many cases the disease is constantly accompanied and aggravated by saprophytic Fungi and Schizomycetes.

"Casse" of Wine.—According to M. Laborde,‖ the deterioration of red wine known as "la casse"—consisting of an iridescence of the surface, precipitation of the colouring matter, and a turbidity of the liquid—is due to the presence of an oxidising diastase or oxydase, the principal source of which is the mould produced by *Botrytis cinerea*. The part played by this oxydase appears to be to absorb the oxygen from the air and give it up to the colouring matter, which is thus rendered insoluble.

Dr. P. Carles ¶ discusses the remedies which may be employed to secure the vines from the attacks of this malady.

Roccelleæ.** — Mr. O. V. Darbishire describes an additional new genus of this family of lichens, with the following diagnosis:—*Roccellina* g. n. Thallus crustaceus v. subfruticulosus, strato corticali distincto, ex hyphis formato plus minusve transversalibus conglutinatis, strato gonidiali et medullari stuppeo; apothecia terminalia v. subterminalia, orbicularia, hypothecio et parathecio fusconigro, amphithecio

* Oesterr. Bot. Zeitschr., xlviii. (1898) pp. 14–7 (1 pl.).

† Zeitschr. f. Pflanzenkrankheiten, vii. (1897) p. 196. See Bot. Centralbl., 1898, Beih., p. 479.

‡ Tom. cit. (1 pl.). See Bot. Centralbl., 1898, Beih, p. 479.

§ CR. Soc. R. Bot. Belgique, xxxvi. (1898) pp. 183–276 (18 figs.).

‖ P.V. Séances Soc. Sci. Phys. et Nat. Bordeaux, 1897, pp. 11–4, 132–5.

¶ Tom. cit., pp. 14–5, 135–6.

** Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 6–16 (1 pl.). Cf. this Journal, 1897, p. 231.

thallino gonidiis instructo, infra hypothecium gonidiis nullis, sporis decoloribus quadrilocularibus; soredia nulla. For one of the new genera previously described, *Dictyographa*, the name *Darbishirella* is substituted. The author proposes the term *parathecium*, instead of perithecium, for the "pars marginalis excipuli," the elevated portion of the hypothecium on each side of the "thecium" or hymenium.

Saccharomyces guttulatus.*—Dr. A. Wilhelmi gives the following description of *Saccharomyces guttulatus* Busc. The cells are elliptical to oval, with rounded ends, 6–16 μ long and 2–4 μ broad. Viewed by transmitted light their colour is pale grey. The nucleus is round, and about 1 μ in diameter. The addition of iodine demonstrates the presence of glycogen in considerable quantity. Under adverse nutritive conditions, two to four highly refracting vacuoles appear. Sprouting begins with division of the protoplasm, and this is soon followed by immigration of the daughter-nucleus. When the nutritive conditions are favourable there is early separation of the buds; when unfavourable, shrub-like colonies are formed. In spore-formation the nucleus divides into 2–4 daughter-nuclei, around each of which protoplasm is deposited, and the young spore becomes invested with a definite membrane. If the material be dried the mother-cells burst. When the spores germinate, they swell, the spore-membrane ruptures, and the germ grows out. Germination and growth are possible only in the presence of 1·25–5 per cent. hydrochloric acid and 10 per cent. grape sugar, and at a temperature of 37° C. *S. guttulatus* occurs normally only in the stomach and intestine of rabbits, but is occasionally met with in guinea-pigs.

Micro-organisms of the Fermentation-Industry.†—M. A. Jörgensen has quite recently published the fourth edition of his well-known work on fermentation organisms. The present volume has been enlarged and thoroughly revised. While the general features of the previous editions are adhered to in the present volume, there are numerous additions in respect of *Saccharomyces* species, and of advances in the application of Hansen's method of pure cultivations, and of the fermentation of wine.

Heliotropism in the Agaricineæ.‡—Herr E. C. Hansen records several examples of negative heliotropism in the stipe of the receptacle in this class of Fungi. It is by no means the case, as has been stated, that the expulsion of the spores takes place only by night. The Coprineæ may be divided into three categories,—those in which the spores are expelled only by night (much the most common); those in which it takes place chiefly by night (*Coprinus Rostrupianus* and *stercorarius*); and those in which it takes place, as a rule, by day (*C. niveus*, *Agaricus semiglobatus*). The negative heliotropism is established by the fact (in *C. stercorarius*) that the spores are expelled on the side furthest from the source of light.

Evolution of the Basidiomycetes.§—Mr. G. Massee regards the Basidiomycetes, and among them the Agaricinæ, as the most modern

* Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 305–9, 353–61, 412–7 (8 figs.).
† Berlin, 1898, 349 pp. See Bot. Ztg., lvi. (1898) 2te Abth., p. 122.
‡ Biol. Gesell. Kjöbenhavn, 1897, p. 1109. See Bot. Centralbl., lxxiv. (1898) p. 114.
§ Journ. Quekett Micr. Club, vii. (1898) pp. 1–9.

group of Fungi, and the most perfectly adapted to existing requirements, as proved by their universal distribution and immense numbers, about 11,000 existing species of the Basidiomycetes having been described. The evolution of the various groups of the Hymenomycetes is thus sketched out:—(1) The Clavarieæ, the lowest type, and showing the least amount of differentiation (about 300 species); (2) The Thelephoreæ, exhibiting the gradual evolution of a method for the protection of the hymenium from rain and dust (about 1000 species); (3) The Hydneæ, in which we see the introduction of a new plan for increasing the area of the hymenium, by covering the spore-bearing portion with densely packed slender teeth (about 1000 species); (4) The Polyporeæ, in which the same idea is carried out in another way, by the hymenium lining the cavities of innumerable slender tubes (about 2500 species); (5) The Agaricineæ, the most modern and highest type (nearly 6000 species).

Tulasnellaceæ, a new Family of Fungi.*—Herr N. C. Juel proposes a new family of Fungi, TULASNELLACEÆ, intermediate between the Tremellaceæ and the Dacryomycetaceæ, with the following diagnosis:—Gymnocarpous Basidiomycetes with spherical unicellular basids without sterigmas; spores not deciduous, germinating on the basids and producing conids. It is made up of the two genera *Tulasnella* (syns. *Prototremella* and *Pachysterigma*), and *Muciporus* g. n., diagnosed as follows:—Receptacle expanded flat, with large crowded pits, consisting of a spongy moderately resistant hyphal tissue, and bearing a very fugitive hymenium; basids and spores as in *Tulasnella.* To this genus belong *M. corticola* (*Polyporus corticola* Fr.), and *M. deliquescens* sp. n., found as a thin slimy coating on the bark of an aspen.

Structure of Mycorhiza.†—M. L. Mangin distinguishes the mycorhizas formed on the roots of different species of Cupuliferæ into two kinds, living and dead. With regard to living mycorhiza, the author disputes the statement usually made that rootlets attacked by mycorhiza are destitute of a root-cap, or that this structure is, at all events, greatly reduced in size. He finds, on the contrary, that the cap attains its normal development, but that it never peels off; the entire surface of these rootlets is covered by the cells of the root-cap, which are partly disorganised. The apex of the rootlet becomes hemispherical instead of conical. When the mycorhiza has completed its term of activity, the substance of the hyphæ becomes connected into a mucilaginous mass composed of pectic and gummy substances, which gradually weaken the vitality of the rootlet, and give rise to the appearance of a great variety of saprophytes.

Protophyta.

a. Schizophyceæ.

Stapfia, a new Genus of Palmellaceæ.‡—Prof. R. Chodat founds a new genus of Palmellaceæ, very nearly allied to *Tetraspora*, with the

* Bih. K. Svensk. Vetensk.-Akad. Handl., xxiii. (1897) No. 12 (1 pl.). See Bot. Centralbl., lxxiv. (1898) p. 116. † Comptes Rendus, cxxvi. (1898) pp. 978–81.

‡ Bull. Herb. Boissier, v. (1897) (1 pl.). See La Nuova Notarisia, ix. (1898) p. 24.

following characters :—Thallus gelatinosus, subfirmus, haud tubulosus, nec saccatus nec membranaceus, sed cylindricus; cellulæ similes eis *Tetrasporæ*, stratum tenuissimum periphericum viride formantes; multiplicatio ut in *Tetraspora*.

Urospora and Hormiscia.*—Herr F. R. Kjellman proposes to sink the genus *Urospora* in *Hormiscia*, the character derived from the form of the zoogonids not being sufficiently constant to maintain the former as a distinct genus.

Movements of Eunotia major.†—Mr. T. C. Palmer describes the peculiar movements of frustules of this diatom, which differ from that known in the Pinnularieæ. The frustules in which they take place are either free or united together in strings of from 2 to 6; and the movement appears to be connected with an evolution of oxygen; it is obviously stimulated by light. The author connects the power of movement with the existence of peculiar pseudopode-like bodies, to which he gives the name "coleopods," and which appear to be present in other nearly related species and genera also of the Fragilarieæ.

Germination of Microchæte tenera.‡—Prof. G. Ritter Beck v. Mannagetta has been able to follow out the formation and the germination of the spores of *Microchæte tenera* Thur. The spores occur as interstitial cells of a filament enclosed in a distinct hyaline sheath, often in continuous rows. They are of an olive-brown colour, cylindrical or barrel-shaped, and vary greatly in size. The spore elongates and divides into two while still within the sheath, one of the daughter-cells becoming a heterocyst, the other, the vegetative cell, undergoing further divisions. At a later period the young plant, consisting of a basal heterocyst and about three vegetative cells, escapes from the sheath. Although the filaments present occasionally a *Tolypothrix*-like pseudo-ramification, the author considers that the organism belongs essentially to the simple (unbranched) Nostocaceæ.

Cyanothrix and Mastigocladus.§—Herr W. Schmidle has come to the conclusion that his genus *Cyanothrix* must be suppressed, and absorbed in *Mastigocladus*. Cultivation of *Cyanothvix vaginata* resulted in the production of two forms—a *Hypothrix* and an *Anabæna*-form, the latter also producing conids. The presence of a distinct sheath indicates that the alga belongs to the Sirosiphonaceæ; a scytonema-like branching was also observed, and a probable formation of hormogones. The author now regards *Cyanothrix vaginata* as identical with *Mastigocladus laminosus*.

β. Schizomycetes.

Remarkable Marine Organism.‖—Prof. A. Dendy describes, under the name *Pontobolbos*, a remarkable marine organism from the Gulf of Manaar, off the Madras coast. At first he felt certain that it was animal

* Bih. K. Svensk. Vetensk.-Akad. Handl., xxiii. (1897) 16 pp. and 1 pl. See Bot. Centralbl., lxxiv. (1898) p. 176.

† Proc. Acad. Nat. Sci. Philadelphia, 1898, pp. 110–9 (2 pls.).

‡ Oesterr. Bot. Zeitschr., xlviii. (1898) pp. 81–6 (1 pl.).

§ Bot. Centralbl., lxiv. (1898) pp. 97–102 (11 figs.).

‖ Journ. Linn. Soc. (Zool.), xxvi. (1898) pp. 443–52 (2 pls.).

in nature, but he has been gradually forced to regard it as bacterial. It forms hemispherical or cushion-shaped masses, of a brown colour, attached to rocks in shallow water, and has a superficial resemblance to a sponge. The author considers various possibilities,—that it may be a bacterial mass like that of *Crenothrix Kühniana*, or something like the calcareous pebbles formed by *Schizothrix fasciculata* as described by Murray, or a symbiosis between bacterial filaments and a gigantic Rhizopod. Apart from the Bacteria, there seems insufficient evidence to show that it is an organism at all.

Action of Röntgen Rays on Bacteria.*—Dr. R. N. Wolfenden and Dr. F. W. Forbes-Ross have shown that the action of the X-rays is stimulating to the growth of *Bacillus prodigiosus*.

The rayed cultures grew better than the control cultures, and peculiar changes were observed in the pigment-forming powers of this microbe. The chief microscopic changes were growth in chains or strepto-bacteria, and spore-formation.

Migula's Bacteriology and the Classification of Bacteria.†—In the first volume of Prof. W. Migula's work on the morphology, development, and classification of Bacteria, the system is given as follows:—

Family I. Coccaceæ.
"Species" 1. Streptococcus (one plane).
2. Micrococcus (two planes).
3. Sarcina (three planes).
4. Planococcus (two planes; flagella).
5. Planosarcina (three planes; flagella).

Family II. Bacteriaceæ.
"Species" 1. Bacterium; no flagella.
2. Bacillus; flagella.
3. Pseudomonas; polar flagella.

Family III. Spirillaceæ.
"Species" 1. Spirosoma; no flagella; rigid.
2. Microspira. 1–3 polar flagella; rigid.
3. Spirillum. 5–20 polar flagella; rigid.
4. Spirochæte; no flagella; flexible.

Family IV. Chlamydobacteriaceæ.
"Species" 1. Streptothrix.
2. Cladothrix.
3. Crenothrix.
4. Phragmidiothrix.
5. Thiothrix.

Family V. Beggiatoaceæ.
"Species" Beggiatoa.

The chief points that may be mentioned as indicative of the line taken by the writer are, that the flagella are continuous with the investing membrane; that arthrospores cannot be distinguished from ordinary vegetative cells; and that germination may occur in three ways: (1) The

* Lancet, 1898, i. p. 1752.
† Jena, 1897, 368 pp. and 6 pls. See Nature, lviii. (1898) pp. 97–9.

spore membrane may remain unruptured, remaining as the investment of the young bacterium, or being dissolved; (2) the spore membrane may rupture at the pole; (3) or equatorially. The existence of a true nucleus in the spore and in the bacterium is held to be improbable, though the granules in the bacterial cell may represent a rudimentary nucleus; but whether "rudimentary nucleus" is meant to be taken in the light of homologue or analogue is left doubtful. There are interesting chapters on pleomorphism and on the biological characters of Bacteria.

Micro-organisms of Lignite.*—M. B. Renault, who has examined specimens of lignite, has found therein abundant micrococci existing either in the decomposing wood or in the substance which binds the animal and vegetable organisms together. This primitive substance was at one time in a fluid condition, and it was probably produced by microbic action on the organisms.

Lignite appears to have been formed in shallow marshy waters adapted to the life and development of numerous Infusoria. The great mass of lignite is composed of vegetable *débris*, often in an advanced stage of decomposition; and it is upon this *débris* that the microscopic fungi developed, and in it that their fructification and mycele are found.

Microbiology as applied to Hygiene.†—At the Congress of Hygiene and Demography held at Madrid, Dr. Behring announced that, as the result of experimental work with the toxin and antitoxin of tuberculosis, he had isolated from the tubercle bacillus a substance a hundred times more powerful than Koch's tuberculin, and had obtained, by passing the virus through the horse, an antitoxin which he believed to be an efficient cure for the disease.

Dr. A. Calmette demonstrated the prophylactic effect on snake-bitten patients of the serum of the blood of horses subjected to small doses of the venom. A rabbit injected with the mixed venom of cobra naja and bothrops died in 20 minutes. Two rabbits were injected with the protective serum, and in 10 minutes each received a dose of the mixture equal in amount to that which killed the first rabbit. No ill effects resulted. The serum is easily prepared, and retains its prophylactic properties for an indefinite period.

M. Nocard described the method of cultivating the microbe of pleuropneumonia of cattle.‡

Dr. E. Vallin drew attention to the existence of saltpetre on the walls of dwelling houses, and its ill effects on the health of the dwellers therein. As the salt is produced by nitrifying organisms, germicides should be mixed with the mortar; and to eliminate the nitrifying organisms from the walls, these should be inoculated with antinitrifying bacilli.

Chatinella, a new Genus of Schizomycetes.§—In the parenchyme of potatoes killed by *Phytophthora*, and in the leaves of tulips killed by *Pseudocommis*, M. E. Roze finds an organism which he regards as the type of a new genus of Schizomycetes, and which he names *Chatinella*

* Comptes Rendus, cxxvi. (1898) pp. 1828–31. Cf. this Journal, 1897, p. 326.
† Nature, lviii. (1898) pp. 15–16. ‡ Cf. this Journal, *infra*, p. 463.
§ Comptes Rendus, cxxvi. (1898) pp. 858–9.

scissipara g. et sp. n. It occurs in the form of naked spherules of protoplasm, varying between 12 and 27 μ in diameter, propagating only, as far as has been observed, by division. This takes place after the spherule has invested itself with an enveloping membrane, the internal protoplasm sometimes clothing itself with a membrane after division while still within the original envelope.

Bacterial Diseases of Plants.—Mr. Erwin F. Smith * gives further details of the brown rot of cabbage caused by the attacks of a Schizomycete. The greater part of the infection takes place through water-pores. The disease is frequently disseminated by insects. The wild mustard (of America), *Brassica sinapistrum*, is one of its common host-plants.

A disease of the sugar-beet has recently appeared in the United States closely resembling that described (in Europe) by Kramer and Sorauer, caused by *Bacillus Betæ*.

Mr. H. L. Russell † gives a full account of the life-history of *Bacillus campestris*, and of the nature of the ravages produced by it in the cabbage-plant; also of the best modes of combating it.

Spread of Infectious Diseases by Biting Insects.‡—Dr. G. H. F. Nuttall, who had made experiments bearing on the question of the dissemination of plague by flies, records the result of researches on the part played by biting insects in the spread of infectious diseases. For this purpose mice, dead or dying of anthrax, fowl cholera, or mouse septicæmia, were allowed to be bitten by hungry bugs and fleas. With the juices from these the animals were infected. All the experiments were negative, that is to say, none of the animals sickened. Culture and inoculation experiments, and microscopical examination of the contents of the insects, showed that the infective agent is rapidly destroyed within the body of the insect, and that this germicidal action is more potent at high temperatures.

The suggestion is thrown out that if biting insects disseminate infectious disorders, this is effected by the host infecting himself by scratching or rubbing in the virus after squashing the insect.

Effect of High Pressures on Micro-organisms.§—Sig. G. Malfitano made a large number of experiments with pure cultures of bacteria, fungi, &c., for the purpose of ascertaining the effect of exposure to high pressure for various lengths of time. The micro-organisms were exposed to pressures ranging between 25 and 60 atmospheres for 20 to 64 hours.

Among those destroyed were *B. coli com.*, *B. anthracis*, *B. prodigiosus*, typhoid and cholera bacilli, and some of the pyogenic cocci; while *B. subtilis*, *B. mesentericus*, *Tyrothrix*, and *B. œdematis* invariably survived. The length of exposure appeared to have more influence than the degree of pressure. On *B. subtilis* the interrupted action of compressed carbonic acid gas for 20 hours, four times repeated at intervals of 24 hours, had no effect. The vitality of the spores of *B. subtilis* was unaffected by liquefied carbonic acid gas.

* Bot. Gazette, xxv. (1898) pp. 107–9. Cf. this Journal, 1897, p. 574.

† Univ. Wisconsin Agric. Exp. Stat., Bull. No. 85, 39 pp and 15 figs.

‡ Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) pp. 625–35. Cf. this Journal, 1897, p. 577.

§ Boll. Soc. Med.-Chir. di Pavia. See Nature, lvii. (1898) p. 614.

Microbe of Peripneumonia of Cattle.*—MM. Nocard and Roux state that the virus of the contagious peripneumonia of the Bovidæ may be easily cultivated in collodion or reed sacs inserted in the peritoneal cavity of rabbits. It may also be cultivated in Martin's bouillon pepton, to which ox or rabbit serum has been added in the proportion of 1 part of serum to 20 parts of bouillon. All other kinds of artificial media failed.

The virus is a microbe of exceeding smallness, smaller indeed than any known microbe. Its shape could not be properly made out even by staining.

After having remained in the peritoneal cavity for 15–20 days, the fluid in the collodion sacs was found to be slightly turbid, and devoid of cells and bacteria. Examined under a magnification of about 2000 diameters, vast numbers of minute mobile highly refracting points were observable.

Inoculation with the fluid from these infected sacs gave positive results.

Bacteriology of Pertussis.†—Dr. H. Koplik, who has already made a communication on hooping cough,‡ gives some further details as to *Bacillus Pertussis*. From the sputum are fished out some of the greyish-white particles; from these cultivations are made directly and without further manipulation, on obliquely set hydrocele fluid. Pure cultures are greyish-white or pearly. The bacillus was cultivated also on agar, blood-serum, and on pepton-bouillon. Its growth is anaerobic as well as aerobic. Stained with Loeffler's blue, the organism has a finely punctate appearance; it is $0 \cdot 8$–$1 \cdot 7\ \mu$ long and $0 \cdot 3$–$0 \cdot 4\ \mu$ broad. It is not decolorised by Gram's method.

On old cultures involution forms are frequent. In the hanging drop movements are visible, but these are probably Brownian in character.

The bacilli are most abundant in the convulsive stage; and if the case be uncomplicated with bronchitis or pneumonia, pure cultures are easily obtained.

Bacteriology of Sour Corn.§—In the United States the canning of maize is an important industry, and any neglect or defect in the treatment of the grain may result in considerable loss, owing to the contents of the tins turning sour. The souring is hastened by a high temperature, and retarded by a low one; thus samples of one and the same packing if sent to a cold climate might keep, and if sent to a sunny land might soon turn sour. Messrs. S. C. Prescott and W. L. Underwood, in an interesting paper dealing with the historical, commercial, and bacteriological aspects of the subject, state that the souring of tinned maize is directly due to the action of microbes, and they describe twelve species of bacteria which they have isolated from cases of sour corn. Four of these were also discovered in the ears of green corn—a fact which makes it probable that the souring depends principally on defective sterilisation. Plates illustrating the appearance of cultures of two of the

* Ann. Inst. Pasteur, xii. (1898) pp. 240–62.
† Johns Hopkins Hosp. Bull., ix. (1898) pp. 79–83 (2 figs.).
‡ Cf. this Journal, 1897, p. 576.
§ Technology Quarterly, xi. (1898) pp. 6–30 (6 pls.).

organisms, *Bacillus U* and *B. W* are given. The morphological and cultural characters of all the 12 species are described in separate tables.

Excretion of Typhoid Bacilli in the Urine.*—Dr. J. Petruschky states that in many cases of enteric fever, typhoid bacilli may be found in considerable numbers in the urine. The germs are alive, and may amount to millions per cubic centimetre of urine. This excretion of living typhoid organisms may last for a week, or even be protracted into the convalescent stage. These observations, though extremely interesting, are merely confirmatory, as it was previously known that typhoid bacilli were occasionally to be found in the urine. They are, however, extremely important as far as regards the epidemiology and prophylaxis of enteric fever.

Micro-organisms of Turned Wines.†—MM. F. Bordas, Joulin, and Raczkowski isolated from wines made in Algeria and the south of France, two filiform bacilli, one of which is described under the name *B. roseus vini.* All the wines in which these organisms occurred have the microscopical appearance and chemical reactions of turned wines (" vins dits tournés "). *B. roseus vini* was isolated by successive passages in glucose-yeast-water, and then on plates composed of glucose-yeast-water and 10 per cent. gelatin. On the plates it forms large thick white colonies. In yeast-water, with 10 per cent. glucose, it forms a thick wrinkled scum, which in a few days becomes rose-coloured, the liquid turning brown, and becoming ammoniacal. The scum is composed of filaments having a diameter of $0 \cdot 6$–$0 \cdot 8\ \mu$. The filaments are mobile, are formed of segments, are easily stained, and are ciliated. The ciliated bacilli are ovoid. As the scum grows old it deposits a sediment, consisting chiefly of spores. The bacillus turns nitrates into nitrites, does not form indol in pepton-bouillon, and coagulates milk, imparting to it an acid reaction. The effect of cultivating in yeast-water, to which glycerin, glucose, or tartar was added, was studied. The bacillus has no action on alcohol, and does not ferment saccharose. Inoculated in wine, a copious sediment is deposited; the glucose and glycerin are diminished, while the tartar and the acidity are unaffected.

By itself this bacillus does not appear to be able to turn wine; but when associated, as it usually is, with another microbe, *Bacillus B*, which destroys the tartar and also acts on the glucose and glycerin, wine becomes turned.

Bacillus of Bitter Wine.‡—MM. F. Bordas, Roulin, and Raczkowski state that the bacillus of bitter wine possesses a terminal spore and cilia at one extremity. It is extremely mobile, and is cultivable in media containing nitrate of potash, but does not convert this salt into nitrite. It does not form indol in peptonised media, and it coagulates milk. It resists desiccation up to 100°. Its optimum temperature lies between 25° and 37°. Inoculated in sterilised wine, the bacillus was found to exert considerable influence on the contained glycerin, giving rise to the production of acetic and butyric acids. A comparison of the tables of wine rendered bitter and of the control wine, shows that the former

* Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) pp. 577–83.

† Comptes Rendus, cxxvi. (1898) pp. 1050–3. ‡ Tom. cit., pp. 1291–3.

loses in sugar, tartar, and glycerin, and gains in fixed and volatile acids.

Pathogenesis and Histogenesis of Cancer.*—Mr. F. J. Bosc states that he has succeeded in cultivating cancer parasites in blood rendered incoagulable by leech extract. The organisms are cellular and of very variable form; from these develop fragile spore forms, and eventually organisms of minute size. They belong to the class Sporozoa, as is shown by their staining and structure, the evolution in the cells, their evolutionary cycle, and their dimorphism. That the Sporozoa developed in cancers are to be regarded as the pathogenic agents is indicated by their constant presence, their numbers, and their dissemination in the zone of increase. Additional corroboration is afforded by the results of inoculating tumours containing parasites; and the only objection that can be raised is that cancer has not yet been reproduced by means of pure cultures. This difficulty is considered to be got over by means of inoculations made with aseptically obtained Sporozoa. When the rabbit is inoculated with *C. oviforme*, tumours, identical with spontaneous tumours, are formed. When *Klossia* is inserted into the peritoneal sac of dogs, rabbits, and guinea-pigs, little disseminated tumours develop; and spores of gregarina inserted into the lymphatic sac of frogs cause the formation of a tumour. In tumours of sarcomatous structure the transition from spore to sporozoit, and the different forms of cell-inclusions, may be followed.

The histogenesis of tumours receives much light if their parasitic nature be conceded; for when epithelium is invaded, the cells proliferate and hypertrophy, or may be destroyed by the development of the parasite; and when the parasite invades the connective tissue, a neoplasm, originally of epithelial origin, assumes a connective tissue type. Hence, the only specific element of malignant tumours is the parasite, and the process is really a chronic inflammation due to the action of a parasite, which at first provokes a hypernutrition of the cell, and afterwards destroys it by living at its expense and compressing its nucleus more and more.

New Form of Tuberculosis.†—M. Céourmont describes an atypical form of human tuberculosis due to the presence of a streptobacillus. The organism grew freely in peptonised bouillon, the medium becoming cloudy in 24 hours at 30°, and without the formation of any pellicle or odour. On gelatin the growth was thin, white, and creamy. The organism is easily stained, but is decolorised by Gram's method. It is a streptobacillus, the ends of which are slightly rounded. It is devoid of motion. Inoculation of the pure culture produced miliary tubercles, caseating abscess, and lesions similar to those produced by inoculation of the original fluid; and the organism could subsequently be demonstrated in the various lesions.

Mobility of the Tubercle Bacillus.‡—Herr W. Schumowski states that he has often observed mobile specimens of tubercle bacilli. By examining young bouillon cultures in the hanging drop, numerous rodlets may be seen moving. The motion consists in a vibration of the

* Comptes Rendus, cxxvi. (1898) pp. 1293–5.
† Arch. Méd. Expér., Jan. 1898. See Epit. Brit. Med. Journ., 1898, No. 389.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) pp. 838–9.

body by which its position becomes changed, and by constant vibration it moves from place to place. If the drop be protected from drying, the movements will last for 48 hours. The mobility is more energetic when a particle from a glycerin-agar culture is placed in a drop of bouillon. Although the movement is probably due to the presence of flagella, these were never observed either in stained or in unstained preparations.

Therapeutic Value of the New Tuberculin.*—Prof. P. Baumgarten and Herr K. Walz have made experiments with the new tuberculin of Koch, for the purpose of ascertaining what therapeutic or curative value it may possess in the treatment of tuberculosis.

Tuberculous guinea-pigs and rabbits were injected with small, medium, and large doses of the tuberculin (T.R.). The results were practically the same as those from the old tuberculin, and may be summed up as follows. Small doses are of no use, and the larger the dose the greater the disadvantage. Indeed it would appear that the tuberculosis of animals treated with tuberculin T.R. runs a more malignant and rapid course than that of untreated animals.

Immunity of Fowls to Tuberculosis.†—MM. Lannelongue and Achard have found from experiments on fowls that these birds are refractory to human tuberculosis. Cultures, pus, or pieces taken directly from human organs, or which have been passed through guinea-pigs and rabbits, only excite local lesions, without the virus becoming generalised. Neither have dead bacilli any effect. The bacilli, however, not only remain alive, but retain their virulence for quite a long time, on the average for 70–80 days, sometimes for as long as 130 days. The serum of birds has no immunising effect.

New Thermophilous Bacillus.‡—Herr H. O. Laxa makes a preliminary communication on a bacillus which was isolated from the scum formed in the course of sugar-making. The organism was cultivated in glycerin-agar and bouillon. It presented itself in the form of interlacing filaments, which afterwards resolved into bacilloid elements, much resembling in size *B. proteus Zenkeri*. Elliptical spores were formed. The organism only began to grow at 25°, thriving more and more with increase of temperature up to near 58°, above which it ceased to vegetate. The bacillus is extremely resistant to moist and dry heat, standing dry heat up to 150°, and moist heat up to 100° for 15 minutes. It was found to be indifferent to the reaction of the medium, and it grew equally well with or without the presence of oxygen. In substrata containing sugar the growth of the bacillus was very energetic, and gas was always formed when saccharose was present. With carbohydrates the growth-reaction was acid; with pepton and asparagin solutions it was alkaline, owing to the formation of ammonia. Nitrates were reduced to nitrites. The scum formation produced after inoculation with pure cultures supports the view that this thermophilous bacillus is the exciting cause of the scum.

* Centralbl. Bakt. u. Par., 1te Abth., xxiii. (1898) pp. 587–93.
† Semaine Méd., 1897, p. 175. See Bot. Centralbl., lxxiii. (1898) p. 412.
‡ Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 362–7.

Bacterium of Foot-and-Mouth Disease.*—According to Herren A. Stutzer and R. Hartleb, the exciting cause of foot-and-mouth disease is a very polymorphic bacterium belonging to the *coli* group. The variations in shape are principally due to alterations in the nutritive and environmental conditions. In bouillon only rodlets appear; but if milk be added, long filaments arise, and in citrate of ammonia solution the organism assumes the spirillum form. Under other circumstances the appearances are those of cocci and streptococci, and even yeast-like forms appear. The reaction of the medium seems a matter of indifference, as the organism thrives when it is alkaline, neutral, or acid. Pure cultures produced fever, with palsy of the hind-limbs, in cattle, and the formation of vesicles in the mucosa of the nose and tongue. The cultivated organism soon loses its virulence. The original derivation was the milk from the diseased udders.

New Bacillus pathogenic to Rats.†—Herr B. Issatschenko isolated a bacillus from the spleen and liver of rats dead from an epizootic malady which broke out in the laboratory at St. Petersburg in 1897.

The bacillus is mobile, and has lateral flagella. Its size varies much, and is dependent on the medium and the age of the culture. It grows well on all the usual substrata. The growth varies in colour from white to yellow. The microbe is very pathogenic to rats and mice; infection of the mouth producing death in 8–14 days in the former, and in 4–8 days in the latter. It has no effect on pigeons or rabbits.

The results of experiments indicate the practical importance of the discovery.

Myxomatogenous Virus.‡—Under this title Prof. G. Sanarelli describes a malady which began in 1896 at Monte Video among the laboratory rabbits. The first symptom was conjunctivitis, followed in 24–48 hours by swelling of the eyelids and the appearance of subcutaneous tumours all over the body. The parts about the face and perinæum became thickened, and there was a hyperplasia of the connective tisues generally where skin and mucosa are adjacent. Inspection of the bodies after death showed subcutaneous tumours of gelatinous appearance, elastic consistence, and highly vascular; hypertrophy of the lymphatic glands, orchitis, and swelling of the spleen. Microscopical examination of the parts affected showed highly vascular myxomatous tissue. All attempts at isolating a particular virus failed, but the disease was easily transferred by means of blood, a fragment of a tumour, a drop of the secretion from the lids, or by a minute piece of a viscus. The infection could be transmitted subcutaneously, by intravenous injection, by the stomach, or through the anterior chamber of the eye. By allowing the blood to spontaneously coagulate, or by centrifuging it, an optically pure and perfectly sterile serum was obtained. Notwithstanding that this serum was bacteriologically pure, it still contained the virus, and on this ground the author throws out the suggestion that there may be agents of disease so small that they are undemonstrable by the Microscope. The virus may be fortified by passage through several rabbits, may be weakened by age or antiseptics, and is destroyed by heating to 55° for a few minutes.

* Arch. f. Hygiene, xxx. p. 372. See Beihefte Bot. Centralbl., vii. (1898) pp. 494–6.
† Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) pp. 873–4.
‡ Tom. cit., pp. 865–73.

Mice, guinea-pigs, monkeys, and birds were refractory to the virus; one positive result was obtained with dogs. The appearances, however, were those partly of inflammation and partly of epithelioma. Two trials of the rabbit serum were made on the human subject. The injection was followed by pain and swelling of the eyes. Attempts to produce a vaccine serum failed.

Ætiology of Beri-Beri.*—Dr. W. K. Hunter observed in fresh blood of two cases of beri-beri micro-organisms flitting about in the plasma. In cultures made from the blood a white staphylococcus developed. Injection into rabbits induced degeneration of the nerves. The same coccus was isolated from rice, and produced parenchymatous degeneration of the nerves in rabbits. The author considers that rice is the source of infection.

Lafar's Technical Mycology.†—The translation into English of vol. i. of Prof. F. Lafar's excellent work on Technical Mycology is a real boon to all who are interested in vegetable microbes. The subtitle, 'The Utilisation of Micro-organisms in the Arts and Manufactures,' indicates the line taken by the author, who has specially directed his attention to the requirements of the brewer, distiller, and agricultural chemist; in short, to all who are interested in fermentation from the industrial side. Though principally intended for practical purposes, the theoretical and historical aspects of fermentation are copiously represented, and from the first page to the last the volume is garnished with facts drawn from their original sources, an initiative which is as useful as it is praiseworthy. The author's style, well rendered into English by Mr. C. T. C. Salter, is clear and bright, and a perusal of this work will be found far more interesting than that of most of the present day fiction.

After an appreciative preface by E. C. Hansen, follows the introduction, wherein are dealt with the theories of spontaneous generation, and of fermentation and the organisms of fermentation.

The rest of the volume treats of schizomycetic fermentation, discussed in nine sections and thirty-eight chapters. Just to indicate the scope and general tenor of the work, we will mention some of these, as the section on lactic fermentation and allied decompositions. This section includes chapters on the general characteristics of the lactic acid bacteria; the production of optically active organic compounds by fermentation; the artificial souring of cream; the curdling of milk; lactic acid bacteria in distilling, brewing, and vinification, and in the preparation of fodder; the part played by bacteria in tanning.

Other sections deal with the formation of mucus and allied phenomena of decomposition, the transformations and decompositions of organic nitrogenous compounds, and with oxidising fermentations. In this last section are discussed the iron bacteria, the sulphur bacteria, the nitrifying bacteria, the acetic fermentation, and the oxydases.

Space does not permit to allude to more than the few casual details already given, but these will be enough to indicate the general scope of the work which, from its enormous stores of facts, logically placed and clearly recited, will be sure of the success it deserves. It is to be hoped that the second volume will not be long in coming.

* Lancet, 1898, i. p. 1748.

† London, Charles Griffin & Co., 1898, xviii. and 405 pp., 1 pl. and 90 figs.

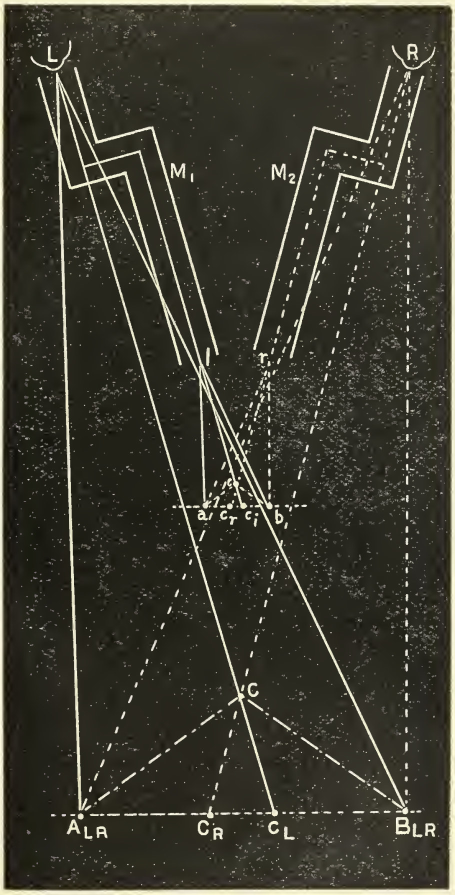
MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Greenough's Stereoscopic Microscope and its Auxiliary Appliances.†—Herren S. Czapski and W. Gebhardt, of Jena, commence their

Fig. 75.



article by setting forth the advantages of a binocular Microscope, and by discussing the conditions which should be aimed at in the construc-

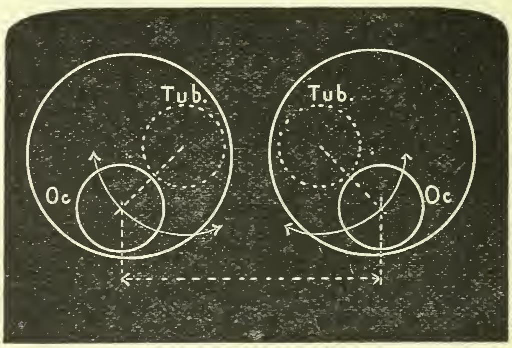
* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Zeitschr. f. wiss. Mikr., xiv. pp. 289-312 (7 figs.).

tion of such an instrument. A sketch of the history of Greenough's endeavour to solve the problem is also given. In analysing the conditions of orthomorphic vision, Greenough's equation is arrived at, viz. $V = \frac{D}{d}$, where V = the linear magnification of the single Microscope; D = distance of the observer's eyes; d = distance of the light entrances of both Microscopes. Another condition can be thus expressed:—"The image must in all its parts in each Microscope-tube appear from the point of sight under the same angular distance as the object from the focus of the primary rays;" or still more simply, "Entrance-pupils and exit-pupils of the Microscope must be on the same points of junction" (*Knotenpunkte*).

In order to investigate this last condition, one must realise that corporeal images are never seen as such, but construct themselves by an unknown psychic process out of two different plane retinal images. Let us take three points a, b, c (fig. 75) not lying in a straight line as the

Fig. 76.

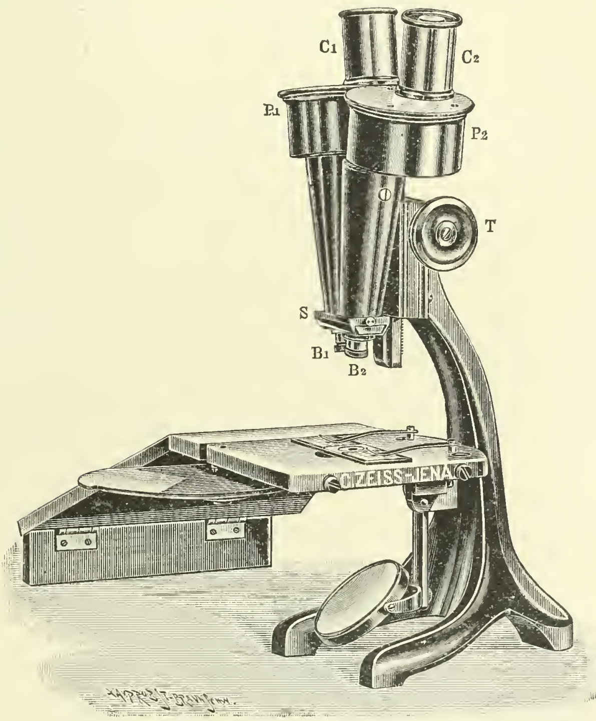


object, and imagine two Microscopes M_1, M_2 inclined to one another at an angle of about 14°, and so directed towards the group of points that the picture of all three falls in the field of view of both Microscopes. Let l, r, be the "entrance-pupils" of both Microscopes in Abbe's sense, i.e. the focus of the image-forming pencil of rays, and consequently the perspective projection centre for representation. Let c_l, c_r be the projections of the point c on the line $a\,b$ produced backwards from l and r. Then the working of the Microscope confines itself to projecting in all its parts an equally magnified reproduction of $a\,b\,c_l$ and $a\,b\,c_r$.

The determination of the visual angles under which the images of $a\,c_l\,b$ and $a\,c_r\,b$, i.e. $A_L\,C_L\,B_L$ and $A_R\,C_R\,B_R$, must be presented to both eyes in the case of normal accommodation, requires that the optical axes should virtually intersect in a point C, whose distances in space from A and B stand to one another in the same ratio as those of c from a and b. This is satisfied only when the angles, under which the image-points A_L, B_L, C_L, A_R, B_R, C_R appear simultaneously to the eye, are equal to those under which the corresponding object-points a, b, c from l and r respectively appear. Increase of this angle would be in stereoscopic view too great an approach of C to A, B, i.e. a relative flattening of the corporeal image, diminished plastique; reduction of the angle, on the contrary, would effect too great a separation of C from A, B, i.e. exaggerated plastique.

The points of an optical system from which the views of objects indifferently proceed are well known by Listing's name of "junction-points" (*Knotenpunkte*), and they stand to one another in the relation of image and object. Therefore the simplest expression of Greenough's condition for orthomorphy is as given above, viz. "Entrance-pupils, &c."

FIG. 77.



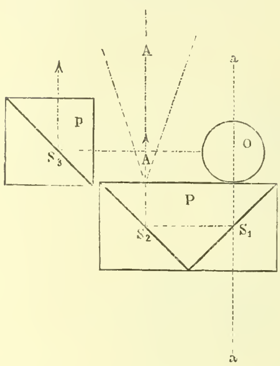
From this the formula $V = \frac{D}{d}$ can be easily deduced; for $\frac{D}{d} = \frac{RB}{rb}$ (by similar triangles).

A system of Porro prisms is used; and, in order to avoid the derangement incidental to the lengthening of the tube for adaptation to different eyesights, a rotation of the tube is employed, which causes an eccentric rotation of the oculars, and allows wide limits of adaptability. (See fig. 76.)

As stops are usually placed near the object, and for many purposes would be a hindrance, they are here adapted for unscrewing. But for the attainment of orthomorphy they are quite inadmissible, as a comparison of sight with and without these stops teaches. Instead of the "entrance-pupils," here the lower "junction-points," it is more convenient to apply stops to the "exit-pupils" or upper "junction-points."

The objective lenses are brought together on a small slide working sideways with a push motion until the fine-adjustment screw is needed. This slide can eventually be fitted with stronger or weaker objectives. One of the objectives permits of an in-and-out screwing movement, to produce sharp definition to the corresponding eye. Complete presentation to both eyes is an essential condition of perfect stereoscopic vision. Oculars of different strengths can be fitted.

Fig. 78.

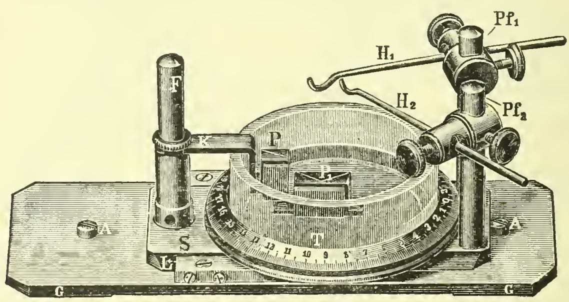


The auxiliary apparatus includes,—(A) a prism rotator, and (B) a capillary tube-stage rotator.

A. The design and working of this little apparatus are easily understood from fig. 78. The object O is placed on the hypothenuse plane of a reflection prism P, so that it is exactly perpendicular over the middle of one of the two silvered right-angled planes S_1. When the examination of O from above is finished, and the observer wishes to examine the under side, he has merely to push the prism P with the object thereon sideways until O comes under the axis A A, and to lower the corresponding tube. A second half-sized prism *p*, worked also sideways, will give a side view.

The framework containing these prisms, and the mode of adjusting them, is shown in fig. 79, which is fully described in the original paper.

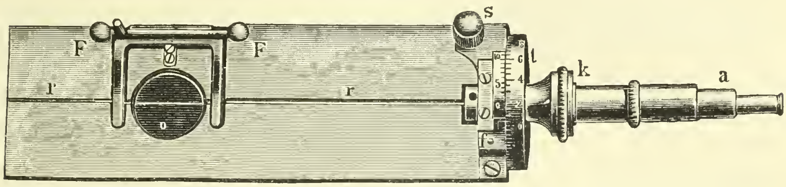
Fig. 79.



B. The object of this (fig. 80) is to facilitate observation with the highest powers—even with immersion objectives—of minute objects which it is desired to view from all points, but whose examination by an ordinary method of rotation would be tedious, and to which much movement might perhaps be productive of injury.

A rectangular plate bears in the direction of its long axis a triangular channel *r*, which passes through a circular sunk opening *o*. The circumference of this orifice has underneath a slight projection bearing a glass plate, the whole forming a chamber of slight depth (about 0·75 mm.). The function of the chamber is to regulate the flow of the homogeneous-immersion medium, so as to avoid injury to the object by

Fig. 80.



alteration of the position of the cover-glass. A screw and drumhead divided into degrees works in an axially perforated cylinder, and effects the rotation of the chamber.

A list of advantages claimed for the apparatus closes the description.

Two Old Microscopes exhibited by the President at the last Meeting.—The first (fig. 81), which was made by Benjamin Martin, is an attempt to improve Cuff's "new constructed double Microscope" (1744), with what success we shall presently see. The instrument, which is mounted on a folding tripod in place of the square box foot, differs essentially from Cuff's, as it is a stage focuser. Cuff's Microscope had a sliding coarse adjustment, the limb which carries the body sliding on a square pillar fixed to the box foot. A jamb screw was attached for the purpose of fixing the limb at a mark engraved on the square pillar, corresponding to the number on the objective on the nose-piece. Alterations in focus were then made by the fine-adjustment screw, which caused the body either to approach or recede from the stage.

In Martin's the body remains fixed while the stage is moved up or down by rack and pinion, until the stage is brought to a mark engraved on the fixed pillar, corresponding to a number on the objective. Parallel to the fixed pillar is a square steel bar, to which the stage may be clamped by a jamb screw. When the fine-adjustment screw is turned, it moves this square steel bar up or down, carrying with it the stage, and in doing this, let it be noted, it turns the coarse-adjustment pinion! This is, of course, a much inferior method to that of Cuff's, both on account of the stage focusing, and also with regard to the manner it is effected, which causes a superabundance of friction. The loss of time on the fine-adjustment screw amounts to no less than one and a half revolutions!

There are six objectives, with a single lieberkuhn common to them all; the lieberkuhn slides on a long nose-piece, after the manner of Cuff's, marks being engraved to indicate its proper position with any given objective.

There are also six magnifiers for use as simple Microscopes; three of these are fitted with proper lieberkuhns. There is an ordinary spring slide-holder, as well a supplementary stage with transverse motion in arc, an arrangement peculiar to Martin's Microscopes. The limb which holds the body is hinged so that the body can be placed in a horizontal position. The limb has also motion in arc with a pin to fix it in the optic axis.

There are two concave mirrors, one of 4 in. and the other of 9 in. focus.

The optical portion of this Microscope is peculiar. The eye-lens is a doublet consisting of a crossed lens of $1\frac{1}{4}$ in. focus and a plano-convex of $1\frac{3}{4}$ in. focus, placed in their proper positions, their combined focus

Fig. 81.

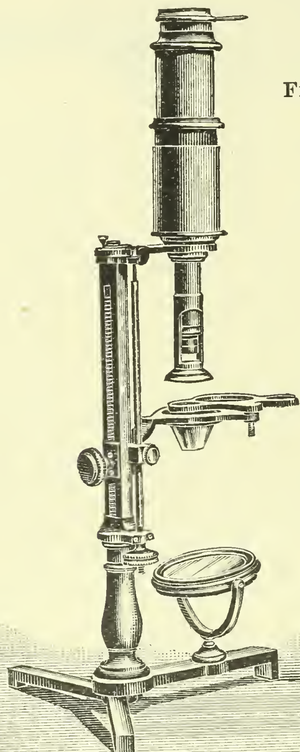
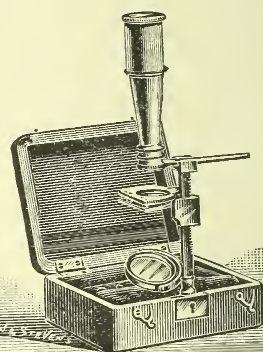


Fig. 82.



being 1 in.; the field lens is a plano-convex of 3 in. focus, properly placed, the distance between the field lens and the compound eye-lens being $1\frac{3}{4}$ in.

There is at the upper end of the long nose-piece an equi-convex lens of $5\frac{1}{2}$ in. focus; this must be considered a part, not of the eye-piece, but of the objective. In reality it is the back lens of the objectives, for it is common to them all; so that, in changing the objectives, it is only the front lens that is changed. This, which, optically speaking, is an improvement, is probably the invention of Martin. The same optical arrangement was employed by Adams in 1771. Opticians copied one another so freely that, in the absence of any published account, it is difficult to determine either the originator of any particular improvement or the date of its introduction. As, however, Benjamin Martin was a mathematician, who understood both the theory and practice of optics, this invention may be safely credited to him. The body has a draw-tube.

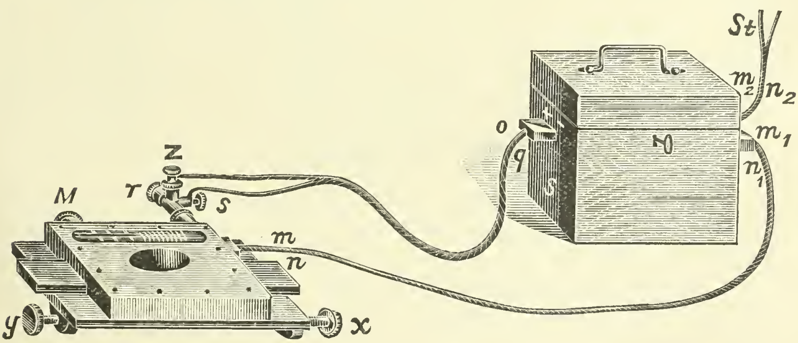
The date of this Microscope must be placed between 1759 when Martin came to London, and 1782 when he died. If, therefore, we say between 1760 and 1770, we shall not be far wrong. It is very portable, the outside measure of its box being $10\frac{1}{2} \times 7\frac{1}{4} \times 2\frac{1}{2}$ in., and its weight in box with apparatus $4\frac{3}{4}$ lbs.

The second Microscope (fig. 82) is by Cary; it is a small simple Microscope of a common form, fitted with rack-and-pinion stage focussing. The vertical pillar screws into a brass plate, let into the box where the hasp is usually placed.

It has also a compound body which may be used in conjunction with the simple lenses. This compound body, which is only $2\frac{3}{4}$ in. long, has a compound eye-lens, similar in arrangement to that of Martin's described above. There are four powers, which screw into one another in the usual manner. The box measures only $3\frac{3}{4} \times 3 \times 1\frac{1}{4}$ in.

Electrically Heated and Regulated Warm Stage.* — Dr. Rudolf Kraus, after summarising the various heating stages that have been invented since the first (by Stricker in 1871), points out that no new application of electric methods has taken place since Stein's in 1884. Stein's method was to place in the hollow stage a spiral connected with

FIG. 83.



an electric current; but this plan had the faults of deficient regulation and liability to great variations of temperature, due to the fact that air is not a good conductor of heat, and therefore is not adapted for a steady constant heating medium.

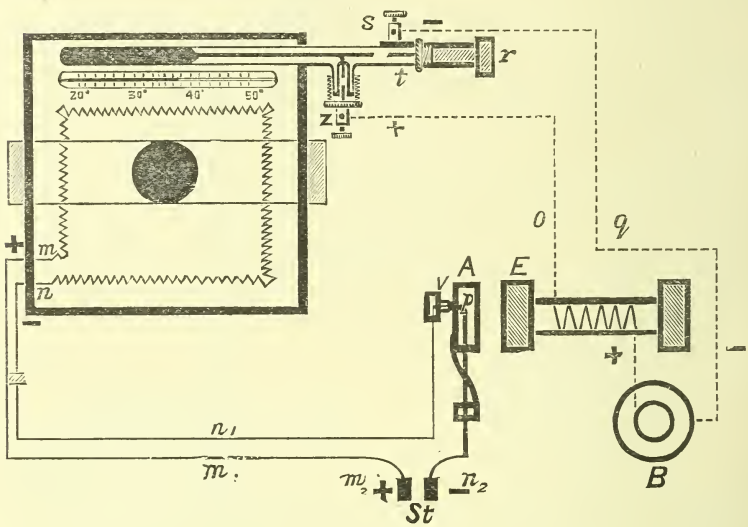
The next idea was to make use of liquids as conducting media; and after many attempts Herr Ehman has succeeded in finding one, viz. paraffin oil, which conducts heat and is not itself decomposed by the current.

* Centralbl. Bakt. u. Par., xxiii. (1898) pp. 16–20 (2 figs.).

The electrically heated object-stage consists of the stage proper, silver spirals, paraffin oil, an ordinary graduated thermometer, and a contact thermometer. There is also a relay (a Neefhammer). The object-stage proper is a deep metal box containing a silver spiral connected with the main current by $m_2 n_2$. The regulating apparatus consists of a contact thermometer inserted in the stage and the relay in a wooden box. The contact thermometer is connected with the relay, and closes and opens the current going to the relay from the battery B.*

The apparatus is worked as follows :—Contact $m_2 n_2$ is made with St the main current, and the current entering by $m n$ into the spiral heats it. The paraffin thus becomes warmed, and the temperature continues to rise until the quicksilver expanding reaches the point of the

Fig. 84.



platinum thread t. At this moment the current $o\,q$ of the element B is closed and the hammer A from E. Contact is opened by $v\,p$, which, in the rest position of the relay, is shut; and the main current $m\,n$, $m_2\,n_2$ is opened. No more heat now goes through the spiral, and the temperature in the stage sinks. Therefore, when the quicksilver thread of the contact thermometer operates, the adjoining current Z S O Q is opened and the main current again introduced. The alteration of the currents is marked by an audible click from the hammer. Only a very weak current (0·2 ampère) goes through the spiral. It was found possible to regulate the temperature to 0·1°, and to keep it constant even for a whole day.

* The contact thermometer is apparently in the liquid, and only its extremity is visible. This arrangement would allow of the conduction to the liquid of any heat which would be generated in the contact thermometer, so tending to counterbalance the loss by radiation and keep the paraffin at a constant temperature.—Ed.

In addition to this advantage of sure regulation and constancy of temperature, the object-stage admits of a rapid attainment of a desired temperature as well as of a rapid alteration.

The attainment of a desired temperature (e.g. 37°) occurs during the passage of the main current. When the thermometer shows 37°, then the platinum thread is brought into contact with the quicksilver thread, and a distinct click is heard from the relay. The temperature then remains constant, and the main current, being shut off, is replaced by the auxiliary current.

A higher or lower temperature is easily attained. To get a higher temperature, e.g. 45°, the platinum thread is withdrawn to a proper distance by rotating the screw-head until the graduated thermometer shows 45°. The quicksilver and the platinum threads in the contact thermometer meet; the main current is shut off and the relay called into action as before. A reverse movement of the platinum thread combined with exclusion of the currents permits a cooling down somewhat below the desired temperature. Then by manipulation of the currents the temperature is raised to the desired point.

(5) Microscopical Optics and Manipulation.

Zeiss' New Comparison Spectroscope.*— This instrument is intended to assist botanists and physiologists in the study of such coloured substances as chlorophyll, and is so named because its special feature is to render possible an exact comparison of the absorption spectra of solutions. As will be seen from the accompanying figure (fig. 85), the apparatus has the general form of a Microscope, and so far resembles one that the special spectral arrangement can be applied to a Microscope stand. The object-table F bears two orifices, 4 cm. apart, through which two mirrors reflect the sun or lamplight perpendicularly upwards. Each of these two pencils, passing through prisms situated in the horizontal box, becomes decomposed and forms a spectrum. The two spectra appear in close proximity, and can be observed through the broad slit C in the eye-piece.

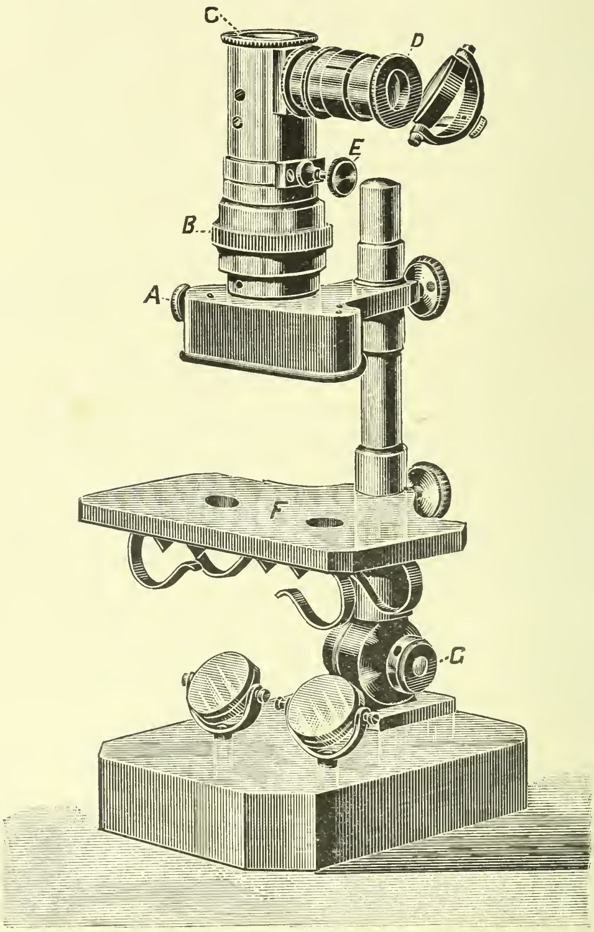
In the side tube D is placed the wave-length scale, which is illuminated by the mirror at the tube's mouth, its image being projected between the two spectra. The width of the slit, and consequently the brightness of the spectra, can be altered by the turning of the knob A.

Rotation of the tube-piece B brings out sharp presentation of the scale and spectra; the screw E causes a side movement of the scale image. The two plane and concave mirrors are movable round vertical and horizontal axes. When the necessary mirror adjustments have been made, two spectra with the most important of Fraunhofer's lines are seen over one another. It is easy by movement of the scale to get the D line on $a = 589$. When daylight is not available, a spirit-lamp with a salted wick or asbestos thread soaked in NaCl solution may be used. When direct sunlight is used, the number of Fraunhofer's lines that appear is endless. The cross-piece carrying the prisms and superincumbent ocular slides up and down in a vertical axis, and can be clamped at any desired height.

* Bot. Centralbl., lxxiii. No. 10, pp. 349–52 (1 fig.).

For comparative observation of absorption spectra of various solutions it is best to use Zeiss' double absorption vessels. The manage-

Fig. 85.



ment of the instrument is easy and remarkably convenient, and its great feature is its adaptability with even relatively unfavourable light.

(6) Miscellaneous.

New Thermo-Regulator.*—Dr. F. G. Novy has devised a thermoregulator which can be used for high as well as low temperatures. Fig.

* Journ. Applied Microscopy, i. (1898) pp. 91–2 (2 figs.).

86 shows the apparatus as a whole, reduced in size. Fig. 87 illustrates the construction of the regulator. Part A is provided with two lateral tubes which have an internal diameter of 6 mm., and has a ground internal surface indicated by the stippled portion of the drawing. Part B is ground to fit the preceding. It is provided with an opening (1) through which the gas passes into the interior. The lower portion of B has a smaller opening (4) 1 mm. in diameter. The lower portion of tube B has an internal diameter of 2 mm., and when placed in position

Fig. 86.

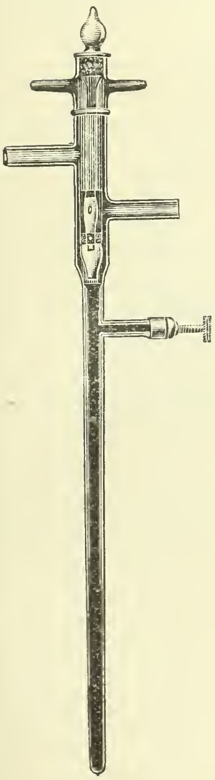
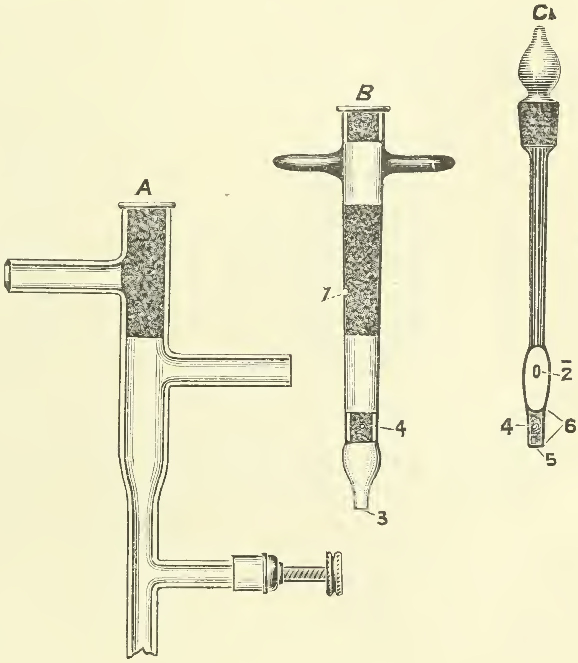


Fig. 87.



inside of A, it should come within one or two millimetres of the bottom of the cup. In this case, the first droplet of mercury, as it issues from below, shuts off the outflow of gas. The upper part of C is solid, and the lower part hollow. The gas enters through a large opening (2) and passes down to (4) the minimum outflow, and to (5) and out at (3). The portion marked (6) is ground to fit exactly the corresponding part in B. If this is not done properly, the minimum outflow of gas cannot be regulated as perfectly as it can be otherwise. The upper portion of C is a ground stopper fitting into B. The manipulation is simple. The gas enters through the upper lateral tube. If it is desired to diminish the inflow of gas, this can be done by turning B. The gas passes through (1) into the inner space and leaves at (2). The gas goes down, and a portion leaves through the minimum supply opening (4), while the remainder passes down through (5) and out of (3). By turning C the minimum outflow of gas can be regulated at will. The regulator works exceedingly well, especially in connection with Murrill's gas pressure regulator.

New Gas-Pressure Regulator.*—Mr. P. Murrill has invented a gas-pressure regulator, the strong points of which are efficiency, simplicity, durability, and cheapness. The outer vessel or pail is 6 in. (15 cm.) in

Fig. 88.

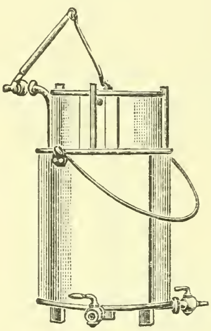
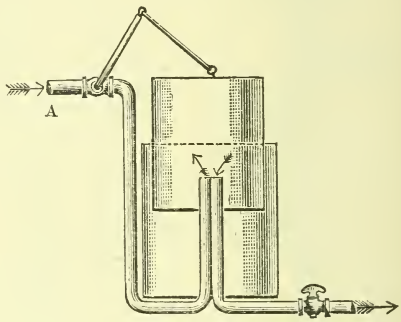
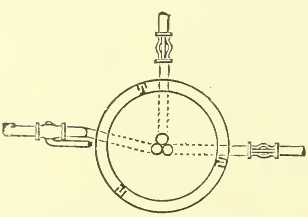


Fig. 89.



diameter and 7 in. (18 cm.) deep. Through the centre of the bottom three tubes enter, rising $5\frac{3}{4}$ in. (14·5 cm.) above the bottom. The direction and arrangement of these tubes is shown in the illustrations. The inlet tube (fig. 89, A) is fitted with a stopcock to which a 4-in. (10 cm.) lever arm is attached. On the inside of the pail are soldered three vertical U-shaped grooves extending 3 in. (8 cm.) above the top. The inner vessel or float is 5 in. (13 cm.) in diameter and 6 in. (15 cm.) deep. On the outside are soldered three vertical flanges, corresponding to the three grooves in the outer vessel. To the top of the float is soldered a stiff wire ring, and this is connected with the lever arm by a wire of such length that the valve is wide open when the float is at its lowest position. The float with attachments should weigh about 25 oz. (700 grm.), under which weight the gas will be delivered at about 40 mm. pressure; but by means of weights placed

Fig. 90.



PLAN-TOP OF INNER PAIL REMOVED

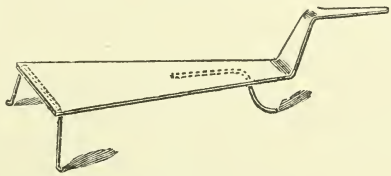
* Journ. Applied Microscopy, i. (1898) pp. 92–4 (4 figs.).

on the float the pressure at which the gas is delivered may be varied at will. The outer vessel is to be filled with water to the depth of 5 in. (13 cm.); or glycerin or liquid paraffin may be used.

The operation of the apparatus is as follows. One of the two exit tubes may be connected with a manometer, or both may go to burners. Gas enters through the stopcock into the float which, as it rises, closes the valve. If the outlets be closed, the float will rise until the valve is entirely closed, in which position it will stand. When the exit tubes are opened the float falls, the valve reopens, and gas is admitted at the same rate at which it is consumed. The apparatus, which is made of metal, is designed to be used in connection with a thermostat, and with it the temperature may be held constant within 0·1° C.

Paraffin Imbedding Table.*—Mr. H. B. Ward has devised a modification of the ordinary paraffin imbedding table, which is superior to the older type in several respects. The table is made of a triangle of sheet copper with a base of 6 in. and a perpendicular height of 14 in.

Fig. 91.



The edges of the triangle are turned under and inward, giving to the table a slightly rounded margin. In height, the main part of the table measures 2 in., and it is about 4 in. high under the apex of the triangle where the flame is applied. The legs are made of five-sixteenths copper rod bent as shown in the illustration, and riveted to the copper sheet.

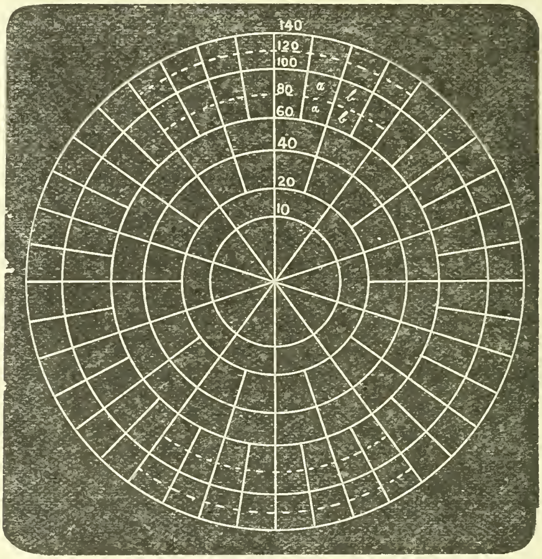
Circular Colonometers.—Mr. H. W. Jeffers † has constructed an apparatus (fig. 92) for counting the colonies of bacteria on circular plates. It consists of concentric zones which are divided into sections, each having an area of 1 sq. cm. The Petri dish can be centred upon this apparatus by the circles, and the area read from the line its edges approach. To facilitate the reading of the area of the plate, the circles 80 and 120, whose areas are equal to 80 and 120 sq. cm. respectively, were drawn as dotted circles, thus making the areas, marked *a* and *b*,, equal to one-half a square centimetre. The colonies in several areas can be counted, an average taken, and the result multiplied by the number of square centimetres in each plate.

The colonometer devised by Mr. J. Weiss ‡ (fig. 93) is made up of eight concentric circles and 92 sector circles. The first or centre circle is 1 cm. in diameter; the second 3 cm.; the third 5 cm.; the fourth 7 cm., and so on to the eighth, which is 15 cm.

* Journ. Applied Microscopy, i. (1898) pp. 88–9.
† Tom. cit., pp. 53–4 (1 fig.). ‡ Tom. cit., pp. 54–5 (1 fig.).

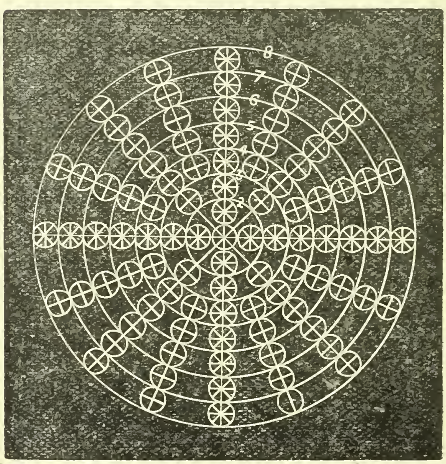
The counting is done as follows. An average number of colonies is found in one of the sector circles, in a definite working area, and the number is multiplied by the ratio of the area of the sector circle to the

Fig. 92.



Diameter one-half actual size.

Fig. 93.



Diameter one-third actual size.

area of the entire plate. The ratios are $2:1 = 9$; $3:1 = 25$; $4:1 = 49$; $5:1 = 81$; $6:1 = 121$; $7:1 = 169$; $8:1 = 225$.

Thus, if in a sector circle of circle 6, the average number of colonies were 12, then the number of colonies is $12 \times 121 = 1452$.

New Test-Plate.*—Dr. H. van Heurck, after alluding to the scarcity of Nobert's plates, suggests that microscopists may avail themselves of the markings of diatoms for the purpose of testing the resolving power of lenses. The author has carefully worked out the following table, giving in parallel columns the diatom-equivalent of Nobert's series.

Nobert's series stops at 19, but the author has continued the calculation for 20, 21, and 22.

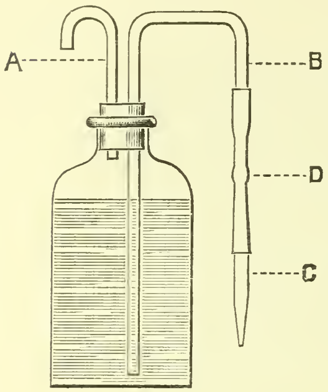
Nobert's Series.	Number of Lines.	Number of Diatom Lines.	Corresponding Diatoms.
1	443	445	Navicula dactylus (str. trans.)
2	665	620	„ lyra „
3	886	900	Epithemia turgida „
4	1108	1100	Navicula Brebissonii „
5	1329	1330	Stauroneis phœnicenteron (str. trans.)
6	1550	1500	Pleurosigma balticum „
7	1572	1800	„ angulatum „
8	1994	2000	Mastogloia meleagris „
9	2215	2200	Surirella gemma „
10	2437	2400	„ „ (str. long.)
11	2658	2600	Mastogloia exigua Lew. (str. trans.)
12	2880	2800	Van Heurckia rhomboides typ. (str. trans.)
13	3100	3100	Nitzschia linearis Sm. (str. trans.)
14	3323	..	„ „ var. tenuis (str. trans.)
15	3544	3400	Frustulia saxonica (str. trans.)
16	3766	3600	„ „ (str. long.)
17	3987	{3800 to 4000}	Amphipleura pellucida (str. trans.)
18	4209	4200	„ „ small (str. trans.)
19	4430		
20	4652		
21	4872		
22	5093	5000	„ „ (str. long.)

Improved Form of Wash-bottle.†—Mr. W. C. Sturgis describes a wash-bottle devised by Mr. A. L. Winton. The apparatus is easily made, easily manipulated, and under perfect control. It consists of a glass

* Zeitschr. f. angew. Mikr., iv. (1898) pp. 1–4.
† Journ. Applied Microscopy, i. (1898) pp. 75–6 (1 fig.).

vessel, the neck of which is plugged with a rubber stopper with two perforations, through which pass two U-shaped tubes. To one of these is fitted a glass nozzle through the intermediary of a piece of rubber tubing. Into the rubber tube is pressed a solid glass ball with a diameter larger than that of the lumen of the rubber tube. The vessel having been filled, the flow is secured by merely pressing the tube immediately above the head D. In this way a steady stream or single drops are made to issue from the nozzle (fig. 94).

Fig. 94.



The Microscope and its Application.* — The concluding portion of Prof. L. Dippel's work on the Microscope and its Application has recently appeared. It contains the third and fourth sections which deal with the structure of the stem, the root and leaves, and also with the development of the various parts of plants. It is copiously illustrated with woodcuts.

B. Technique.†

(1) Collecting Objects, including Culture Processes.

Method for Making Anaerobic Roll-Cultures with Gelatin or Agar.‡—The following simple method for making anaerobic roll-cultures is given by Herr G. Marpmann. Two test-tubes are required, one of which can be pushed just inside the other. The larger is then 1/4 filled with the medium and sterilised. The medium is inoculated, and then stirred up with a glass rod for 5–10 minutes. The smaller tube is now jammed inside the larger, its surface having been previously sterilised in the flame. The layer of inoculated medium is set by plunging the tubes into cold water. The ends of both are sealed with paraffin or covered with a rubber cap. The colonies are easily counted. Inoculations can be made from any particular colony by merely withdrawing the inner tube, or by cutting through the glass.

Cultivation Media suitable for Tropical Climates.§—M. A. Morel, writing from Java, where the mean temperature is over 25° C., states that he has been in the habit of using for some time past a culture medium which remains firm at the hottest season of the year. It is composed of $12\frac{1}{2}$ parts white gelatin, 0·25 parts agar, and 90 parts

* Braunschweig, F. Vieweg u. Sohn, 1898, pp. 445-644, with Index, Contents, and 132 woodcuts.

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

‡ Zeitschr. f. angew. Mikr., iv. (1898) pp. 37–8.

§ Tom. cit., pp. 4–6.

bouillon. This mass filters well through a hot-water filter, it is only liquefied over 30° C., and makes excellent plates which set in half an hour without the aid of ice.

The addition of the small amount of agar does not prevent the liquefaction of the medium by peptonising bacteria, though the action is less rapid than on gelatin alone.

The gelatin may be clarified in the usual way by means of egg albumen or by means of "clearing clay," a magnesium-aluminium hydrosilicate, which in conjunction with water is decomposed into the hydrate; and this in the nascent condition has the property of throwing down all muddy and even colouring matters, leaving a clear and colourless supernatant fluid. When the gelatin or agar solutions are ready for filtering, 1 per cent. of clearing clay is added, and having been well shaken the mixture is steamed for one hour before it is filtered.

Production of Plague Serum.*—Herr G. Gabritschewsky, finding that living cultures of plague bacillus were unsuitable for immunising horses, made experiments for the purpose of obtaining immunising and toxic substances from cultures of *Bacillus pestis* by plasmolysis. In bouillon with 4 per cent. glycerin the plague bacillus grows freely, on pure glycerin at 37° not at all. Horses were immunised by means of cultures sterilised by the addition of glycerin. Agar plates were inoculated from bouillon cultures, and in 24–48 hours at 37° a copious plague culture was obtained. This was distributed in test-tubes, each containing 2 ccm. of glycerin. In 24 hours a cloudy slimy mass was formed, and this diluted with an equal bulk of bouillon was injected subcutaneously into horses. At the injection site considerable infiltration occurred, and the temperature rose to 39·2°. On intravenous injection the temperature rose to 40°, falling again after 24–48 hours. This immunising method is only suitable for horses, as glycerin by itself is poisonous to mice, and in rabbits and guinea-pigs causes local necrosis.

The rest of the paper is devoted to the plasmolytic method of sterilising cultures.

Culture of Pleurococcus.†—Miss Dorothea F. M. Pertz recommends for the culture of this organism Knop's solution 0·2 per cent. in sterilised glass dishes and flasks; also in hanging drops of the same solution. Chodat's filamentous form of the alga did not occur.

(2) Preparing Objects.

Method for Preparing Plankton Organisms.‡—Herr G. Marpmann gives the following for preparing soft organisms such as plasmodes, Radiolaria, Infusoria, &c. A 1 per cent. solution of hydrochlorate of cocain is added to the fluid to be examined in the proportion of one-third to one-half the volume of the latter. Observation under the Microscope shows that the organisms, even the lower plants, lie quite still, their processes, tentacles, &c. being fully extended. A drop of formalin is then added. This kills and fixes the organisms at once.

* Russ. Arch. f. Pathol., klin. Méd. u. Bakt., 1897. See Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) pp. 808–9.

† Rep. Brit. Ass. Toronto, 1897 (1898) p. 864.

‡ Zeitschr. f. angew. Mikr., iv. (1898) pp. 42–3.

It is now a very easy task to stain such objects, and mount them in glycerin, glycerin-jelly, or balsam. If they are mounted in balsam the preparations should be successively treated with alcohol, xylol, and lavender oil. Care must be taken lest the organisms get dry during the process.

Fixing and Preparing Freshwater Algæ.*—F. Pfeiffer R. v. Wellheim recommends the following process. The fixing fluid is composed of equal parts in volume of 40 per cent. formol, pyroligneous acetic acid, and methyl-alcohol. After decanting the greater part of the water from the alga, the fixing fluid is added, and must be at least double in volume of the water that remains. The algæ may remain in this fluid for weeks or months. If the alga is of a gelatinous character, it must be transferred from the fixing fluid into strong alcohol; and this must always be done before examining or staining.

Algæ fixed in this way may be stained by any of the familiar colouring reagents. Very favourable colouring solutions are the following:—(1) 100 ccm. of 50 per cent. alcohol, with 2–3 ccm. of iron chloride solution in 90 per cent. or in absolute alcohol; (2) A concentrated solution of perfectly pure carmin-acid in 50 per cent. alcohol. Before staining the object must lie in 50 per cent. alcohol. It must then remain in solution (1) for at least 4–6 hours, and be then freed from the excess of iron chloride by 50 per cent. alcohol. A few drops of solution (2) are then added; and the staining is completely effected in a few hours. The object is next placed in 95 per cent. alcohol, and then transferred to the imbedding substance.

By this process the structure of *Spirotænia trabeculata*, and the honey-comb structure of *Oscillatoria princeps*, are very well shown.

Preparing Parasitic Fungi.†—Prof. A. N. Berlese adopts the following method of preparing microscopic fungi parasitic on leaves. The special advantage is that the observer can at once detect whether the fungus is in the stage desired for examination, without waiting the result of a long and tedious process.

Pieces of the leaf infected by the parasite are placed in absolute, or in 96 per cent. alcohol, or in concentrated picric acid, or better, in a mixture of 15 ccm. 0·5 per cent. chromic acid, 6 ccm. 1 per cent. osmic acid, and 1 ccm. glacial acetic acid, and then in concentrated nitric acid. After washing in distilled water and boiling in alcohol, they can be examined under a low magnifying power. For imbedding, the material is hardened in absolute alcohol and then placed in chloroform in a closed glass vessel. The pieces of infected leaf remain floating on the chloroform. Alcohol is then run in until the material is completely covered by it. After a short time the two fluids mix; the material becomes impregnated, and falls to the bottom of the vessel. The saturation is generally completed after from four to six hours, and the pieces of leaf are then placed in a concentrated solution of paraffin in chloroform or directly in pure paraffin melting at 50° C. After sectioning, the sections are freed from paraffin by turpentine-oil; then placed in absolute alcohol until required for staining.

* Oesterr. Bot. Zeitschr., xlviii. (1898) pp. 53–9, 99–105.

† Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxi. (1897) pp. 166–70.

Simple Method for Demonstrating the Production of Gas by Bacteria.*—Mr. H. E. Durham describes a modification of the fermentation tube which consists in placing a small test-tube in an inverted position within the ordinary test-tube used for cultivations. The small tube should be freely movable when placed inside. The tubes are filled by means of a burette, and are then steam sterilised on three successive days. In most cases the smaller tube becomes completely filled after the first sterilisation, and it is not usual for a bubble to persist after the second. The tubes must not be tilted too much when they are inoculated (fig. 95).

Fig. 95.

Demonstrating Pacini's Corpuscles.†—Pacini's corpuscles, which may be regarded as the highest development of nerve-endings, are easily demonstrable by *intra vitam* staining. The animal is to be injected with a saturated solution of methylen-blue at 37°, and when dead the pieces are to be stained in saturated aqueous solution of picrate of ammonia. Methylen-blue forms with picrate of ammonia a combination insoluble in water, but soluble in spirit. The preparations are then immersed in a solution of molybdate of ammonia 1, water 20, aceto-hydrochloric acid 1 drop. With molybdic acid, methylen-blue forms a compound insoluble in alcohol, and now the preparations can be dehydrated, imbedded, cut, stained, and mounted without detriment.

Formol-Methylen-Blue Treatment of Nerve-fibres.‡—Herren G. Rossolino and W. Muraview adopt the following procedure for the demonstration of normal or diseased nerve-fibres. The pieces are placed for one or two days in 2–2·5 per cent. formalin, and then transferred finally to 4 per cent. formalin. After at least four days the formalin may be exchanged for 95 per cent. alcohol, and the pieces teased out or sectioned. The pieces or sections are stained in a hot 0·5 per cent. aqueous methylen-blue solution. After the solution has cooled down, the preparations are transferred to 1 per cent. alcoholic solution of anilin for a few seconds or for some minutes. They are then washed in 95 per cent. alcohol to remove the anilin, cleared up in cajeput oil, and mounted in balsam.

By this procedure two different kinds of nerve-fibres can be distinguished. In one of these the medullary sheath is studded all over with small round granules of variable size and form. The method is satisfactory also for the nerve-cells and the connective tissue elements. The preparations are permanent, retaining the stain well, but they do not bear exposure to sunlight.

Demonstrating the Nucleoli of Cells in Central Nervous System.§—Herr V. Růžička reports a method for demonstrating the histo-

* Brit. Med. Journ., 1898, i. p. 1387 (1 fig.).
† Zeitschr. f. angew. Mikr., iv. (1898) pp. 38–41.
‡ Neurol. Centralbl., xvi. (1897) pp. 722–7.
§ Zeitschr. f. wiss. Mikr., xiv. (1898) pp. 452–5.

logical structure and peculiarities of nucleoli in the cells of the central nervous system. Pieces of spinal cord, 0·5 centimetre thick, may be hardened in alcohol, or they may be first fixed in saturated solution of sublimate, or in commercial formol diluted to one-half, and then after-hardened in alcohol.

The celloidin sections are immersed for 10 seconds in warm 1 per cent. aqueous methylen-blue solution, or in carbol fuchsin. The sections are decolorised in alcohol, and then placed in chloroform, which dissolves out the celloidin. After dehydrating in alcohol and clearing in cajeput oil, the sections are mounted in Canada balsam.

By this method, while the nuclear mass remains unstained, the nucleoli or nuclear corpuscles are highly coloured, and show one centrally placed body, or several extremely small granules with no definite distribution and a crenated appearance.

Bowhill's solution * is also recommended as a good stain for demonstrating the nucleoli.

Peroxide of Hydrogen in Microscopical Research.†—Herr R. Volk recommends peroxide of hydrogen for killing motile and sensitive animals of minute size. One drop of three per cent. solution to 2 ccm. of water suffices for some Rotatoria, and 1 drop to 1 ccm. of water kills Anureæ and other Loricata. The solutions should always be as weak as possible, especially as delicate species are damaged by the oxidising action of the stronger mixtures. When the animals are dead, the mixture must be replaced by water, or by water with 0·3 per cent. of salt. When washed the animals are fixed in the usual way. For objects which contain carbonate of lime the peroxide must be perfectly free from acid.

Preparing Permanent Blood-Films.‡—Herr A. Zielina prepared blood-films by receiving a minute drop of blood on one side of a cover-glass, and then distributing it over the surface by touching it with the edge of a slide which is drawn across the cover-glass from left to right. A clean edge is necessary for each film, and the wound should be wiped before taking the next drop.

The films are dried in the air, and are fixed by drawing them eight or nine times through the flame. When cool they are stained for 30 seconds in Nicolle's one-third eosin (saturated alcoholic solution of eosin 50 ccm., 95 per cent. alcohol 100 ccm.). The superfluous stain is removed, and the preparation dried. The film is again stained in ripe Ehrlich hæmatoxylin for 30–40 minutes. The cover-glass, film side downwards, is then suspended on water for a time. It is again stained with the one-third eosin solution for 30 seconds. After having been washed with water, it is dried, and mounted in balsam.

How to examine the Blood and Diagnose its Diseases.§—Dr. A. C. Coles has, by producing a compact account of methods for examining the

* See this Journal, *ante*, p. 244.
† Zool. Anzeig., xix. (1896) pp. 294–5. See Zeitschr. f. wiss. Mikr., xiv. (1898) p. 469.
‡ Zeitschr. f. wiss. Mikr., xiv. (1898) pp. 463–4.
§ London, Churchills, 1898, 260 pp. and 6 pls.

blood and for the diagnosis of its diseases, conferred a benefit on those who are desirous of becoming practically acquainted with the technique of blood preparations and with the pathology of the blood. The work is divided into three parts, which deal with methods for examining the blood, the general morphology of the blood, and the diseases in which the blood is primarily or secondarily affected.

The author does not lay claim to originality, modestly avowing that the work is more or less a compilation. It is obvious, however, even from a superficial examination, that he speaks authoritatively on a large number of points, and that the knowledge conveyed is the result of personal experience and acquaintance with the subject. The coloured illustrations are extremely effective.

(3) Cutting, including Imbedding and Microtomes.

Combination of the Paraffin and Celloidin Methods of Imbedding.*—Mr. U. Dahlgren adopts the following method for imbedding ova and embryos of amphibia. The objects are infiltrated with celloidin in the usual way, and then immersed in a large quantity of chloroform for twenty-four hours. They are then transferred to a bath of one-half chloroform and one-half cedar oil. In twenty-four hours they are placed in the water-bath in paraffin of the grade that will be finally used to imbed them. Several changes are necessary, and more time must be allowed than for tissues imbedded by the plain paraffin method.

(4) Staining and Injecting.

Action of Pigments on Living Sponges.†—Dr. G. Loisel finds that granules of Congo-red and tournesol-blue are absorbed by endodermic and mesodermic cells of *Reniera ingalli* and *Spongilla fluviatilis*. Various kinds of colouring matter in solution (safranin, iodine-green, &c.) are stopped at the surface of the sponge, while others again are readily absorbed. Congo-red and tournesol-blue are peculiarly changed inside the cells enclosing them, as if by the action of an acid. After a time, the substances are got rid of into the intercellular spaces, and are taken up by phagocytes, or transported outwards by the contractions of the matrical substance. Loisel goes on to notice the colouring of some living Protozoa, Medusæ, and other animals by various reagents.

Staining Blood-Films.‡—Dr. H. Rubinstein recommends the following procedure for staining blood. The cover-glasses should be very thin and perfectly clean. All traces of grease must be removed by passing them several times through the flame. The drop of blood placed on the cover-glass should not be larger than a pin's head. The second cover-glass should be superimposed so that the two form an octagonal figure; and, when the blood has spread out, the two are to be separated without the one exerting any pressure on the other.

After having been dried in the air, the films are fixed by heating the cover-glasses film side downwards on a copper plate about 30 cm. long

* Journ. Applied Microscopy, i. (1898) p. 97.
† Journ. Anat. Physiol., xxxiv. pp. 187–234 (1 pl. and 3 figs.).
‡ Zeitschr. f. wiss. Mikr., xiv. (1898) pp. 456–62.

and 9 cm. broad, the heat being applied at one end of the plate by a gas or spirit lamp.

The part of the plate to be used for fixation is the area lying between the zones where water boils and where it assumes the spheroidal state. The time required is from half to one minute. The films are stained with Ehrlich's triple stain for 5, 6, or 7 minutes. After having been washed with water, they are dried and mounted in balsam.

Staining the Envelope of Milk-Globules.*—Mr. W. Narramore states that by staining milk with eosin and with picrocarmin, he found that the structure surrounding the fat-globules became stained, and that without doubt the much debated membrane of the fat-globule was present. At the same time, this was not universally the case, as a large number showed no trace of a covering. The author remarks that Storch, a Danish investigator, has also succeeded by means of picrocarmin in staining the suspected envelope, which is more condensed or viscous towards its inner side, and more watery on its outer side.

Under the Microscope the fat-globules, colourless in themselves, are seen to be surrounded by a narrow faint red border.

Staining the "Vacuole-Granules" in Yeast-Cells.†—Herr E. Küster states that the "vacuole-granules" of yeast-cells, by immersing a sample of cake-yeast in a thin aqueous solution of neutral red, 1 to 5000 or 1 to 10,000, are sufficiently stained in a few minutes. The granules are stained dark red, the rest of the cell remaining uncoloured. If the action of the stain be prolonged, the vacuoles, by absorbing more and more of the pigment, eventually become non-transparent, and look like dark red balls lying in the colourless plasma.

Double-Stain for Gums.‡—M. L. Lutz recommends the following formulæ respectively for (1) a hydro-alcoholic solution of red extract of Cassella, and (2) a hydro-alcoholic solution of acid green J E E E (Poirrier):—(1) Rouge de Cassella 0·25 grm., 90 per cent. alcohol 20 grm., distilled water 30 grm.; (2) Acid green J E E E (Poirrier) 0·10 grm., 90 per cent. alcohol 20 grm., distilled water 30 grm. He uses them for the double staining of sections of roots or root-stocks containing gums.

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

Method of Preserving Culture Media.§—Mr. F. T. Bioletti preserves culture media by means of the following simple device, which merely consists in the use of a second plug of antiseptic cotton. The test-tubes are cleaned and plugged in the ordinary way, except that the plug is only half the usual length. After having been sterilised and filled, the plug is pushed in to half an inch below the top of the tube, and a plug of antiseptic cotton is put over it. The tubes are sterilised in the usual way, and may then be covered with a rubber cap or be put in a closed vessel to prevent evaporation. The antiseptic cotton is

* Rep. Liverpool Micr. Soc., 1898, pp. 23–4.
† Biol. Centralbl., xviii. (1898) p. 306.
‡ Bot. Gazette, xxv. (1898) p. 280.
§ Journ. Applied Microscopy, i. (1898) pp. 72–3.

prepared by soaking ordinary cotton in a solution of water 100, alcohol 20, copper sulphate 3. The cotton should be dried slowly, as it chars easily.

By this method tubes can be kept unchanged for at least three months, i.e. there is no evaporation and no contamination.

Fixative Solutions.*—Dr. K. Tellyesniczky discusses the value of a large number of fixative fluids, and gives a very long list of these solutions and the original references thereto. The solutions are considered in order of ascending complexity, simple solutions of one reagent being first treated of. The double, triple, and quadruple solutions are subdivided into those which do and those which do not contain acetic acid. In fact, the author's paper is in praise of the neglected virtues of acetic acid. This acid, used in connection with plasma-preserving reagents such as potassium bichromate and osmic acid, gives extremely satisfactory results.

There are numerous formulas containing bichromate, osmic acid, and acetic acid, and other fixatives such as sublimate, picric acid, and nitric acid. These are too well known, under the names of their inventors, such as Perenyi, Flemming, Altmann, Rabl, Zenker, to need further description.

To a mixture of 3 grm. potassium bichromate, 5 ccm. acetic acid, and water 100 ccm., the author's own name is attached. Small pieces of material are left in this fluid for one or two days, and larger ones for longer. After removal they are thoroughly washed in water, and then further hardened in alcohol of increasing strength, beginning at 15 per cent.

Method for the Preservation of Protoplasmic Spinnings.†—Mr. G. F. Andrews gives the following as being the best method for the preservation of protoplasmic processes. The fumes of 2 per cent. osmic acid are concentrated by heat in a glass chamber. For this was used a large closed tube whose base rested on each side on a glass slide, leaving just space enough in the centre for a third slide to be slipped in and out. The whole stood on a glass plate on a water-bath. The central slide carried a watch-glass of osmic acid solution whose ingress and egress was provided for by a hole in the glass tube, which can be closed by a rubber band. When the fumes were sufficiently concentrated, the central slide was replaced by another of like size. On this the eggs had been previously arranged with just enough water to cover them. After fixation and removal from the chamber, the eggs were washed in many changes of water. The exact length of time the eggs should be exposed to the fumes cannot be given; but in any case it is very short, a second too much or too little either way spoiling the result. The best preservative was found to be concentrated sea-water.

Method for Fixing Leucocytes and Blood-plates.‡—Dr. H. Deeljen recommends that the blood drawn from the finger should be received on a film of agar, to which 0·75 per cent. of NaCl has been added. On this the cover-glass is placed. When examined on the warm stage the white corpuscles are seen to be in an actively motile condition. The preparations were next fixed with formalin or osmic acid vapour, and afterwards may be stained in the usual way.

* Arch. Mikr. Anat. u. Entwickl., lii. (1898) pp. 202–47 (1 pl. and 38 figs.).
† Zeitschr. f. wiss. Mikr., xiv. (1898) pp. 447–52.
‡ München. Med. Wochenschr., 1897, pp. 1192–3.

Selenium as a Mounting Medium for Diatoms.* — Selenium, says Herr G. Marpmann, is an element of a brown colour, of sulphur-like consistence, with a refractive index nearly as great as that of sulphur, and when heated melts to a brownish-red fluid. By itself alone, selenium is too dark for a mounting medium, but by mixing with sulphur or arsenic this disadvantage is obviated. By mixing equal parts of *sulfur depuratum* and *selenium metallicum*, rubbing them together and melting in a test-tube, a red fluid is obtained, and this on cooling becomes a bright yellowish-red, and maintains its transparency for a considerable time. It seems that when mounted the preparations are cloudy or even opaque in places, and in order to remove these defects it is advisable to place the mounted preparations in a thermostat at 150°.

Of selenium compounds, selenium ethyl Se $(C_2H_5)_2$ is a fluid which possesses a boiling point between 107° and 108°. In this fluid considerable quantities of sulphur and selenium can be dissolved. In this way is produced a thick oily fluid, having a refractive index of about 1·90, and forming a medium which should meet the requirements of diatomists.

Picro-formalin in Cytological Technique.†—Mr. Graf states that the best fixative for demonstrating the cell-structure of the lower animals is picro-formol in varying strengths, 1 vol. saturated aqueous solution of picric acid and 1 vol. of 5, 10, or 15 per cent. formol, or 95 vols. picric acid solution and 5 vols. formol, or 90 vols. picric acid solution and 10 vols. formol. The animals (*Clepsine nepheloidea* sp. n. Whitm.) are placed (alive) in the mixture for 30 minutes. After immersion in alcohol of increasing strength up to absolute, they are imbedded in paraffin. Sections 3 μ thick were stained with hæmatoxylin and Bordeaux-red. By this procedure the delicacies of the cell structure, network, microsomes, and vacuoles, are rendered extremely clear.

Preservative for Freshwater Sponge.‡—Mr. F. L. Washburn finds the following solution to be of value for preserving freshwater sponges. Pure glycerin 2/3; 3 per cent. formalin 1/3. In this the green sponge will keep for at least three months, the liquid remaining perfectly clear, and allowing the external anatomy of the sponge to be beautifully seen.

(6) Miscellaneous.

Microbiological and Serotherapeutical Technique.§—M. A. Besson's guide to laboratory work, dealing with the technique of microbiology and serum therapeutics, is one that deserves to obtain universal approbation. It is divided into a general and special portion, the first describing the various methods in use at laboratories, the second describing the numerous species of pathogenic organisms. In a third section the bacteriological examination of water and air is treated of.

* Zeitschr. f. angew. Mikr., iv. (1898) pp. 6–8.
† State Hospitals Bull., 1897, No. 1; also Neurol. Centralbl., xvi. (1897) p. 550. See Zeitschr. f. wiss. Mikr., xiv. (1898) p. 469.
‡ Journ. Applied Microscopy, i. (1898) p. 73.
§ Paris, 1898, 223 figs. See Zeitschr. f. wiss. Mikr., xiv. (1898) pp. 519–20.

Camera Drawing.*—Mr. G. F. Andrews devised a method of camera drawing which proved invaluable for recording delicate appearances. Instead of white drawing-paper, he used dark shades of thin dull surface tinted papers, varying the shade and hue according to the amount of light, on the brightest days using black. The point of the pencil was whitened with Chinese white. This device obviated the necessity for using smoked glasses in the camera. There was a notable gain in light and definition. Various coloured crayons to differentiate optical planes or cell-series were used, and sometimes a brass or an ivory point.

* Zeitschr. f. wiss. Mikr., xiv. (1898) pp. 451-2.

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on June 15th, 1898, at 20 Hanover Square, W., The President, E. M. Nelson, Esq., in the Chair.

The Minutes of the Meeting of May 18th, 1898, 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
Verslag der algemeene vergadering, 1897. (8vo, Utrecht, 1897)	*La Société Provinciale des Arts et Sciences, établie à Utrecht.*
Aanteekeningen van de sectie vergaderingen, 1897. (8vo, Utrecht, 1897)	
Alfred C. Coles, M.D., The Blood: how to examine and diagnose its diseases. (8vo, London, 1898.)	*Mr. George Pearce.*
Marian S. Ridley, A pocket guide to British Ferns. (16mo, London, 1881.)	*Mrs. M. S. Farquharson (née Ridley).*
Lithograph Portrait of Professor John Quekett, by Wm. Lens Aldous.	*Mr. C. Lens Aldous.*

The President said that since their last meeting the Society had lost one of its oldest Fellows, Mr. Henry Perigal, who had died at the advanced age of 98, and certainly had attended their meetings when he was at least 93 or 94. He did not know Mr. Perigal personally very well, but whilst looking up some interesting details as to some old Microscopes in the Society of Arts Journal he came across an interesting paper on the way in which the great monoliths at Stonehenge could have been moved and erected without the use of other than savage appliances; and on looking for the name of the author, he found it was Henry Perigal.

On turning over a few pages he found in the same journal an announcement that a prize had been awarded to Master J. E. Millais for a sepia drawing, so that at the time when Mr. Perigal was writing papers like that, the late President of the Royal Academy was a boy; yet Mr. Perigal had survived him. This forcibly brings to one's mind what 98 means. Mr. Perigal did a great deal of work with the lathe, especially with elliptic and eccentric chucks. A microphotograph of him, and also an ordinary photograph, were on the table that evening.

In addition to the presents already mentioned, he would call the attention of the Fellows to an excellent lithographic portrait of Professor John Quekett, which had been presented to the Society by Mr. Aldous. These portraits were the work of Mr. Aldous' father, and some of these having been lately found, the one before them had been very kindly given to the Society, for which he was sure their hearty thanks would be returned.

Mr. J. J. Vezey said he should like to be permitted to supplement the remarks made by the President respecting Mr. Perigal. He thought it would interest the Fellows to be reminded that Mr. Perigal joined the Society in 1852; and though microscopy had not been so great a hobby with him as astronomy and geometry, yet he always took the keenest interest in the proceedings of the Society, as indeed he did in all the numerous scientific societies to which he belonged. Mr. Vezey had had the pleasure of paying Mr. Perigal a weekly visit for many years past, and he could testify to the eagerness with which he wished to be informed of all that was going on in the scientific world, especially since the time when he had been obliged to relinquish his attendance at the meetings. Mr. Vezey felt sure Fellows would greatly regret the removal of a notable name from their roll of membership. Mr. Perigal died on the 6th June, and Mr. Vezey had seen him so lately as the 3rd June.

Mr. Swift, being called upon by the President, said that he had brought to the meeting a camera lucida, and also a new monochromatic screen for exhibition. These were both made by Mr. F. E. Ives; and as that gentleman was in the room he would ask him to describe them.

Mr. Ives said that the camera lucida did not present any great novelty in principle. He had merely taken one which he found in Mr. Swift's show case, and had slightly modified it by depositing on one of the inside faces of the compound prism a very thin specular film of silver through which it was possible to see the pencil without having to centre the eye, as was formerly the case where the film was thick and opaque with a small hole left to look through, as in the Abbe camera lucida. The other thing was the result of his attempts to make a monochromatic green screen by means of dyed films between two plates of glass, which he thought would be found to possess some advantages over the liquid screens in use. The one now shown would cut off all beyond the F line on the blue side (including the ultra-violet), and also all red and yellow. Nothing whatever but green light was transmitted.

Mr. C. Beck thought it was a fact that Zeiss had made a camera lucida on this principle, which had a very thin silvering between two prisms; this was used with a side reflector—the President would perhaps remember it.*

Mr. Swift said he had never seen one of this kind, and did not know of any which carried out the idea in the way Mr. Ives had done it.

The President thought the method was a very valuable one, and he did not remember ever having seen this idea carried out in this way before. It certainly seemed preferable to the method of a thick film of silver with a hole in it.

Mr. Swift said there certainly was some difficulty in centering the eye properly in the old form which did not exist in the one before them; the pencil used for making the drawing being seen with a considerable amount of ease whilst tracing over the object under observation.

In reply to an inquiry, if this really gave monochromatic or only coloured light, and what was the wave-length,—

Mr. Ives said that, of course, the light was not strictly monochromatic, although it was all spectrum green. It was a mixture of the pure green in the spectrum at the E line, with some yellow-green on one side and blue-green on the other. The screen transmitted very freely a well defined band in the spectrum, with the E line in the middle of it. A screen could be made to transmit a broader or narrower band of the spectrum, and more towards the red or the blue, if desired.

The thanks of the meeting were unanimously voted to Mr. Ives for his exhibits.

The President exhibited and described two old Microscopes, one of which, made by Benjamin Martin, probably dated from about 1770, and the other, made by Cary, somewhere about 1740 (see p. 473).

The President said that Mr. B. W. Priest had taken the trouble to bring down to the meeting a remarkably beautiful collection of microscopic preparations of Sponges for exhibition. He hoped Mr. Priest would favour them with a few remarks upon the subject.

Mr. Priest said that he had much pleasure in responding to a request from the Society that he would give an exhibition of slides of sponges, but he had done so upon the understanding that it would be impossible for him to read a paper describing the different specimens exhibited, as he felt he could not, in the time at his disposal, do justice to so vast a subject. He had brought a selection, which he trusted would be sufficiently characteristic, of the order Calcarea and the three sub-orders of Silicea, namely, the Monaxonidæ, Tetractinellidæ, and Hexactinellidæ. He had placed cards with each instrument specifying the name of the exhibit, and might perhaps call attention more particularly to the Hexactinellidæ, on account of their extreme beauty and complexity of detail. There were also some slides of freshwater sponges, showing the statoblasts, so named by his late friend Mr. H. T. Carter of Budleigh Salterton, because of their strong resemblance to the statoblasts of the

* Since the meeting Mr. Beck has written to say that the camera referred to was made by Nachet, and had a gilding used instead of silvering.

freshwater Polyzoa. He should be very pleased after the meeting to answer questions or give any information desired as to any special slide.

The Secretary said they had received a paper by Mr. Millett in continuation of his former communication on the Foraminifera of the Malay Archipelago (see p. 258). It was no doubt a paper of value, but was highly technical, and as it would appear *in extenso* in the Journal, he hoped he should be excused from reading it to the meeting.

The paper was then taken as read.

The President said that their hearty thanks were due to Mr. Priest for so kindly bringing down these very beautiful slides for exhibition. Their thanks were also due to Mr. Baker for the loan on that occasion of the number of Microscopes on the tables, by means of which it had been possible to show so large a number of objects.

Votes of thanks to Mr. B. W. Priest and Mr. Baker were then put to the meeting, and carried with acclamation.

The President reminded the Fellows present that the next meeting of the Society would not take place until October 19th, and wished them all a pleasant vacation.

It was announced that the library would be closed from August 12th to September 12th.

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

The Society:—A Microphotograph and a Carte-de-visite of the late Mr. Henry Perigal, date about 1855 to 1857.

The President:—An old Microscope made by Benjamin Martin and another made by Cary.

Mr. Swift:—A Camera Lucida, and a new Monochromatic Light-Screen designed by Mr. Fred. E. Ives.

Mr. W. B. Priest:—Slides of the following Sponges:—CALCAREA: *Grantia ciliata*; ditto opaque, showing vents; *G. compressa*, showing ova; *Leucosolenia botryoides*; *L. lacunosa*. HEXACTINELLIDÆ: *Aphrocallistes Beatrix*; *A. Bocagei*; *Euplectella aspergillum*, showing florocome spicules; *Farrea fecunda*; *F. spinulenta*; *Hyalonema Sieboldi*, showing amphidiscs; *Lanuginella pupa*; *Myliusia callocyathes*; *Periphragella elisae*; *Semperella Schultzi*. LITHISTIDÆ: *Discodermia polydiscus*. MONAXONIDÆ: *Hymeniacidon celata*, boring sponge; *Raphidotheca Marshall Hallii*. TETRACTINELLIDÆ: *Ecionema acervus*, vertical section; *Geodia Barretti*, vertical section; *G. McAndrewi*, spicules and sterrasters; *Pachymatisma Johnstoni*, vertical section. FOSSIL SPONGE: *Cœloptychium agaricoides*, showing lantern-like processes. FRESHWATER

SPONGES: *Meyenia fluviatilis*, showing statoblasts; *M. fluviatilis* var. *Meyeni*, showing statoblasts; *Spongilla fragilis*, showing statoblasts. Group of SPONGE SPICULES.

New Fellows:—The following were elected *Ordinary* Fellows:—Mr. Theodor A. Delcomyn, Mr. James Pike, and Prof. W. F. R. Weldon, F.R.S.

JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.
OCTOBER 1898.

TRANSACTIONS OF THE SOCIETY.

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

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

(*Read* 15*th June*, 1898.)

Plates XI. and XII.

Group of *Miliolina circularis* Bornemann sp.

Miliolina circularis Bornemann sp., plate XI. figs. 1–3.

Triloculina circularis Bornemann, 1855, Zeitschr. d. Deutsch. Geol. Gesell., vol. vii. p. 349, pl. xix. fig. 4. *T. enoplostoma* var.

EXPLANATION OF PLATES.

Plate XI.

Fig. 1.—*Miliolina circularis* Bornemann sp., Triloculine form. × 75.
„ 2. „ „ „ Biloculine form. × 90.
„ 3. „ „ „ Quinqueloculine form. × 60.
„ 4. „ „ var. *sublineata* Brady. × 60.
„ 5. „ *valvularis* Reuss sp., Triloculine form. × 60.
„ 6. „ „ „ Biloculine form. × 90.
„ 7. „ „ „ Quinqueloculine form. × 60.
„ 8, 9. „ *labiosa* d'Orbigny sp. Fig. 8 × 60, fig. 9 × 90.
„ 10, 11. „ *tricarinata* d'Orbigny sp., striate form = *M. Terquemiana* Brady. Fig. 10 × 90, fig. 11 × 40.
„ 12. „ „ d'Orbigny sp., reticulated form = *M. Bertheliniana* Brady. × 90.
„ 13. „ *suborbicularis* d'Orbigny sp. × 90.

Plate XII.

Fig. 1 *a, b, c.*—*Miliolina Parisiensis* d'Orbigny sp. × 55.
„ 2 *a, b.* „ *Cuvieriana* d'Orbigny sp. × 30.
„ 3 *a, b, c.* „ *cristata* sp. n. × 135.
„ 4 *a, b.* „ *Parkeri* Brady. × 30.
„ 5 *a, b, c.* „ *undosa* Karrer sp. × 75.
„ 6 *a, b.* „ *Ferussacii* d'Orbigny sp. × 60.
„ 7 *a, b, c.* „ „ „ var. × 60.
„ 8 *a, b.*—*Articulina lineata* Brady, smooth var. × 90.
„ 9, 10 *a, b, c.* „ *conico-articulata* Batsch sp. Fig. 9 × 60, fig. 10 × 90.
„ 11. „ *funalis* var. *inornata* Brady. × 60.

grammostomum Reuss, 1867, Sitzungsb. k. Akad. Wiss. Wien, vol. lv. Abth. i. p. 72, pl. ii. fig. 5. *Biloculina ventruosa* Reuss, 1867, ibid., p. 69, pl. i. fig. 9. *Miliolina circularis* (Born.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. Abth. ii. p. 235, pl. ii. figs. 61–63. *M. circularis* (Born.) Jones, 1895, Palæontographical Soc., p. 121, pl. v. fig. 4.

Continuing with the forms which typically have the chambers round or crescentiform in cross section, by imperceptible degrees changing into those in which the chambers become angular or carinate, we have now to treat of the short robust forms, in which the long straight chambers characteristic of *M. oblonga* are replaced by short ones, more or less curved.

M. subrotunda would almost as well have served for the type; but on the whole *M. circularis* appears to possess a larger number of the characters common to the group. As shown by the figures on plate XI., it exists in the Biloculine, Triloculine, and Quinqueloculine forms, all of which are edentate and have an aperture formed simply by a tent-like fold of the last added chamber, leaving the surface of the penultimate chamber exposed.

The Biloculine form, fig. 2, appears to be the *B. ventruosa* of Reuss. Although the specimen selected for illustration approaches *Biloculina sphæra* d'Orbigny, there are many others which are identical with *B. ventruosa* as figured by Reuss. Fig. 1 is the *Triloculina circularis* of Reuss, whilst the Quinqueloculine form, fig. 3, is scarcely separable from *Miliolina subrotunda* Montagu. The admirable researches of MM. Schlumberger and Munier-Chalmas show that individuals of the Miliolinæ in various stages of growth assume Biloculine, Triloculine, and Quinqueloculine characters. In the examination of a large series of specimens it is scarcely practicable to apply Schlumberger's laborious method of research; but there are on the exterior of the test certain characters, too subtle for scientific definition and appreciable only by a faculty we all possess which is somewhat akin to instinct—the kind of faculty which, to use a common illustration, enables the shepherd to identify each individual member of his flock, although at the same time he is totally incapable of defining the minute differences which serve to distinguish one from the others. By the exercise of some such quality of the mind, we arrive at the conclusion that the three forms in question can be no other than variations of *M. circularis*. Speaking of *M. procera*, Dr. Axel Goës says,* "It seems to be clearly allied to *M. circularis* (Bornem.) Br., the chief difference being its quinqueloculine arrangement of the chambers." Dr. Goës has thoroughly studied the subject, and his opinion is of great value; still, although fig. 3 is Quinqueloculine, it possesses too many of the characters of *M. circularis* to be separated from it with advantage.

* Bull. Mus. Comp. Zoology at Harvard College, vol. xxix. No. 1, 1896, p. 82.

The Biloculine form has been found only at Stations 14 and 22. The other forms occur at most of the Stations, the Quinqueloculine being the most numerous of the three.

'Challenger' Stations are Prince Edward's Island, Kerguelen Islands, and Bass Straits. Amongst other localities Dr. Egger records it from two 'Gazelle' Stations off the coast of Australia.

Miliolina circularis var. *sublineata* Brady, plate XI. fig. 4.

Miliolina circularis var. *sublineata* Brady, 1884, Chall. Rept., p. 169, pl. iv. fig. 7. *M. circularis* var. *sublineata* Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. Abth. ii. p. 237, pl. ii. figs. 78, 79.

This rare variety differs from the 'Challenger' and 'Gazelle' forms in having a cribrate aperture. The shell is thin and subtranslucent, as in the 'Challenger' specimens. In size it considerably exceeds the specimens of *M. circularis* with which it is associated in the Malay Archipelago.

It is rather plentiful at several stations in both areas.

Brady gives but one locality, "off the Admiralty Islands on the north coast of New Guinea"; and the sole 'Gazelle' station is off the coast of Mauritius.

Miliolina valvularis Reuss sp., plate XI. figs. 5–7.

Triloculina valvularis Reuss, 1851, Zeitschr. Deutsch. Geol. Gesell., vol. iii. p. 85, pl. vii. fig. 56. ?*Miliolina valvularis* (Reuss) Brady, Chall. Rept., p. 161, pl. iv. figs. 4, 5. *Miliolina valvularis* (Brady) Goës, 1894, Kongl. Svenska Vet.-Akad. Handl., vol. xxv. p. 115, pl. xxii. fig. 871.

Whilst the aperture of this species, in general form, is similar to that of *M. circularis,* it differs in being provided with a tooth or valve which varies in size and form from a mere tubercule on the penultimate chamber to a large valve covering the whole of the aperture with the exception of a narrow semicircular slit at the margin. Speaking of *M. valvularis*, Brady says,* "The species is one of the few that may rank with *Miliolina trigonula* and *Miliolina tricarinata* as a true *Triloculina*"; but in the Malay Archipelago it occurs also in the Biloculine and Quinqueloculine forms, and the figures by Goës above referred to represent it as having but two chambers visible externally; however, these have not the symmetry characteristic of *Biloculina*, and the arrangement of the earlier chambers is Triloculine or Quadriloculine.

The *Quinqueloculina dilatata* d'Orb., from the Gulf of Marseilles, figured by Schlumberger,† resembles the wild growing forms of *M. valvularis*. Biloculine forms similar to this species, if not identical,

* 'Challenger' Report, 1884, p. 161.

† Mém. Soc. Zool. France, vol. vi. 1893, p. 217, fig. 30 and pl. iii. figs. 73, 74.

are *B. globulus* Bornemann, *B. Grinzingensis* Karrer, and *B. ringens* var. Balkwill and Wright.

In the Malay Archipelago the distribution is similar to that of *M. circularis*, but it is less abundant.

The 'Challenger' specimens were obtained on the north-east coast of New Zealand. Those described by Dr. Goës were from the North Atlantic, from deep water in both instances.

Miliolina labiosa d'Orbigny sp., plate XI. figs. 8, 9.

Triloculina labiosa d'Orb., Foram. Cuba, p. 178, pl. x. figs. 12–14. *Miliolina labiosa* (d'Orb. sp.) Brady, 1884, Chall. Rept., p. 170, pl. vi. figs. 3–5.

This very unsatisfactory species occurs at only a few of the Stations, and never in great abundance. In form it ranges from *Nubecularia Bradyi* to *Miliolina valvularis*, the specimen figured being one of the most symmetrical.

D'Orbigny describes it as tolerably numerous in the sands of Cuba, and it is recorded from numerous 'Challenger' Stations.

Miliolina subrotunda Montagu sp.

"Serpula subrotunda dorso elevato," Walker and Boys (1784), Test. Min., p. 2, pl. i. fig. 4. *Vermiculum subrotundum* Montagu, 1803, Test. Brit., part ii. p. 521. *Miliolina subrotunda* (Walk. and Boys) Goës, 1894. Kongl. Svenska Vet.-Akad. Handl., vol. xxv. p. 109, pl. xix. figs. 846, 847. *Miliolina subrotunda* Jones, 1895, Palæontographical Soc., p. 120, woodcut, fig. 9.

In the Malay Archipelago typical forms of this ubiquitous species are not common, most of the specimens possessing some of the characters of *M. circularis* and *M. valvularis*.

It appears in Prof. Bütschli's list of Foraminifera from the Malay Archipelago.

Miliolina suborbicularis d'Orbigny sp., plate XI. fig. 13.

Quinqueloculina suborbicularis (d'Orb.) Schlumberger, 1893, Mém. Soc. Zool. France, vol. vi. p. 73, plate ii. figs. 63, 64, pl. iii. fig. 67, and woodcuts, figs. 26–28.

The Malay specimens, as will be seen from the illustrations, closely resemble those from the Gulf of Marseilles figured by Schlumberger.

It is moderately abundant at a few of the Stations.

Under the name of *M. Fichteliana*, Brady records it from Madagascar, the Inland Sea of Japan, and the Chinese Seas.

Miliolina tricarinata d'Orbigny sp.

Triloculina tricarinata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 299, No. 7. *Miliolina (Triloculina) tricarinata* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. Abth. II. p. 234, pl. ii. figs. 35–37. *M. tricarinata* (d'Orb.) de Amicis, 1893, Boll. Soc. Geol. Ital., vol. xii. fasc. 3, p. 30, pl. iii. fig. 2. *M. tricarinata* (d'Orb.) Goës, 1894, Kongl. Svenska Vet.-Akad. Handl., vol. xxv. p. 114, pl. xxi. figs. 866–869. *M. tricarinata* (d'Orb.) Jones, 1895, Palæontographical Soc., p. 119.

This very common species is well represented, being found at most Stations in both areas. It appears in Prof. Bütschli's list of Foraminifera from the Malay Archipelago.

Miliolina tricarinata, striate var., plate XI. figs. 10, 11.

Miliolina Terquemiana Brady, 1884, Chall. Rept., p. 166, pl. cxiv. fig. 1.

This striate variety is not uncommon in the Malay Archipelago, and is most abundant in Area 1. Its characters are distinctly those of *M. tricarinata,* and there are no passage forms towards *M. trigonula.* Brady writes,* "*Miliolina terquemiana* is exceedingly rare. Hitherto I have only seen specimens from two localities, namely, in shallow-water sand, dredged off Calpentyn, Ceylon, and in littoral sand from the east coast of Madagascar."

Miliolina tricarinata, reticulated var., plate XI. fig. 12.

Miliolina Bertheliniana Brady, 1884, Chall. Rept., p. 166, pl. cxiv. fig. 2.

This variety is very rare in the Malay Archipelago, being represented by one specimen only from Station 2. Its form is that of *M. tricarinata,* but approaching that of *M. trigonula.* Brady gives four localities: "Off Ascension Island, 7 fathoms; off Calpentyn, Ceylon, 2 fathoms; and in the shore-sands collected by Mr. Kitching near Tamatavé, Madagascar, and near Port Elizabeth, Algoa Bay."

Miliolina trigonula Lamarck sp.

Miliolites trigonula Lamarck, 1804, Ann. du Mus., vol. v. p. 351, No. 3. *Miliolina trigonula* (Lam.) Sherborn and Chapman, 1889, Journ. Roy. Micr. Soc., p. 484, pl. xi. fig. 1. *M. trigonula* (Lam.) Terrigi, 1891, Mem. R. Com. Geol. Ital., vol. iv. part i. p. 66, pl. i. fig. 4. *M. trigonula* (Lam.) Goës, 1894, Kongl. Svenska Vet.-Akad. Handl., vol. xxv. p. 115, pl. xxii. fig. 870.

This form, like *M. tricarinata,* is represented at most of the Stations in both areas, but is not quite so abundant.

Miliolina trigonula, striate var.

Miliolina insignis Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. N.S. p. 45. *Miliolina insignis* Brady, 1884, Chall. Rept., p. 165, pl. iv. figs. 8, 10.

* 'Challenger' Report, 1884, p. 166.

This variety is rare in the Malay Archipelago, although it occurs at three Stations.

Brady gives several localities, amongst them Bass Straits and the coast of Java.

Miliolina Parisiensis d'Orbigny sp., plate XII. fig. 1, *a, b, c.*

Quinqueloculina Parisiensis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 301, No. 5 (not described). *Q. Parisiensis* d'Orbigny, 'Planches Inédites,' pl. i. fig. 1. *Q. Parisiensis* d'Orbigny, 1850, 'Prodrome de Paléontologie,' vol. ii. p. 409. *Q. Parisiensis* (d'Orb.) Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii. p. 181, pl. xix. fig. 21.

Although the Malay specimens of this pretty little form do not accord in all respects with the figures given and referred to by Terquem, yet so many of the characters are similar that there need be no difficulty in referring them to the same species.

D'Orbigny's references are to the figures in the 'Planches Inédites,' and his only published description is in the Prodrome, "Espèce renflée et striée." Thanks to the kindness of Signor Fornasini of Bologna, I am in possession of a tracing of the figure in the 'Planches Inédites'; this represents an elongate Quinqueloculine shell, with fine striæ and an edentate circular aperture at the extremity of a short prolongation of the anterior portion of the last formed chamber.

The unnamed and undescribed figures in 'Description des Coquilles fossiles des environs de Paris,' by Deshayes, referred to by Terquem, represent tests with simple longitudinal striæ; whilst Terquem describes his specimens as having longitudinal costæ with the intervals marked by a series of perforations. In the Malay specimens, as shown by the figure, the sculpture consists of transverse costæ crossed at right angles by larger longitudinal ribs. The aperture has three or more lobes, with sometimes traces of an obscure tooth. The test is Triloculine, and the shell substance thin and fragile.

It occurs only at Station 2, and there very sparingly.

Miliolina reticulata d'Orbigny sp.

Triloculina reticulata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 299, No. 9. *Miliolina (Triloculina) reticulata* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 239, pl. ii. figs. 83, 84. *Quinqueloculina reticulata* (d'Orb.) Schlumberger, 1893, Mém. Soc. Zool. France, vol. vi. p. 214, fig. 25 and pl. ii. fig. 62.

In this common species the Quinqueloculine form usually has the chambers circular in transverse section, whilst in the Triloculine form they are generally more or less angular.

It is common at several Stations, mostly in Area 1.

Group of *Miliolina seminulum.*

Miliolina seminulum Linné sp.

Serpula seminulum Linné, 1767, Syst. Nat., 12th ed., p. 1264, No. 791. *Miliolina seminulum* (Linné) Jones, 1895, Pal. Soc., p. 116, pl. iii. figs. 35, 36.

Although this grouping of the *Miliolinæ* is far from natural, as indeed any system must be which aims at linking together the different forms in a linear series, it serves to bring together forms which the profusion of intermediate specimens in this collection shows to be nearly related.

In this group, chambers with the rounded transverse section cease to be the rule, and in most of the forms the chambers are angular or carinate.

M. seminulum occurs so abundantly in all seas and at all depths, that it is needless to specify localities. In the Malay Archipelago it is as numerous and as widely distributed as elsewhere.

Miliolina Auberiana d'Orbigny sp.

Quinqueloculina Auberiana d'Orbigny, 1839, Foram. Cuba, p. 167, pl. xii. figs. 1–3. *M. Auberiana* (d'Orb.) Goës, 1894, Kongl. Svenska Vet.-Akad. Handl., vol. xxv. p. 109, pl. xix. fig. 844, *a–d*.

This stout angular variety is not common in the Malay Archipelago, and does not appear to have been hitherto recorded from this region, although Bütschli in his list gives *M. triangularis*, which is a closely allied variety, differing in little more that the amount of acuteness of the periphery. A. Silvestri * records it from two localities in the Adriatic.

Miliolina Cuvieriana d'Orbigny sp., plate XII. fig. 2 *a, b*.

Quinqueloculina Cuvieriana d'Orbigny, 1839, Foram. Cuba, p. 190, pl. xi. figs. 19–21. *Miliolina Cuvieriana* (d'Orb.), Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., p. 234, pl. ii. figs. 47–49 and pl. iv. figs. 22–24. *M. Cuvieriana* (d'Orb.) Jones, 1895, Pal. Soc., p. 119, pl. vi. fig. 4 *a, b*.

In his description of this species d'Orbigny states that two or three longitudinal striæ accompany the keel on each side of it. In the figure in the Cuba Memoir these striæ are represented, but they do not appear in any other of the figures ascribed to this species. The *Q. Schroekingerii* var. *Calabra* Seguenza † has the peripheral edges of the chambers flattened and striate. The *Q. seminuda* of Reuss ‡ has the periphery rounded and striate; whilst Terquem,§ regardless of

* Atti e Rendic. d. Accad. Sci. Lett. e Arti d. Zelanti e PP. dello Studio di Acireale, vol. viii. 1896–7, p. 15.

† R. Accad. dei Lincei, 1880, p. 154, pl. xiv. fig. 13.

‡ Denkschr. k. Akad. Wiss. Wien, vol. xxv. 1865, p. 125, pl. i. fig. 11.

§ Mém. Soc. Géol. France, sér. 3, vol. i. 1878, p. 76, pl. xiv. fig. 8.

priority of nomenclature, names a form *Q. seminuda* in which the peripheral striæ are replaced by costæ. Brady,* Egger, and T. Rupert Jones all figure the species without striæ or costæ, and specimens of this kind occur in the Malay Archipelago, but not so abundantly as the costate form figured. The proportion of the peripheral margin marked by costæ varies in different specimens, the tendency always being to develop in the direction of *M. bicornis*.

It is most abundant and attains its greatest size at Station 14, but it occurs at a few other Stations.

Miliolina cristata sp. n., plate XII. fig. 3 *a*, *b*, *c*.

Test nearly circular, unequally biconvex, chambers triangular in cross-section, peripheral margin acute, that of the last formed chamber boldly serrated, aperture with a thickened margin, dentate. Length 0·20 mm.

This description will serve to identify a minute form whose zoological position appears to be between *M. Cuvieriana* d'Orbigny and *M. venusta* Karrer. It may possibly be allied to *M. excisa* Brady, Parker, and Jones,† from the Abrolhos Bank.

The solitary specimen is from Station 22.

Miliolina venusta Karrer sp.

Quinqueloculina venusta Karrer, 1868, Sitzungsb. k. Akad. Wiss. Wien, vol. lviii. p. 147, pl. ii. fig. 6. *Miliolina venusta* (Karrer) Sherborn and Chapman, 1889, Journ. Roy. Micr. Soc., p. 2, pl. xi. figs. 2, 3. *M. venusta* (Karrer) Chapman, 1891, Journ. Roy. Micr. Soc., p. 573, pl. ix. figs. 5, 6. *M. venusta* (Karrer) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 235, pl. ii. figs. 56–58.

As might be expected of this essentially deep-water species, it is but scantily represented in the anchor-mud from the Malay Archipelago, although it occurs at several of the Stations.

One of the 'Gazelle' Stations is Western Australia; and under the name of *M. Candeiana*, Dr. Goës ‡ records it from the North Atlantic.

Miliolina undosa Karrer sp., plate XII. fig. 5 *a–c*.

Quinqueloculina undosa Karrer, 1867, Sitzungsb. k. Akad. Wiss. Wien, vol. lv. p. 361, pl. iii. fig. 3. *Miliolina undosa* (Karrer) Egger, 1893, Abhandl. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 237, pl. ii. figs. 41, 42.

Brady remarks,§ "this is a Quinqueloculine variety, somewhat of the '*Ferussacii*' type." Of the specimens figured by Brady on

* 'Challenger' Report, 1884, p. 162, pl. v. fig. 12.
† Trans. Zool. Soc., vol. xii. 1888, p. 215, pl. xl. fig. 33.
‡ K. Svenska Vet.-Akad, Handl., vol. xxv. No. 9, 1894, p. 109, pl. xix. fig. 845.
§ 'Challenger' Report, 1884, p. 176.

pl. vi., figs. 6 and 7 resemble *M. bicornis* in general contour, whilst figs. 8 *a*, *b* appear to be more nearly related to *M. Ferussacii*. The Malay specimens, as shown by the figures, approach still more closely to the thin elongate forms of *M. Ferussacii*, and Egger's specimens seem to be of the same character. The *Quinqueloculina signata* of Reuss * combines the characters of *M. undosa* and of *M. Ferussacii*, and is of much interest as an instructive intermediate form. Judging from external appearances, *Q. undulata* d'Orbigny, described and figured by Schlumberger,† pl. i. figs. 53, 54, differs from *M. undosa* in having traces of longitudinal costæ, whilst pl. ii. figs. 60, 61, resembles the typical *M. bicornis* as figured by many authors.

It occurs at Stations in both Areas, but is not very abundant.

The localities given by Brady are "Challenger Station 162, off East Moncœur Island, Bass Strait, 38 fathoms; but it occurs also on the coral reefs of the Sandwich Islands, 40 fathoms; on the south coast of Papua, Flinders Passage, 7 fathoms; and off Ascension Island, 7 fathoms." Egger records it only from Mauritius. A. Silvestri has found it in the Adriatic. Schlumberger's specimens of *Q. undulata* are from the Gulf of Marseilles.

Miliolina Parkeri Brady, plate XII. fig. 4 *a*, *b*.

"*Quinqueloculina* with oblique ridges," Parker, 1858, Trans. Micr. Soc. London, N.S., vol. vi. p. 53, pl. v. fig. 10. *Miliolina Parkeri* Brady, 1881, Quart. Journ. Micr. Sci., N.S., vol. xxi. p. 46. *M. Parkeri* Brady, 1884, Chall. Rept., p. 177, pl. vii. fig. 14.

This species seems to be nothing more than a robust and complex form of *M. undosa*. The passage-forms are numerous and varied, making a complete series from the one to the other. The Malay specimens are large and well developed, and are less triangular, that is to say, more rounded at the periphery, than those figured by Brady.

It is most abundant and at its best at Station 22, but is found at all other Stations in both Areas. Parker's specimens were from the East Indian Seas. Brady says of it, "essentially a coral-reef species. It occurs at seven 'Challenger' Stations amongst the islands of the Pacific, and with one exception (off Tahiti, 420 fathoms), always in shallow water. It has been found in sand dredged off the Seychelles (E. P. Wright), off Java (Robertson), and in the Red Sea.'

Miliolina Ferussacii d'Orbigny sp., plate XII. figs. 6 *a*, *b*, 7 *a*, *b*, *c*.

Quinqueloculina Ferussacii d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 301, No. 18; Modèle No. 32. *Miliolina Ferussacii* (d'Orb.) var. Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. p. 325, pl. xii. figs. 10–12. *M. Ferussacii* (d'Orb.)

* Denkschr. k. Akad. Wiss. Wien, vol. i. 1850, pl. l. fig. 11.

† Mém. Soc. Zool. France, vol. vi. 1893, p. 213, figs. 23, 24, and pl. i. figs. 53, 54, and pl. ii. figs. 60, 61.

Sherborn and Chapman, 1886, Journ. R. Micr. Soc., p. 742, plate xiv. fig. 5. *M. Ferussacii* (d'Orb.) Chapman, 1891, Journ. R. Micr. Soc., 1891, p. 574, pl. ix. fig. 8. *M. contorta* (D'Orb.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 111, pl. xx. figs. 851, 852. *M. contorta* (d'Orb.) var. Goës, 1896, Bull. Mus. Comp. Zool. at Harvard College, vol. xxix. p. 82, pl. vii. figs. 10–12; pl. viii. figs. 1–7.

This species is represented by numerous varieties, from the smooth eeble form fig. 6 to the strongly costate fig. 7; but here, as in most other regions, the variety *M. contorta* is the most abundant of them all, especially the rugose form resembling *Q. bidentata* d'Orbigny * and *Q. sclerotica* Karrer.† A considerable proportion of the specimens of the strongly costate variety show a tendency to wildness of growth, some of the later chambers deviating from the normal plan of aggregation, as in *M. separans* Brady, and in *Triloculina nodosaroides* Karrer.

This species and its varieties are common at most of the Stations in both Areas.

Its distribution in the northern hemisphere is very wide, but according to Brady, in the southern hemisphere it has only been noted at two or three points on the coast of Australia, one of which is Raine Island, Torres Strait.

Miliolina agglutinans d'Orbigny sp.

Quinqueloculina agglutinans d'Orbigny, 1839, Foram. Cuba, p. 168, pl. xii. figs. 11–13. *Miliolina agglutinans* (d'Orb.) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. p. 355, pl. xiii. figs. 1–3. *M. agglutinans* (d'Orb.) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 215, pl. xl. figs. 34, 35. *M. agglutinans* (d'Orb.) Chapman, 1891, Journ. R. Micr. Soc., p. 574, pl. ix. fig. 7. *M. agglutinans* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 239, pl. ii. fig. 55. *M. agglutinans* (d'Orb.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 110, pl. xix. fig. 848 and pl. xx. fig. 849.

Included in this so-called species are the agglutinate forms of *M. Ferussacii* and *M. seminulum.* To the former of these belong the *Quinqueloculina agglutinans* and *Q. enoplostoma* of the Cuba Memoir, these having the contour of *M. contorta,* which again, when it has a rough surface, is the *M. sclerotica* of Karrer, and this form sometimes agglutinates sand-grains, or incorporates them sparingly into its shell-substance. The specimens figured by Brady, Balkwill, and Wright, Brady, Parker, and Jones, Chapman and Egger, are of the *seminulum* type, as are also some of those figured by Goës, whilst others have the form of *M. contorta* and *M. Cuvieriana.*

* Foram. Cuba, 1839, p. 197, pl. xii. figs. 18–20.
† Sitzungsb. k. Akad. Wiss. Wien, 1868, p. 152, pl. iii. fig. 5.

The Malay specimens are all of the *seminulum* type; they occur at several Stations in both Areas, but are nowhere abundant.

Miliolina pulchella d'Orbigny sp.

Quinqueloculina pulchella d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 303, No. 42. *M. pulchella* (d'Orb.) Jones, 1895, Pal. Soc., p. 123, pl. vi. fig. 3. *M. pulchella* (d'Orb.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 114, pl. xxi. figs. 862–864.

This species, whose surface ornament often combines the fine striæ of *M. bicornis* with the strong costæ of *M. Ferussacii*, is here represented only by a few feeble specimens.

Miliolina Linnæana d'Orbigny sp.

Triloculina Linneiana d'Orbigny, 1839, Foram. Cuba, p. 172, pl. ix. figs. 11–13. *Miliolina Linnæana* (d'Orb.) Brady, 1884, Chall. Rep., p. 174, pl. vi. figs. 15–20. ?*Miliolina* (*Triloculina*) *Linnæana* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 239, pl. ii. figs. 80, 81.

The Malay specimens resemble those figured by Brady, the costæ being irregular and sometimes interrupted or bifurcate.

It occurs sparingly at a few Stations.

The localities named by Brady are West Indies, Madagascar, and eight 'Challenger' Stations in the neighbourhood of the coral islands of the Pacific, within the tropical zone. Egger's rather doubtful example is from Mauritius.

Miliolina bicornis Walker and Jacob sp.

Serpula bicornis ventricosa Walker and Boys, 1784, Test. Min., p. 1, pl. i. fig. 2. *Miliolina bicornis* (Walker) Williamson, 1858, Rec. Foram. Great Britain, p. 87, pl. vii. figs. 190–195. *Adelosina bicornis* (W. and J.) Schlumberger, 1886, Bull. Soc. Zool. France, vol. xi. p. 546, figs. 1–5, and pl. xvi. figs. 10–15. *M. bicornis* (W. and J.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 237, pl. ii. figs. 73, 74. *M. elegans* (Williamson) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 112, pl. xx. fig. 857. *M. bicornis* (W. and J.) Goës, ibid., p. 113, pl. xxi. figs. 860, 861. *M. bicornis* (W. and J.) Madsen, 1895, Meddelelser fra Dansk Geol. Forening, No. 2, p. 180, pl. fig. 1.

This species is most numerously represented by its elongate form, which, as before mentioned, merges into the costate variety of *M. Bosciana*.

It is abundant in Area 1, but occurs also in Area 2.

The 'Gazelle' specimen figured by Egger is of the elongate variety, and closely resembles the *M. bicornis* var. *elegans* of Williamson. It is from Mauritius, the only Station named for the species.

Miliolina Boueana d'Orbigny sp.

Quinqueloculina Boueana d'Orbigny, 1846, Foram. Foss. Vienne, p. 293, pl. xix. figs. 7–9. *M. Boueana* (d'Orb.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 114, pl. xxi. fig. 865.

This form is not well represented, and the specimens might almost with as much reason have been included in the *Miliolina oblonga* group.

It occurs at a few Stations in both Areas.

Miliolina alveoliniformis Brady.

M. alveoliniformis Brady, 1879, Quart. Journ. Micr. Sci., N.S., vol. xix. p. 54. *Schlumbergerina areniphora* Munier-Chalmas, 1882, Bull. Soc. Géol. France, sér. 3, vol. x. p. 425, figure. *M. alveoliniformis* (Brady) Brady, 1884, Chall. Rept., p. 181, pl. viii. figs. 15–20. *M. alveoliniformis* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 232, pl. ii. figs. 17–19.

This abnormal form of *Miliolina* is tolerably common and well developed at Station 22 in Area 2. All the specimens have the porous aperture as represented by Brady and Munier-Chalmas, thus differing from the example figured by Egger. In my cabinet are specimens from 'Challenger' Station 172, Nukualofa, Tongatabu, which are more regular in form, are entirely porcellanous, and the aperture resembles that of *M. circularis.*

Brady speaks of it as being essentially a coral reef species, and as having a wide range. The localities given by Munier-Chalmas for *Schlumbergerina areniphora* are the coast of Madagascar and the Gaboon and Torres Strait. The 'Gazelle' Stations are, off the Cape of Good Hope and Mauritius.

Sub-Family **Haueríninæ.**

Articulina d'Orbigny.

Articulina sulcata Reuss.

Articulina sulcata Reuss, 1850, Denkschr. k. Akad. Wiss., vol. i. p. 383, pl. xlix. figs. 13–17. *A. sulcata* (Reuss) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. pt. vii. p. 215, pl. xl. fig. 11. *A. sulcata* (Reuss) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 243, pl. ii. fig. 5.

The specimens of this species are neither numerous nor widely distributed. They are of the form figured by Brady and by Egger, which differs slightly from those figured by other authors.

Brady records four 'Challenger' Stations, one of which is Raine Island, Torres Strait. The 'Gazelle' Stations are West Africa and Mauritius.

Articulina Sagra d'Orbigny.

Articulina Sagra d'Orbigny, 1839, Foram. Cuba, p. 183, pl. ix. figs. 23–26. *A. Sagra* (d'Orb.) Brady, 1884, Chall. Rept., p. 184, pl. xii. figs. 22–24.

None of the Malay specimens have the extreme development of the *Vertebralina mucronata* of d'Orbigny,* nor of the *A. Sagra* as figured by Brady, but they form a series extending from the Cuba specimens of the latter form to the *A. lineata* of Brady; the decoration varying from costate to striate.

It is pretty evenly distributed, although not common.

Articulina lineata Brady.

Articulina lineata Brady, 1884, Chall. Rept., p. 183, pl. xii. figs. 19–21.

As before stated, this variety is connected with *A. Sagra,* and it would perhaps be better to include it in that species. None of the Malay specimens however have the margin "thin and sharp," as have some of the 'Challenger' examples.

It occurs at the same Stations as *A. Sagra,* and is rather more abundant.

It has been found at four 'Challenger' Stations, one of which is Raine Island, Torres Strait. There seems to be no other record of its occurrence.

Articulina lineata Brady, smooth variety, plate XII. fig. 8.

This form occurs in company with *A. lineata,* and is rather more abundant. In differs only in the absence of the striations. Length 0·50 mm.

Articulina conico-articulata Batsch sp., plate XII. figs. 9, 10.

Nautilus conico-articulatus Batsch, 1791, Conch. Seesandes, p. 3, pl. iii. fig. 11. *Vertebralina conico-articulata* (Batsch) Goës, 1882, K. Svenska Vet.-Akad. Handl., vol. xix. No. 4, p. 121, pl. ix. fig. 317. *A conico-articulata* (Batsch) Brady, 1884, Chall. Rept., p. 185, pl. xii. figs. 17, 18, and pl. xiii. figs. 1, 2. *A. conico-articulata* (Batsch) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 216, pl. xl. figs. 7–9. *Articulina* sp.? Wisniowski, 1888, Jahrb. k. k. Geol. Reichs., vol. xxxviii. p. 694, pl. xiii. fig. 62. *A. conico-articulata* (Batsch) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 224, pl. iii. fig. 2. *A. extensa* Egger, 1893, ibid., p. 242, pl. iii. fig. 3.

It is unfortunate that the figure of this species given by Batsch should have been taken from a specimen in which the initial chambers are wanting, seeing that this cylindrical *Articulina* is found in two distinct forms. In one of these the earlier chambers are arranged on

* Foram. Cuba, 1839, p. 52, pl. vii. figs. 16–19.

the Milioline plan as in *A. nitida* d'Orbigny, whilst in the other the initial portion consists of a spherical primordial with circumambient chamber as in the genus *Orbitolites*. Speaking of *Vertebralina conico-articulata*, Goes remarks,* "Its most singular form is that in which the primordial chamber is flask-formed, and the subsequent chamber develops itself from the top of its neck and so on, one chamber after the other in *Nodosarina* fashion; thus its usual *Miliolina* formed stage is passed over altogether." All the Malay specimens are of this form, and are extremely attenuated. It will be noticed that the *Nubecularia tibia* (pl. v. fig. 3) has the initial chambers of this character, and it becomes a question if this species should not be removed to the genus *Articulina*. Jones and Parker remark,† "From the Clam-shells of the East Indian Seas, and from the *Strombus gigas* of the West Indies, we get minute rectilinear individuals of *Nubecularia*, with a spiral commencement (*N. tibia* var. nov.)." And again (p. 456), "Of the straight specimens (*N. tibia*) we have only fragments, the spiral portion being absent." Brady also writes,‡ "Owing perhaps to the thinness of the walls and the slenderness of the stoloniferous tubes, specimens are scarcely ever found with more than three segments." A glance at the published figures of *N. tibia* will suggest that nearly all of them represent imperfect examples, and it might reasonably be assumed that the earlier chambers were of the same character as those of the Malay specimens. In these latter the shell substance of *N. tibia* is dense and opaque, whilst that of *A. conico-articulata* is thin and somewhat translucent. It must be left to subsequent researches to prove whether *N. tibia* is a distinct species, or if it is only a smooth form of *A. conico-articulata*.

As for the latter, it may be convenient to assume that Batsch's species, as indeed the contour of the figure suggests, had the initial chambers of the *Orbitolites*-form, whilst d'Orbigny's *A. nitida* with the Milioline commencement may be treated as a distinct species.

Acting on this assumption, it may be stated that *A. nitida* is not represented in the gatherings by Goës from the Caribbean Sea, nor in Mr. Durrand's anchor mud; that, allowing for errors of interpretation, they both occur in the 'Challenger' and Abrolhos Bank collections; and that, supposing Egger's *A. extensa* to be equal to *A. conico-articulata*, they are both represented in the 'Gazelle' soundings.

For *A. conico-articulata* Egger's Stations are Mauritius and West Australia, and for *A. extensa* (which he considers a variety of *A. funalis*) Mauritius only.

In the Malay Archipelago the *Orbitolites*-form is very abundant, and occurs at nearly all the Stations in both areas.

* K. Svenska Vet.-Akad. Handl., vol. xix. 1882, p. 121.

† Quart. Journ. Geol. Soc., vol. xvi. 1860, p. 455.

‡ 'Challenger' Report, p. 135.

Articulina funalis Brady.

Articulina funalis Brady, 1884, Chall. Rept., p. 185, pl. xiii. figs. 6–11. *A. funalis* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 242, pl. iii. fig. 1.

Fragments of this species occur at a few Stations in both areas, but the initial club-shaped portion is always wanting.

'Challenger' Stations are, Kerguelen Island, off Prince Edward's Island, and Humboldt Bay on the north coast of Papua.

What appears to be a fragment of this species is represented in 'The Foraminifera of the Abrolhos Bank,' Brady, Parker, and Jones, 1888, pl. xl. fig. 7, and figs. 5 and 6 of the same plate may represent the striate and smooth forms of the like species.

Articulina funalis var. *inornata* Brady, plate XII. fig. 11.

Articulina funalis var. *inornata* Brady, 1884, Chall. Rept., p. 186, pl. xiii. figs. 3–5. *A. inornata* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 242, pl. iii. fig. 4.

Occurs at the same Stations as the typical form, and is somewhat more abundant.

The only 'Challenger' Station is Prince Edward's Island, and the only 'Gazelle' Station Mauritius; rare in both localities.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.

*Including Original Communications from Fellows and Others.**

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Span of Gestation and Cause of Birth.‡—Dr. J. Beard has given this title to another of his suggestive papers. It should have been reported on sooner, but the author gives one much to ponder over.

In the early days of Mammalian evolution, before an allantoic placenta had arisen, the birth period and the critical period coincided, as is still seen in many Marsupials. Then, too, the ovulation period must have been almost equal to—really a little longer than—the critical period. A coming ovulation, a reflex message from ovary to uterus, was the direct cause of birth.

The evolution of an allantoic placenta made it possible for birth to be postponed to a later time, for the new structure provided for the nutrition of the fœtus beyond the critical period or, more technically, beyond the single "critical unit." Then, too, the ovulation period was extended to embrace two critical units instead of one, as still seen in mouse, rabbit, &c. This marked the passage from the Metatherian to the Eutherian status.

A gestation of two units, although an advance on a gestation of one unit only, did not yield the advantages to be gained by still further prolongation to include three or more critical units. This further prolongation was acquired, but still preserved the correspondence between the length of gestation and a certain number of critical and ovulation units. Illustrations are given of cases up to eight critical units.

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

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

‡ 'The Span of Gestation and the Cause of Birth; a Study of the Critical Period and its Effects in Mammalia,' Jena, 1897, 8vo, ix. and 132 pp.

As a rule, forms with a greater number of critical units included in the gestation period are born in a condition more advanced than those with fewer. Mere length of gestation does not affect this; for a mouse attains in 20 days a degree of development as advanced as a rabbit in 30, or as a dog in 62 days.

The association of a greater degree of development at birth and an increased number of critical units embraced in gestation, is due to the fact that forms with gestation periods of several critical units, must, in their ancestral history, have passed through conditions in which the number was smaller.

But the matter is complicated by the fact that in horse, sheep, pig, and man, the critical unit seems to be no longer the equivalent of one ovulation unit, but almost of two. The gestation length has been doubled without altering the grade of development at birth, a change which is perhaps associated with a probable increase of size in the course of ancestral history.

In all mammals, ovulation is either abortive or suppressed during gestation, for its normal occurrence would lead to abortion. The *corpus luteum* is probably connected with the suppression. Its commencing degeneration some little time before the end of the gestation, like its rapid atrophy when fertilisation has not taken place, allows of preparation being made for a new ovulation. The approach of this ovulation is, in a reflex manner, the direct cause of birth.

The critical period, multiples of this, and the ovulation periods, must very frequently be times of abortion in mammals.

Menstruation is comparable to an abortion prior to a new ovulation. It is an abortion of a decidua prepared for an egg, which was given off subsequently to the preceding menstrual period, and has escaped fertilisation. It is comparable to an abortive birth at a former critical period.

Lactation, gestation, the ovulation unit, and the critical unit, are all connected as expressions of the rhythm of reproduction in mammals. The basis of this rhythm is in the ovary. By ovulation the rhythm is proclaimed throughout the reproductive life of the female; in gestation the same rhythm is maintained, but in a modified fashion; and as the span of uterine life draws to a close, it again asserts itself, and induces birth. Thus harmony and law reign in the reproductive life of Mammalia.

Our summary is very closely in the author's own words; but it must be understood that we have been forced to leave out the concrete arguments. We will quote the final sentence: "The reign of law prevails in the infinitely little no less than in the immeasurably vast; and that this should be, is probably not less momentous and vital for human existence, than that the law which moulds a tear should guide a planet in its course."

Orthogenesis.*—The late Prof. G. H. Th. Eimer used this word to denote progressive development in a definite direction, and it is pro-

* 'Entstehung der Arten auf Grund von Vererben erworbener Eigenschaften nach den Gesetzen d. organischen Wachsens. II. Theil. Orthogenesis der Schmetterlinge, ein Beweis bestimmt gerichteter Entwickelung und Ohnmacht der natürlichen Zuchtwahl bei der Artbildung. Zugleich eine Erwiderung an August Weismann.

minent on the title-page of his last work. The idea is no new one; Nägeli was one of its exponents; it has cropped up in many guises; what Eimer tried to do was to prove its reality.

Organisms *grow*, and vary progressively in definite directions, defined by external conditions; at certain stages of stability there is a stoppage in the process, and species arise by "genepistasis." This is the central thesis, which we have previously summarised; the aim of the book is to show the adequacy of the theory as an interpretation of Lepidoptera.

The chapters deal with the following subjects:—the theory of orthogenesis and the limits of natural selection; criticism of Weismann's "germinal selection" theory; origin of leaf-like characters; types of marking and pseudo-mimicry; mimicry; succession of colours and markings; sexual dimorphism and selection; climatic influences as factors in evolution.

We cannot agree with the late Professor's collaborateur Dr. C. Fickert that "the book furnishes incontrovertible proofs of the inheritance of acquired characters and a complete refutation of Weismannian speculations;" but it is a careful attempt to vindicate a position in which there is doubtless some truth, if we could only get at it. It will remain as a memorial of a devoted and courageous student of evolution who was not afraid to be in a minority.

Physiological Import of Maturation.*—Dr. N. Iwanzoff has studied this in *Holothuria tubulosa* and other Echinoderms. The immature ova form pseudopodia when surrounded with spermatozoa, and the younger the ovum, the greater is the mutual attraction, and the more intense the production of pseudopodia. In the case of very young ova, however, the pseudopodia are few or absent. In quite ripe eggs, again, there is but one pseudopodium—the receptive protrusion—which is relatively small. The spermatozoa which are taken in by the immature ova serve as food and are digested. The process of maturation weakens the vitality of the ovum by the elimination of an important part of the nucleus, and that in such a way that the ripe ovum is unable to digest the spermatozoon. Fertilisation is fundamentally a nutritive process.

Germinal Vesicle and Polar Bodies in Urodela.† — Profs. J. B. Carnoy and H. Lebrun continue their investigation of the germinal vesicle and polar bodies in Amphibia, the present memoir dealing with the axolotl and the newts. The nucleoli are definitely nuclein-bodies; the structure of the cytoplasm and nucleoplasm is reticular not alveolar; the nuclein ribbon is typical and apparently continuous, and gives rise at an early stage to a few primary nucleoli, or sometimes is wholly resolved into these; in any case the ribbon is resolved, and disappears as such, some of the granules forming secondary nucleoli.

From this point onwards, until the occurrence of the polar kineses, all the figures are nucleolar, one set succeeding another in ephemeral sequence, of which the authors give a detailed description. It is errone-

Unter Mitwirkung von Dr. C. Fickert.' Leipzig, 8vo, x., xvi., and 513 pp., 2 pls., 235 figs. See Zool. Centralbl., v. (1898) pp. 241–51; Biol. Centralbl., xviii. (1898) pp. 403–16, 444–56.

* Bull. Soc. Imp. Nat. Moscou, 1897 (published 1898), pp. 355–67 (1 pl.).

† La Cellule, xiv. (1898) pp. 113–200 (4 pls.).

ous to speak of the persistence of the nuclear ribbon as such, or to maintain that it forms the figures.

Superfluous products resulting from the successive dissolutions pass out into the cytoplasm and serve to nourish it, forming vitelline plates. There are no longitudinal nor transverse divisions of the nuclein elements at any stage in the whole process. At the time of the polar kineses, some of the products of the nucleolar dissolution which is in process form the rods of the figures, but it is nonsense to say that these come directly from the primitive ribbon. The authors offer severe criticism of the results reached by other observers, whose vision, they say, has been distorted by theoretical prejudice.

Segmentation of Ovum in Sheep.*—Mr. R. Assheton has succeeded in obtaining a very fairly perfect series of specimens from the time of fertilisation to shortly before the stage at which Bonnet's account begins. His results agree with what he has already observed in the pig. At an early stage, perhaps as early as the 8-segment stage, the future epiblast and hypoblast are differentiated. *The hypoblast surrounds the epiblast*, so that at the morula stage the embryo consists of a few *internal epiblast* cells surrounded by hypoblast cells, which at one pole form a thicker investment than elsewhere. In the middle of this thickened mass of hypoblast the cavity of the blastodermic vesicle arises. Subsequently, by the rupture of the hypoblast, the epiblast comes to the surface. The cavity of the blastocyst is not the segmentation-cavity, but (as Robinson stated) the archenteron surrounded on all sides by hypoblast. Thus there is no blastopore. The hypoblast is, owing to mechanical and physical causes, double over part of the wall. Assheton goes on to consider the hypothesis of the hypoblastic origin of the trophoblast.

Spermatogenesis in Man.†—Prof. K. von Bardeleben makes his eighth contribution on this subject. (1) He gives further proof that the intermediate-cells (*Zwischenzellen*) pass through the walls of the seminal tubules into the lumen, bearing crystals, pigment, and fat with them. (2) The development of the spermatides into the "spermatosomes" or unripe spermatozoa is then discussed, seven stages being described. There is what may be called a futile attempt at continued cell-division—a "kytokinesis" without karyokinesis—and there is an adaptation of external form in relation to movement. (3) The occurrence of an accessory form (*Nebenform*) of spermatosome and spermatozoon, in addition to the main form (*Hauptform*), is upheld.

Rudimentary Ova in Frog's Testis.‡—Herr F. Friedmann describes a case in which distinct ova occurred in the seminiferous tubules of *Rana viridis*. The ova showed none of the typical yolk-plates, nor any of the characteristic brownish pigment, but were otherwise clearly ova. Fifteen were fairly well developed; three were degenerate and like the cells in Bidder's organ.

Effect of Mechanical Stimulus on Unfertilised Ova of Silkmoth.§—J. Pérez notes that friction, washing with sulphuric acid, and other

* Quart. Journ. Micr. Sci., xli. (1898) pp. 205–62 (4 pls. and 6 figs.).
† Jenaische Zeitschr. f. Naturwiss., xxxi. (1898) pp. 475–520 (3 pls. and 5 figs.).
‡ Arch. Mikr. Anat., lii. (1898) pp. 248–62 (1 pl.).
§ Procès Verb. Soc. Sci. Bordeaux, 1896–7 (received 1898), pp. 9–10.

influences, are known to hasten the development of silkworm eggs. The removal of the varnishing secretion facilitates gaseous interchange, and increases the vitality.

More striking, however, is the fact that unfertilised eggs are stimulated to parthenogenetic development by gentle friction. Parthenogenetic development does indeed occur apart from this, and is most frequent in the eggs of robust females.

Wind-Eggs.*—M. Xavier Raspail describes a "wind-egg" or "cock's egg" which he found in the nest of *Cannabina linota*. He has in his long experience found only four of these peculiar eggs in the nests of wild birds. Various hypotheses have been suggested to explain them. That they are cock's eggs is absurd; that they are laid by immature or exhausted females is contradicted by the case described. Raspail's conclusion is that they are not really eggs at all. Some stimulus provokes the secretion of albumen in the upper part of the oviduct; the mass acquires ovoid form as it passes downwards; and a shell is formed around it.

Fourth Visceral Cleft and lateral Thyroid in Cat.†—P. Verdun finds that the median thyroid arises as an epithelial bud from the anterior wall of the bucco-pharyngeal cavity near the level of the second branchial arches. All the secretory parenchyma, as in rabbit and mole, comes from this median rudiment. The lateral thyroids are paired organs, which seem to arise on each side of the ventral wall of the fourth visceral pouch. The thyroidean glands arise as hemispherical thickenings of the dorsal and external wall of the same pouches.

Development of Hedgehog's Spines.‡—Dr. Hs. Sprenger gives a detailed account of the structure and development of the hedgehog's spines. Like hairs, they show three areas,—a medulla, a cortex, and a cuticula; and their development in the embryo is at first essentially the same as that of hairs.

Organ in Embryo Reptiles like a Hypochorda.§—Prof. A. Prenant finds that in embryos of *Anguis fragilis*, *Lacerta viridis*, *L. agilis*, *Agama Bibronii*, and *Tropidonotus natrix*, there is a median dorsal pharyngeal plate, which seems comparable to, if not strictly homologous with, the hypochorda of Ichthyopsida.

Gastrula and Archenteron of Salamander.‖—Dr. Hj. Grönroos concludes that the primitive alimentary cavity in *Salamandra maculosa* is formed from two components,—(*a*) in small part, from the gastrula-invagination, and (*b*) for the most part, from an independent cavity arising internally as a modification of the segmentation cavity.

Chondrocranium in Ichthyopsida.¶—Mr. G. M. Winslow has studied this in *Amblystoma* and other Urodela, in *Pipa*, in *Ichthyophis*, and in *Polypterus*, *Protopterus*, and trout. He gives excellent figures of the models which he constructed by Born's method. One of his aims was to

* Bull. Soc. Zool. France, xxiii. (1898) pp. 94–7.
† Journ. Anat. Physiol., xxxiv. (1898) pp. 265–304 (1 pl. and 12 figs.).
‡ Zool. Jahrb., xi. pp. 97–152 (3 pls.).
§ Journ. Anat. Physiol., xxxiv. (1898) pp. 433–62 (3 pls.).
‖ Anat. Anzeig., xiv. (1898) pp. 456–63 (6 figs.).
¶ Tufts College Studies, No. 5, 1898, pp. 147–201 (4 pls.).

see how far the chondrocranium can be employed as an aid in classification. Thus he finds evidence against associating the Cæcilians with any of the Urodela, and in favour of keeping them in a distinct group co-ordinate with the Urodela and Anura. As regards the Dipnoi, the evidence confirms W. N. Parker's view that they should not be retained among the fishes.

Early Stages in the Development of Salmonidæ.*—Dr. J. Jablonowski finds (in the salmon) that the endoderm, first established by the gastrulation, forms the definitive lining of the most anterior blind cupola of the archenteron, which afterwards undergoes degeneration; that the anterior boundary of the rudiment of the central nervous system corresponds with the roof of this archenteric cupola; and that the dorsal blastoporal lip is originally situated not far behind this anterior boundary. In the latter part of his paper, he works out four points of agreement between the trochophore and the vertebrate embryo.

Development of Teleostean Scales.†—Herr S. A. Ussow has studied this in *Cobitis tænia*, &c. The upper layer consists of a structureless homogeneous material formed, at the expense of the mesoderm of the cutis, from the scleroblasts. Its inorganic substance is amorphous calcium phosphate. In short, the tissue is a simple form of bone. The lower layer is formed from the same mesodermic elements, and consists of hardened connective tissue threads without any cells between.

Development of Cæcum in Amphioxus.‡—Prof. J. A. Hammar finds that this organ arises as a median "liver-fold," which is constricted off caudalwards to form a blind sack. Thus the development is like that of a typical vertebrate liver. The position on the right side is secondary. The chief peculiarity is the non-formation of any parenchyma.

Law of Ancestral Heredity.§—Prof. K. Pearson expounds and illustrates what he terms *Galton's Law of Ancestral Heredity*, which "enables us to predict *a priori* the values of all the correlation coefficients of heredity, and forms the fundamental principle of heredity from which all the numerical data of inheritance can in future be deduced, at any rate, to a first approximation."

In the notation adopted, a father is called a 1st parent, a grandfather a 2nd parent, a great-grandfather a 3rd parent, and so on; the mid s^{th} parent or the s^{th} mid-parent is derived from all 2^s individual s^{th} parents.

With reservations as to how "mid-parent" should be defined, Pearson states the law of ancestral heredity as follows.

"If k be the deviation of the s^{th} mid-parent from the mean of the s^{th} ancestral generation, and k_0 be the probable deviation from the mean of the offspring of any individual, σ_s the standard deviation of the s^{th} mid-parental generation, σ_0 of the generation of the offspring, then

$$k_0 = \frac{1}{2}\frac{\sigma_0}{\sigma_1}k_1 + \frac{1}{4}\frac{\sigma_0}{\sigma_2}k_2 + \frac{1}{8}\frac{\sigma_0}{\sigma_3}k_3 + \frac{1}{16}\frac{\sigma_0}{\sigma_4}k_4 + \ldots\,.$$

* Anat. Anzeig., xiv. (1898) pp. 532–51 (19 figs.).
† Bull. Soc. Imp. Nat. Moscou, 1897 (published 1898), pp. 339–54 (2 pls.).
‡ Anat. Anzeig., xiv. pp. 602–7 (5 figs.).
§ Proc. Roy. Soc., lxii. (1898) pp. 386–412.

This is the somewhat generalised form of the law which Mr. Galton sums up as follows:—"Each parent contributes on an average one-quarter, or $(0 \cdot 5)^2$, each grandparent one-sixteenth, or $(0 \cdot 5)^4$, and so on; and generally the occupier of each ancestral place in the n^{th} degree, whatever be the value of n, contributes $(0 \cdot 5)^{2n}$ of the heritage." Prof. Pearson concludes his paper with the sentence, "If Darwinian evolution be natural selection combined with heredity, then the single statement which embraces the whole field of heredity must prove almost as epoch-making to the biologist as the law of gravitation to the astronomer."

Formation of Breeds and Species.*—Herr H. Kohlwey has been led to some general conclusions as the result of many years' experimental breeding of pigeons. In free-living forms especially, but also in domesticated breeds, external conditions are of great importance as evolutionary factors. He is convinced as to the inheritance of acquired characters, and finds in the environment a primary cause of variation. Even the colour of the birds is influenced, either indirectly through the nervous system, or directly. The offspring tend to resemble male parent *or* female parent, according to the relative potency of the germ-cells. Inbreeding need not lead to degeneration if the stock be sound. Whether we accept the author's main thesis or not, a contribution to evolution theory from a breeder is always of interest. We have not seen the original essay.

b. Histology.

Centrosomes and Nucleus.†—Dr. B. Němec compares cell-divisions in which the centrosome functions, with those in which the centrosome seems to be absent, as in higher plants. There is no doubt as to the essential resemblance; and the author's point is that in cells without a centrosome the nucleus serves the same purpose in the prophases and anaphases. In short, the centrosome is in such cells homodynamous with the nucleus before and after nuclear division.

Structure of Cytoplasm.‡—Prof. J. Arnold has examined many different kinds of cell with reference to the architecture of their substance. His method was to allow fragments of tissue to steep in potassium iodide iodine solution. In many cases, as in leucocytes and the cells of bone-marrow, plasmosomes are recognisable, bound by thread-like or rod-like processes into systems, sometimes reticular and sometimes spongy. The plasmosomes enclose granules (somatia) variously disposed, and there is a hyaline substance (paraplasm) in the interstices of the plasmosome systems. But with these materials great structural variety is possible, as the author shows.

In a second paper,§ dealing with nervous tissue, Arnold describes the general occurrence of rows of granules. In ganglion-cells there are, apart from the hyaline interstitial substance, at least two different substances forming systems of granules. It may be that the one system,

* 'Arten- und Rassenbildung. Eine Einführung in das Gebiet der Tierzucht. Mit einem Vorwort von Dr. G. H. Th. Eimer,' Leipzig, 8vo, 72 pp., 5 figs. See Biol. Centralbl., xviii. (1898) pp. 377–80; Zool. Centralbl., iv. (1897) pp. 569–70.

† Anat. Anzeig., xiv. (1898) pp. 569–80 (18 figs.).

‡ Arch. Mikr. Anat., lii. (1898) pp. 134–51 (1 pl.).

§ Tom. cit., pp. 535–52 (1 pl.).

composed of "neurosomes," has to do with conduction, while the other, composed of plasmosomes, has to do with nutrition.

Structure of Nerve-Cells.*—Dr. A. Bühler gives a detailed description of the minute structure of the spinal ganglion-cells in a variety of types. There is a granular meshwork, in the interstices of which fluid can circulate, an arrangement which makes it easy for food to come in and for waste to be got rid of. The conditions of stability in the framework are connected with the system of organic radii associated with the central corpuscles. The fibrils in the process which links one ganglion-cell to another are differentiations of the cell-substance serving as paths for the stimuli. These fibrils spread out within the cell, and are intimately connected, both mechanically and physiologically, with the cell as a whole. The basophile bodies in the cell are specific substances connected with the nervous metabolism, perhaps in part reserve-material capable of reacting strongly to slight stimulus. Each element in the cell is under the influence of the other elements, and reacts on them, and the expression of their unified co-operation is nervous function.

Vascular Epithelium.†—Prof. F. Leydig refers to a recent research by Maurer in which emphasis was laid on the occurrence of capillaries in the buccal epithelium of Amphibians. Leydig had noticed such cases in his 'Zelle und Gewebe' (1885). He now calls attention to vascular epithelium in earthworm and leech, *Menopoma giganteum* and *Pleurodeles Waltii*, *Ichthyophis glutinosus*, &c., quoting the observations of various investigators on the subject. Leydig had previously pointed out the respiratory importance of the superficial emergence of blood-vessels.

So-called Vascular Epithelium.‡—Herr H. Joseph maintains that the buccal epithelium of Amphibia does not contain any blood-vessels, and is not vascular in Maurer's sense. There is merely a *sub-epithelial* capillary network, the branches of which bear diverticula directed towards the epithelium and projecting on its base.

Intercellular Connections in Epithelium.§—Prof. A. Kolossow gives evidence in support of the thesis that the organic connection of cells in epithelial tissue is a constant structural characteristic, and suggests, though demonstration is still impossible, that the intercellular bridges may be important, in glandular epithelium in particular, not merely mechanically, but as paths for stimuli from cell to cell.

Epidermoid Structures in Mammals.‖—Prof. F. Leydig discusses a number of peculiar structures in the skin of *Balæna mysticetus*, the snout of the ox, the bill of *Ornithorhynchus*, the snout of the mole, &c. He feels almost convinced that they are related to hair-structures, and yet they show some resemblance to the cup-organs of lower Vertebrates. If this last point could be demonstrated, it would, Leydig admits, point towards Maurer's theory of the derivation of hairs from integumentary sense-organs.

* Verh. Phys.-med. Ges. Würzburg, xxxi. (1898) pp. 285–392 (2 pls. and 2 figs.).
† Arch. Mikr. Anat., lii. (1898) pp. 152–5.
‡ Tom. cit., pp. 167–76 (1 pl. and 1 fig.).
§ Tom. cit., pp. 1–43 (3 pls.).
‖ Tom. cit., pp. 156–66.

Minute Structure of Glandular and Epithelial Tissue.* — Herr K. W. Zimmermann has studied this in numerous organs. His research bears especially on the central corpuscles and the secretory capillaries. The microcentrum, although very varied in its composition, including one centrosome or a centrodesmosis of several, may be interpreted throughout, in general terms, as the motor centre, as contrasted with the nucleus which is the chemical centre of the cell. The microcentrum is a "kinocentrum," and the nucleus a chemocentrum. The author distinguishes the various conditions as regards secretory capillaries; they may be absent; they may be exclusively intercellular; or both intercellular and intracellular types may occur together. The number of cases in which intracellular secretory capillaries occur is much less than is usually asserted.

Histogenesis of Elastic Tissue.†—M. Gardner has studied this in the amniotic membranes of various mammals, and has reached the following conclusions. (1) The elastic substance is formed entirely in the protoplasm of the cells, in the form of granules. (2) The elastic granules fuse into very delicate filaments, and this fusion may occur within the limits of a single cell, or in several anastomosed cells. The nucleus has no obvious relation either to the formation of the granules or to their fusion. (3) The delicate elastic filaments of adjacent cells fuse into a larger filament, and this is joined to two or more analogous filaments to form a larger fibre. (4) No active intrusion of elastic filaments into the extra-protoplasmic substance is observable. The formative cells determine the eventual reticular or fibrous structure. Those who do not read Russian will welcome the new journal in which this paper occurs; the papers are to be published in French or German.

Digestive Tract of Salmon.‡—Dr. G. Lovell Gulland gives an interesting account of the minute structure of the digestive tract of the salmon, and the changes which occur in it in fresh water. The most striking change is of the nature of a desquamative catarrh, probably associated with the general state of nutrition of the fish. "Probably for some time before the fish enter the river, and certainly while they are lying at the mouth of it, the catarrhal change begins, and begins clearly in the intestine and pyloric appendages; the stomach is at that time unaffected. By the time the fish have reached the upper waters, the stomach has been attacked, and the whole digestive tract is in a state of catarrh. After spawning is over, the stomach is the first part to recover, and in the kelts it is again histologically normal, while the intestine and pyloric appendages probably recover when the fish have returned to the sea." In no part of the alimentary canal of the many fish examined from fresh water, including kelts, were there any remains of undigested food.

Comparative Histology of Digestive Tract.§—Dr. Edith J. Claypole gives an interesting general account of this, in great part based

* Arch. Mikr. Anat., lii. (1898) pp. 552–706 (3 pls. and 14 figs.).
† Le Physiologiste Russe, i. (1898) pp. 3–14 (2 pls.).
‡ Anat. Anzeig., xiv. (1898) pp. 441–55 (12 figs.). Cf. Report of Investigation on the Life History of Salmon. Fishery Board for Scotland, 1898, pp. 13–22 (6 pls.).
§ Trans. Amer. Micr. Soc., xix. (1897) pp. 83–92 (1 pl.).

on her own observations, which are mainly confirmatory of those of others. Ciliated epithelium is primitive; but in the adult mammal it is present only in the respiratory tract. The same is true of birds. In turtles one group (great sea-turtles) agrees with the above-named; in the others the œsophagus is lined with stratified columnar ciliated cells, and mucus-glands are largely developed. In Amphibia there is an added ciliated area in the roof of the mouth in land forms. In Ganoids the cilia occur as far down as the stomach, but not in the mouth. In Cyclostomes the whole intestinal tract is more or less ciliated. On the whole, there is a reduction of ciliation and a reduction in the size of the cells, as we ascend the series.

Buccal and other Glands of Colubridæ.*—Mr. G. S. West describes (*a*) the unicellular glands in the mouth, (*b*) the labial glands which are solely mucus-secreting, (*c*) the parotid which becomes the poison-gland of the venomous forms, (*d*) the Harderian which varies greatly in size, and (*e*) the sublingual which lubricates the sheath of the tongue, as Minot alone has noticed. Snakes are the only animals in which a considerable admixture of mucus is present in the parotid saliva, this mucus being derived in all cases from some of the epithelial cells of the duct, and sometimes also from special accessory mucous alveoli. The author makes two brief notes on the succession of the teeth and on the relation of the poison-duct to the fangs.

Phosphorus-containing Substances of the Cell.†—Dr. T. Gregor Brodie points out that our knowledge of the form and position in which the phosphorus is held in the animal cell has of recent years been considerably advanced by the researches of Miescher, Kossel, and their co-workers, and has been greatly stimulated by Altmann's discovery that from the chief and most abundant of the phosphorus proteids the phosphorus can be split off in the form of a complex acid—nucleic acid. Dr. Brodie gives an account of nucleic acid and of the compounds in which it forms a part in the cell, e.g. protamine.

"It is remarkable," he says, "to find that the chromatin of such cells as the spermatozoa should chemically consist of substances which, relatively to proteids, are of simple constitution. If it be true that hereditary characteristics are transmitted by the chromatin of the reproductive cells, we should have expected a most complex chemical structure for these parts; and it therefore becomes the more striking to note that the most complex protamine obtained, arbacin, is from the animal lowest in the scale (*Arbacia*, a sea-urchin), and that in the higher Vertebrates examined no protamine is present at all."

Structure of Suprarenal Capsules.‡—Prof. H. Stilling gives a detailed account of the minute structure of these organs in the edible frog. A point of particular interest is the difference observable at different seasons, which may be indirectly connected with the state of the reproductive organs. The author has also observed a seasonal variation of weight in the supra-renals of the rabbit.

* Journ. Linn. Soc. (Zool.), xxvi. (1898) pp. 517–26 (2 pls.).
† Science Progress, vii. (1898) pp. 131–49.
‡ Arch. Mikr. Anat., lii. (1898) pp. 176–95 (1 pl.).

Comparative Study of Hair.*—Dr. W. G. Reynolds has a paper on this subject which hardly admits of summary. We note it on account of its practical interest to the medico-legal expert, or to the microscopists whom he may consult.

Organs of Taste.†—Dr. A. E. Loveland has studied these both in the human fœtus and in the adult. His results are mainly confirmatory. Gustatory or sensory cells and sustentacular or supporting cells are distinguished. The central prolongations of the gustatory cells end bluntly in the tissue, and nerve-fibrils come everywhere into close apposition with them, though there is no actual communication. The nerve-fibrils ramify and form various networks, both around and within the taste-bulbs, but the further distinction between perigemmal and intergemmal external fibrils is superfluous. The sub-epithelial cells may be auxiliary to the taste function, and may be regarded as "secondary sensory" cells, as Retzius called them.

Muscle-Fat in the Salmon.‡—Mr. S. C. Mahalanobis finds that the fats taken with its food by the salmon in the sea accumulate between the muscle-fibres and also inside the fibres between the fibrils, and that during the sojourn of the fish in the river these fats steadily diminish, being either used up as a source of energy by the muscle, or transported from the muscle to the growing ovaries. There is no evidence of fatty degeneration; and many cases of so-called fatty degeneration in other animals are merely such interfibrillar infiltration as occurs in the salmon's muscle.§

c. General.

Origin of Vertebrata.‖—Prof. E. Perrier states eight essential characteristics of Vertebrata:—(1) bilateral symmetry and metamerism; (2) the presence of cilia; (3) gill-clefts; (4) a closed vascular system and a ventral heart; (5) nephridia; (6) notochord; (7) dorsal nerve-cord; (8) an inverted position compared with lower animals. Applying the method of exclusion, he rejects theory after theory until only the Annelid theory is left. This is not done, however, without making many assertions which are subjects of legitimate difference of opinion.

Origin of Mammals.¶—Prof. H. F. Osborn marshals the evidence in favour of the general conclusion that the Theriodontia constitute a group which contains practically all the primitive characters of the Mammalia in the skeleton and teeth, and that no other reptiles or amphibians approach so near the hypothetical pro-mammal. The explanation of amphibian characters in the soft parts of existing mammals may be that the pro-mammal sprang from primitive reptiles which preserved a number of still more primitive amphibian or stegocephalian characters.

Theory of Limbs.**—Dr. H. Braus has made a detailed study of the innervation of the limbs in Selachii, Holocephali, and Dipnoi, and bases

* Trans. Amer. Micr. Soc., xix. (1897) pp. 117–28 (2 pls.).
† Tom. cit., pp. 129–74 (3 pls.).
‡ Government Report of the Fishery Board for Scotland, 1898, pp. 106–11 (4 pls.).
§ Cf. *infra*, p. 525.
‖ Comptes Rendus, cxxvi. (1898) pp. 1479–86.
¶ Amer. Nat., xxxii. (1898) pp. 309–34 (14 figs.).
** Jenaische Zeitschr. f. Naturwiss., xxxi. (1898) pp. 239–468 (8 pls. and 3 figs.).

on this some discussion of the general theory of limbs. His results as to the relation of the appendicular musculature to the appendicular skeleton, and as to the extent of displacement which the girdles may show in relation to the vertebral column, furnish indirect but effective evidence in favour of Gegenbaur's theory of the visceral arch origin, as opposed to the Thacher-Mivart-Balfour-Dohrn theory of the origin of paired fins from lateral folds.

Cranial Nerves and Sense-Organs of Fishes.*—Mr. F. J. Cole points out that it is "unphilosophical," at present at any rate, to regard the cranial nerves as a fixed number of serially arranged pairs; that even in the case of the branchial nerves, where the serial arrangement is most marked, it would be hazardous to assert that each represented a metameric unit; that the cranial nerves form an association whose form is due practically to physiological necessities, and not to a survival of an original serial arrangement; and that the lateral sense-organs on the head are certainly not metameric, and only secondarily so in the body.

Biology of the Salmon.†—Dr. D. Noel Paton edits an interesting 'Report of Investigations on the Life History of the Salmon,' three papers from which we have summarised separately. The report deals mainly with the condition and capability of the food-canal while the salmon are in fresh water, and with the changes in the weight and composition of the muscles, reproductive organs, &c.

That the return from the sea to the native river is not governed by the growth of the reproductive organs and *nisus generativus*, is shown by the fact that salmon are ascending the rivers throughout the whole year in all stages of reproductive development. The salmon returns when it has accumulated the necessary supply of food-material. The conclusion of Miescher-Ruesch is confirmed that the salmon, at least before spawning, does not feed during its sojourn in fresh water. The solids greatly diminish, but the percentage of water in the flesh increases. A detailed study of some of the changes as regards fats, proteids, pigments, &c., has been made by the various authors who share in this report.

Markings of Boidæ.‡—Dr. J. Zenneck has made a very thoroughgoing study of the markings in this large family. After describing a long series of particular cases, he leads up to the most general conclusion. "All the species discussed may be arranged in a relatively small number of series. Each link of such a series differs in the same way from its preceding or succeeding link in the same series. Thus the various links of a series may be regarded as various steps in one and the same process." In short, Zenneck confirms Eimer's observations and conclusions as to the wall-lizard, but over a wider field. The facts seem to the author to point very clearly to definite progressive variation along a few lines. Apart from its evolutionary interest, the memoir is of importance in regard to classification and bionomics.

* Trans. Liverpool Biol. Soc., xii. (1898) pp. 228–47.

† Report of Investigations on the Life History of Salmon. Fishery Board for Scotland, 1898, 176 pp.

‡ Zeitschr. f. wiss. Zool., lxiv. (1898) pp. 1–384 (8 pls. and 28 figs.).

Warning Colours and Mimicry.*—Mr. F. Finn has followed up his experiments with Babblers (*Crateropus canorus*) by a series of experiments with other birds of the babbler and bulbul groups. The birds were kept together, and were daily offered a choice of "non-warningly coloured" and "protected" butterflies. Mr. Finn concludes that there is a general appetite for butterflies among insectivorous birds, but that many, if not most, species dislike the "warningly coloured" *Danainæ*, *Acræa violæ*, *Papilio aristolochiæ*, and *Delias eucharis.* The mimics of these are relatively palatable, and their mimicry is commonly effective under natural conditions, but may not stand the severe test of aviary or cage conditions.

Each bird has apparently to acquire its own experience; for young hand-reared birds had no instinctive knowledge of "nauseous" forms, but soon learned to avoid them. His results go, on the whole, therefore, to support the theory of Wallace and Bates.

Mr. Finn recommends future observers to make their observations on birds at liberty, or, if that be impossible, to use wild-caught, rather than hand-reared birds, confining them singly, and feeding them *naturally*, that they may be neither hungry nor pampered.

Pigments of Muscle and Ovary in the Salmon.†—Miss M. I. Newbigin finds two pigments, of which one is red and gives the blue lipochrome reaction, corresponding closely to zooerythrin, while the other is yellow and does not give the lipochrome reaction. As the colour of fish changes, there seems to be a direct transference of the red pigment from the muscles to the ova. It is probable that this yellow pigment is due to excess of fatty food, and that part of it is converted in the muscle into the red pigment. If this be so, "it shows that a characteristic pigmentation may be acquired as it were incidentally in the life-history of the individual."

Division and Budding among Animals.‡—Dr. F. von Wagner criticises a recent paper by M. von Bock.§ Wagner re-emphasises what he has previously maintained,—the necessity for clearly distinguishing between division and budding, and the thesis that the modes of asexual multiplication have had independent origins in the various groups in which they occur.

Remarkable Abnormality in a Frog.‖—Mr. E. Warren describes a vascular connection between the rectal vein of the hepatic portal and the apex of the lung. The blood-vessel was not attached to the mesentery, but was quite free in the body-cavity. "If the abnormality be not regarded as due to reversion or disease, it is a striking example of the potentialities of an organism."

Vitalism and Evolution.¶—Prof. J. T. Wilson, in an interesting presidential address to the Linnæan Society of New South Wales, deals especially with the lasting problems of vitalism and evolution. His

* Journ. Asiatic Soc. of Bengal, lxvii. (1897) pp. 613–68.
† Gov. Rep. Fishery Board for Scotland, 1898, pp. 159–64.
‡ Biol. Centralbl., xviii. (1898) pp. 130–9.
§ Jenaische Zeitschr. f. Naturwiss., xxxi. (1897) pp. 105–52 (3 pls.).
‖ Anat. Anzeig., xiv. (1898) pp. 551–2 (1 fig.).
¶ Proc. Linn. Soc. N.S.W., xxii. (1898) pp. 812–46.

point of view may perhaps be inferred from the closing sentence,—"In this way may a perfect loyalty to the evolution doctrine throughout the entire domain of cosmic process, from its lowest to its highest manifestations, bring with it an emancipation from bondage to those mechanical principles which seem alone suggested on the lower plane of the inorganic, and which may, for certain purposes, though with more conscious effort, be applied throughout the whole sphere of objective science."

Sensitiveness to Light in Amphioxus.*—Herr R. Hesse answers Krause's criticism of his work. Krause's hypothesis that the pigment in the spinal cord of the lancelet corresponds to the optic purple of the Vertebrate eye, is baseless. Hesse adheres to his account of the structure and function of the "cup-eyes."

Lethargy in Birds.†—Dr. C. Fabani discusses the much debated question as to the possible hibernation of birds, citing many statements both old and new. His conclusion is that, although there is no evidence of a strict hibernation, comparable to that of the marmot, for instance, yet there are cases of lethargy or suspended animation, as in *Anthus spinoletta*, lasting for a prolonged period.

Respiration in Spelerpes fuscus without Lungs.‡—Dr. E. Bethge infers from the distribution of capillaries that *Salamandra maculata* can breathe in gullet, buccal cavity, and skin, as well as by lungs; that in *Triton tæniatus* œsophageal respiration is slight or absent; and that in *Spelerpes fuscus*, without lungs, both cutaneous and bucco-pharyngeal respirations are important.

Digestion in Dogfish.§—Prof. E. Yung finds that the mucosa of the stomach in dogfishes has deep glands whose cells resemble the *Belegzellen* in the stomach of Mammals. The digestive juice is very acid, doubtless in adaptation to the calcareous shells of the Crustaceans, &c., which the fishes eat. Experiments showed that a proportion of about 7 parts of hydrochloric acid in 1000 was most favourable; the maximum, in *Lamna cornubica*, was 11 in 1000. The artificial digestion of chitin did not succeed. As Richet has shown, there is no diastase in the stomach.

Phagocytosis in Amphibians and Mammals.‖—Mr. J. M. Berry has experimented by injecting lamp-black, as Miss E. J. Claypole did, and he confirms her results. The phenomena in Amphibia and Mammals are essentially the same; the carbon passes from lymph to blood and *vice versa*; the carbon-laden phagocytes tend to collect under serous membranes, and the foreign matter escapes from the body through lungs, intestinal tract, kidneys, and skin.

Distribution of Batrachia.¶—Prof. J. Palacký gives an account of the geographical distribution of Batrachia, which is in many respects remarkable. There are no Arctic nor Antarctic frogs, and out of the

* Anat. Anzeig., xiv. pp. 556–7.
† Atti Accad. Pontif. Nuovi Lincei, li. (1898) pp. 83–98.
‡ Zeitschr. f. wiss. Zool., lxiii. (1898) pp. 680–707 (2 pls.).
§ Comptes Rendus, cxxvi. (1898) pp. 1885–7.
‖ Trans. Amer. Micr. Soc., xix. (1897) pp. 93–106 (5 pls.).
¶ Verh. Zool.-bot. Ges. Wien, xlviii. (1898) pp. 374–82.

total of about 1000 species of Anura, about half belong to America, more than a quarter to Asia, over a sixth to Africa, and at most sixteen species to Europe. There are 57 species in Madagascar, 21 in Celebes, 125 in British India, and 135 in Mexico. The three genera *Rana*, *Bufo*, and *Hyla* are almost cosmopolitan. But we cannot do more than direct attention to this interesting paper.

Marine Fauna of Brittany and the Gulf of Lyons.* — Dr. G. Pruvot makes a comparison between the marine faunas of these two areas. He distinguishes,—(1) a littoral region, with a sub-terrestrial and a strictly littoral zone, the latter divided into three sub-zones or horizons; (2) a coast region, with two zones; and (3) a deep region, also divided into two zones. We do not know how to summarise the author's paper within our narrow limits, but it is much too important to be left unrecorded.

Plankton of Puget Sound.†—Messrs J. I. Peck and N. R. Harrington have found, in regard to *Peridinium*, *Coscinodiscus*, *Melosira*, Copepods, and Nauplii, that the surface strata present the greatest numbers of living individuals, and furnish the most favourable, although irregular, conditions for the growth and reproduction of these organisms. In the case of the large diatoms, burdened with their siliceous case, there is a relatively rapid sinking into the strata beneath, and in other diatoms the conditions of growth seem to be well fulfilled in the lower strata. All the forms treated of except the Copepods were found alive down to 112 fathoms, probably the lowest depth to which the method of quantitative estimate has been carried.

Plankton of Rivers. — Dr. C. Zimmer ‡ distinguishes (*a*) the "autopotamic" plankton, restricted to flowing water, and consisting exclusively of algæ, unless perhaps *Tetramastix opoliensis* Zach.; (*b*) the "eupotamic" plankton, occurring in standing as well as in flowing water; and (*c*) the "tychopotamic" plankton, of exceptional occurrence in rivers. A list of observed forms is given, but as yet it is a short one.

Herr B. Schröder § also discusses the plankton of the Oder, and compares it with that of the pond (fed by the river) in the botanic garden at Breslau.

Common Eel in the Open Seas.‖—M. Léon Vaillant notes that a specimen of *Anguilla anguilla* L., a yard long, was taken by Captain Chaves from the stomach of a cachelot-whale, which seems to show that this remarkable fish goes far out to sea. If we understand the last paragraph aright, the author does not seem to be aware of Grassi's results.

Biological History of Carbon.¶—A. Bach completes an essay on this subject, which shows at least the incompleteness of our knowledge. By a process analogous to electrolysis, CO_2 is decomposed in the green plant; formic aldehyde is formed and is polymerised to give rise to glucose; thence, perhaps by some ferment, other sugars and starch

* Arch. Zool. Expér., v. (1897) pp. 511-660 (6 pls.) maps and curves.
† Biol. Centralbl., xviii. (1898) pp. 513-22.
‡ Tom. cit., pp. 522-4. § Tom. cit., pp. 525-35 (1 fig.).
‖ Comptes Rendus, cxxvi. (1898) pp. 1429-30.
¶ Arch. Sci. Phys. Nat., v. (1898) pp. 520-35.

arise. In an unknown manner the formic aldehyde serves as the starting point for nitrogenous compounds (e.g. formaldoxime and formamide), and these give origin to the nitrogenous reserve asparagin. The latter is somehow associated with carbohydrates to form proteids. The synthesis of fat is equally mysterious. The various sets of carbon-compounds formed by plants are oxidised in the animal body, and CO_2 is the last term, as it was the first.

Possible Rôle of Electricity in Vital Processes.*—F. Solvay records (1) that the synthesis of a sugar has been effected by Dr. A. Slosse by passing an electric current for five hours through a mixture of carbon monoxide and hydrogen, both dry and pure; and (2) that the synthesis of urea has been similarly effected from carbon monoxide and ammonia, both dry and pure.

Terminology of Classification.†—M. Charles Janet discusses the categories of classification, of which he recognises fourteen, and the best endings for the terms. It is difficult, however, to change old usages or to secure unanimity on the subject.

Tunicata.

Classification of Molgulidæ.‡—M. Antoine Pizon finds that the characters of the branchial apparatus cannot be relied upon to define the major divisions of the family. Thus the new genus *Gamaster* has its branchial system exactly like that of *Eugyra*, while the genital organ is situated on the right side instead of on the left. The genera *Paramolgula* Traustedt, *Bostrichobranchus* Traustedt, and *Anurella* Lac.-Duth. are without value, and *Pera* Stimpson is very doubtful. There remain eight genera, which may be arranged in three sections:—

(1) Molgulidæ with a single gonad situated on the right side; *Gamaster* g. n.

(2) Molgulidæ with a single gonad situated on the left side (misprinted in the text); *Eugyra* Hancock, *Eugyriopsis* g. n.

(3) Molgulidæ with paired gonads:—*Astropera* g. n., *Molgula* Forbes, *Ctenicella* Lac.-Duth., *Stomatropa* g. n., and *Ascopera* Herdm., which may be arranged according to the curvature of the intestine and the state of the siphons.

Classification of Tunicata.§—Prof. E. Perrier discusses the position and classification of Tunicata, starting from the conclusion that Vertebrates comparable to *Amphioxus* have given rise to Tunicates. The Cynthiidæ have undergone least modification from the supposed ancestral type. The Larvacea, such as *Appendicularia*, are not primitive forms, but are arrested larvæ with precocious reproduction. We cannot, however, follow the author into the more detailed classification. It may be noted in passing that he bases his arguments on the "logical and rigorous application" of the "law of patrogonie" (repetition of phylogeny by ontogeny), which he speaks of as "a universally admitted principle."

* Bull. Acad. Roy. Belg., xxxv. (1898) pp. 547–51.
† Mém. Soc. Acad. de l'Oise, 1898, pp. 5–12.
‡ Comptes Rendus, cxxvi. (1898) pp. 1814–17.
§ Tom. cit., pp. 1758–62.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

New Family of Cephalopoda.* — Prof. L. Joubin describes the external features of a pelagic Cephalopod—*Galiteuthis armata* g. et sp. n.—of which the only known specimen was bought by M. Gal in the market at Nice. In the Œgopsida division of Decapoda, there are four families, Ommastrephidæ, Onychii, Cranchiæformes, and Taonoteuthi. This new type requires a new family—Cranchionychiæ—which should be placed third on the list. The mantle is united to the neck and funnel, as in Cranchiæformes; the tentacles bear a double row of hooks, as in Onychii. In short, *Galiteuthis* is like a *Taonius* with the tentacles of Onychii.

Muscular Attachment in Ammonoids.† — Mr. G. C. Crick has studied this in many forms. As in the recent Nautilus, so in the Ammonoids, the shell was external, and the animal was attached to it by means of "shell muscles" and an "annulus." Indications of this muscular attachment are fairly common. In the Ammonites and such allied forms as *Baculites*, *Hamites*, &c., the shell-muscles were attached to the dorsal portion of the shell; they frequently either approximated or met each other in the median line of this region; when they did not quite meet, they were doubtless united by a more or less narrow band corresponding to the dorsal portion of the annulus in the recent Nautilus. It would appear as if the provision of an annulus were an absolute necessity to the animal in addition to the shell-muscles; and most probably Dr. Waagen's explanation of its occurrence is the correct one, viz. that the annulus and shell-muscles served not merely to hold the animal to its shell, but formed also an air-tight band around it, fastening the mantle to the shell.

Grimalditeuthis.‡—Prof. L. Joubin describes *Grimalditeuthis richardi* g. et sp. n., a pelagic cuttlefish, captured by Dr. J. Richard on the 'Princess Alice' in the Atlantic, 23·39 long. W. and 38·55 lat. N. The body is elongated and very transparent; the mantle shows a long dorsal *boutonnière*, joined to the siphon by two oval ventral pallial membranes; there is a valve in the siphon; the eyes are without a lachrymal sinus; there are two fins, one quite terminal and sharply defined off; there is a straight tubular pen; the arms are almost equal, and the small suckers have small hooks; there are no natatory brachial membranes. The animal belongs to the family Taonoteuthidæ, of which a diagnostic key is given.

γ. Gastropoda.

Central Corpuscles in Sex-Cells of Snail.§ — Dr. O. vom Rath finds that the sex-cells of *Helix pomatia* have distinct central corpuscles, visible in the resting state as well as in mitosis. The siderophilous corpuscles are quite distinct bodies. In these and other respects the author's results differ from those of Bolles Lee.

* Ann. Sci. Nat., viii. (1898) pp. 279–92 (9 figs.).
† Trans. Linn. Soc. (Zool.), vii. (1898) pp. 71–113 (4 pls.).
‡ Bull. Soc. Zool. France, xxiii. (1898) pp. 101–13 (2 figs.).
§ Zool. Anzeig., xxi. (1898) pp. 395–6, 413–5.

Reno-pericardial Canals in Patella.*—Mr. E. S. Goodrich shows that in *Patella vulgata* and *P. cœrulea* there are two reno-pericardial canals, opening by means of projecting ciliated funnels from the pericardium into the right and left kidneys respectively.

Indo-Malayan Nudibranchs.†—Prof. H. Simroth discusses the genera *Parmacochlea*, *Parmarion*, and the *Microparmarion* group (with *Microparmarion* and *Collingea* g. n.). He also refers to *Girasia* and *Parmella*. Their essential interest, he says, is that they disclose structural divergences of considerable morphological importance; and his task has been to set the series in better order.

Structure and Classification of Janellidæ.‡—Prof. L. H. Plate gives an account of *Janella schauinslandi* sp. n. and *Aneitella berghi* sp. n., and a general discussion of the family. The Janellidæ are Nudibranchs from New Zealand, Australia, and Polynesia. There are two ommatophores, and two small oral lobes. The head-shield is triangular, pointed behind; the genital opening is just behind the right tentacle. The small mantle-cavity communicates with the diverticula of the peculiar *Büschellunge*. A very large blood-sinus on the back communicates directly with the atrium, and encloses the lung, the kidney, the shell-vesicles, and a sensory vesicle which is regarded as a modified osphradium. The shell is rudimentary, in the form of calcareous particles enclosed in numerous isolated vesicles. There are very numerous transverse rows on the radula, with over 200 lateral teeth on each side of the rachis tooth. The central nervous system has closely apposed partly fused visceral ganglia. The hermaphrodite reproductive organs are usually without a seminal vesicle; the sperm-oviduct may be absent or well developed; there is always an albumen-gland and a sessile or shortly-stalked *receptaculum seminis*. Diagnoses are given of the four genera:—*Janella*, *Aneitella*, *Aneitea*, and *Triboniophorus*—and of the known species. Their possible relationships are also discussed, but there seems little certainty.

Development of Limax maximus.§—Dr. J. Meisenheimer completes his account of this, describing the later stages. The head vesicle appears very early, directly after the gastrula stage; it has a wall of ectoderm and scattered internal mesoderm; unlike the actively pulsating podocyst, which appears a little later, it is quite passive. The primitive kidney is wholly ectodermic, and is absorbed towards the end of the larval period. The pulmonary cavity arises as an invagination of ectoderm, with which a secondary inrolling is associated, forming the true mantle-cavity. A vesicle constricted off from the ectoderm forms the shell-gland. Henchman's results in regard to the nervous system are entirely confirmed. The tentacles arise from the apical plates; the integumentary sense-organs described by the Sarasins in other forms occur; the otolithic vesicle is formed by an ectodermic proliferation; the eye is an ectodermic invagination, and lies at first at the base of the tentacle. The endoderm-sac is the beginning of the gut, and to this

* Quart. Journ. Micr. Sci., xli. (1898) pp. 323–8 (1 pl.).
† Zool. Jahrb., xi. (1898) pp. 151–72 (1 pl.).
‡ Tom. cit., pp. 193–280 (6 pls. and 3 figs.).
§ Zeitschr. f. wiss. Zool., lxiii. (1898) pp. 573–664 (9 pls. and 20 figs.).

two ectodermic regions are afterwards added. Originally the visceral coil lies in the mantle over the foot. Heart and kidney have a common ectodermic *Anlage*. The blood-vessels arise directly from lymph-spaces in the body.

Convergence in Gastropod Shells.*—Dr. Gräfin Maria von Linden maintains that there are but a few fundamental forms of Gastropod shell, and that similar forms recur in unallied groups. She gives evidence of "homöogenesis" or convergence in Melaniidæ, Pleurotomidæ, Cancellariidæ, Rissoidæ, and Columbellidæ. Almost identical forms may arise in groups which are at most very distantly related.

Development of Acmæa.†—M. Louis Boutan has studied the hitherto unknown development of *Acmæa virginea*, one of the intermediate forms connecting cyclobranch Docoglossa, like the limpet, with the Rhipidoglossa. Although resembling *Patella*, it has a cervical gill like the Rhipidoglossa. The eggs are laid in April and May, and are scattered in the water. The author followed the whole development, but he restricts himself in this note to a notice of two important points:—(*a*) The torsion of the visceral mass cannot have to do with the twisting of the shell, for the shell is symmetrical; it depends on the development of the foot. (*b*) The position of the terminal peak in patelliform shells, turned backwards in *Emarginula*, forwards in *Acmæa*, is immaterial; whatever be the position of the peak, the animal always has the same relative position in the shell.

Structure of Pleurotomaria.‡—MM. E. L. Bouvier and H. Fischer continue their account of *Pleurotomaria Quoyana*, describing the nervous system, sense-organs, and radula. The results bear out the conclusion previously arrived at, that this is a primitive type.

δ. Lamellibranchiata.

Structure of Nuculidæ.§—Dr. W. Stempell gives a detailed account of *Leda sulculata* Gould and *Malletia chilensis* Des Moulins, two Chilian forms whose structure has hitherto been undescribed. They are among the most primitive of living bivalves, as is suggested on palæontological grounds, and by the following anatomical facts:—the simple relations between shell and body, the primitive nature of the shell (e. g. absence of prismatic layer), the presence of a creeping sole and the slight development of the byssus apparatus, the simple structure of the feather-like gills, the primitive nature of the kidney, the fact that the gonads are sometimes in connection with the pericardium, the more or less separate pleural ganglia, the persistence of the otocyst duct, and the marked difference between nearly related species. In short, though true Lamellibranchs, the Nuculidæ are phylogenetically near the base of the stem which diverged very early from the main Molluscan stock.

Arthropoda.

α. Insecta.

Wings of Insects.||—Messrs. J. H. Comstock and J. G. Needham devote the third chapter of their studies on wings to a discussion of

* Zeitschr. f. wiss. Zool., lxiii. (1898) pp. 708–28 (2 pls.).
† Comptes Rendus, cxxvi. (1898) pp. 1887–9. ‡ Tom. cit., pp. 1361–3.
§ Fauna Chilensis, ii., Supplement iv. Zool. Jahrb., 1898, pp. 339–430 (4 pls.).
|| Amer. Nat., xxxii. (1898) pp. 230–57 (24 figs.), 335–40 (9 figs.). Cf. this Journal, *ante*, p. 190.

specialisation by reduction. This may take place by atrophy of veins, or by a coalescence of two or more adjacent veins. In this connection they describe the venation of the wings of certain Plecoptera, of *Psocus*, of a *Cicada*, of Heteroptera, Lepidoptera, Trichoptera, and Diptera.

Daily and Seasonal Activity of Hive-Bees.*—Mr. F. C. Kenyon gives an account of a series of experiments made by a French bee-keeper, M. Leon Dufour. By hourly recording the weight of a hive, the experimenter obtained data from which it was possible to plot daily and seasonal curves showing the relations between the activity of the bees and the flow of nectar during the day and the season, as well as the relation between the daily amount of nectar collected and the number of bees in the hive, and between the number of bees and the different seasons. The curves showed that, at any rate in the locality where the experiments were made (Fontainebleau), there are four distinct periods of honey-flow, two comparatively poor and two abundant. These latter are due to the blooming of acacias and heather respectively. During the poor flow there is a period of comparative inactivity in the middle of the day, corresponding apparently to a period of small flow of nectar. During the season of abundant flow, the activity of the bees is more or less constant throughout the day. Apart from such midday inactivity, the bees go and come steadily, and the hive, after the minimum is passed, increases in weight progressively and with comparative steadiness.

When the flow of nectar is poor, the bees leave the hive slowly for the first hour or so; then the rate of departure is rapid till the minimum weight is reached. When the flow is abundant, the reduction in weight is less marked, probably because the bees secure their stores easily and return more frequently to the hive.

Early in May the workers were numerous, and their numbers increased rapidly up to the middle of July, but fell again until, in the end of August, comparatively few left the hive.

Geographical Distribution of Ants.†—Dr. O. Stoll directs attention to some of the new facts which have been established in regard to the geographical distribution of ants. Perhaps the most important result is the evidence of a striking relationship between the ant-fauna in the tropical and sub-tropical parts of Australia and that in India and the Indian Archipelago. New Guinea is an important connecting link between the two.

Psychical Qualities of Ants and Bees.‡—Herr A. Bethe credits an animal with "psychical qualities" when it gives evidence of utilising its experience and of controlling its action in relation to what it has learned. Without this, it is only a *Reflexmaschine*, exhibiting reflexes, the more complex of which are usually called "instincts," though the author avoids the word. As to the origin of these reflexes, he agrees with Weismann and not with Wundt.

Among his experiments are the following:—If a *Myrmica* or *Camponotus herculeanus* be washed and then bathed in the juice of *Tetra-*

* Amer. Nat., xxxii. (1898) pp. 90–5.
† MT. Schweiz. Ent. Ges., x. (1898) pp. 120–6.
‡ Arch. Ges. Physiol., lxx. (1898) pp. 15–100 (2 pls.). See Zool. Centralbl., v. (1898) pp. 273–6.

morium, it will remain unmolested when introduced into a nest of the latter. In finding their way back to the nest or back to discovered booty, the sense of smell seems to be the guide. The bees of one colony seem to have the same odour, which makes recognition possible. In flying home to the hive, bees are guided neither by smell nor by sight; they obey an influence which is operative within a radius of a few miles; but what the influence is remains a riddle. Bethe's conclusion is that ants and bees have no "psychical qualities."

An Insect Virus.*—J. H. Fabre gives after his manner a most interesting account of his search for the virus which makes itself felt on the fingers, &c. of those who handle the caterpillars, or the eggs, or even the excreta, of *Bombyx pityocampa*. It is a urinary product, and occurs in other caterpillars, perhaps in all insects. Its isolation might have some practical import, like that of cantharidine.

Cases of Myasis.†—Prof. N. Leon reports the occurrence of larvæ of *Sarcophaga magnifica* from the big toe and in the external ear; of larvæ of *Sarcophaga carnaria* on the nose; of larvæ of *Musca domestica* on feet, arms, and back; and other cases, e.g. of undetermined larvæ from a tooth abscess. Prof. A. Blanchard adds a note of other cases, and refers to the popular treatment of them.

Recent Experiments in Hybridisation.‡—Mr. F. A. Dixey gives an account of the experiments made by Dr. M. Standfuss, and collected in the second edition of his '*Handbuch der paläarktischen Gross-Schmetterlinge*' (Jena, 1896). In hybridising distinct species, Standfuss found (1) that the freshly hatched larva closely resembles the female parent; (2) that with growth a resemblance to the male parent gradually increases; (3) that the final extent of approximation towards the male parent depends on the relative phylogenetic age of the two species; the older being able to transmit its properties, whether of structure or habit, better than the young; (4) that in reciprocal pairing the male is able to transmit the characters of the species in a higher degree than the female.

In pairing normal forms with aberrations and local races, Standfuss found (1) that when the normal form of a species (*Grundart*) is crossed with a gradually formed local race of the same species, the result is a series of intermediate forms; but (2) that when the normal form is crossed with a sporadic aberration, the result in many cases is that the issue agrees either with the normal form or with the sport, intermediate forms being absent.

False Homochromism.§—Prof. L. Cuénot adheres to his opinion,|| which Plateau ¶ has sought to controvert, that the resemblance of *Venilia macularia* L. to spotted withered leaves of poplar, &c., is quite accidental and not an adaptation. The occurrence of the insect on a congruent background of withered leaf appears to be very rare.

* Ann. Sci. Nat. (Zool.), vi. (1898) pp. 253–78.
† Arch. Parasitol., i. (1898) pp. 314–7.
‡ Science Progress, vii. (1898) pp. 185–202.
§ Bull. Soc. Zool., xxiii. (1898) pp. 99–100.
|| Tom. cit., p. 37. ¶ Tom. cit., p. 87.

Frenulum of Lepidoptera.*—Mr. G. C. Griffiths gives a careful account of this apparatus for connecting the fore- and hind-wings of many Lepidoptera during flight. It is analogous in its purpose to the less perfect jugum of the Trichoptera and *Micropteryx*, to the wing-hooks of the Hymenoptera, and to the locking apparatus of *Belostoma*.

Seasonal Dimorphism in Precis.†—Mr. G. A. K. Marshall has been able to demonstrate by breeding, what he concluded from field observations, that *P. sesamus* is the dry-season form of the wet-season *P. octavia*, "the most remarkable instance of seasonal variation as yet known among the Lepidoptera." He gives the details of the case, and discusses the theoretical interpretation. His own view is that the tendency to variation was initiated by climatic influences, especially humidity, and subsequently utilised and developed by natural selection for protective purposes.

Affinity of Wild and Domestic Silkworms.‡—Prof. C. Sasaki discusses the wild silkworms of Japan. They agree entirely with *Theophila mandarina*, as described by F. Moore. From this species the domestic silkworm has been derived.

Metamorphosis of Caterpillars.§—M. Arnold Pictet describes the way in which the imago emerges from the chrysalid state, and the various symptoms of the near approach of emergence. The process may be hastened by mechanical excitation and by raising the temperature.

Metamorphosis of Muscidæ.‖—Sig. A. Berlese describes the wandering cells (trophocytes) which occur in great numbers in the pupæ of Muscidæ, and serve to store up the albuminoid detritus resulting from the disruption of the larval organs. The store may be compared to a second yolk, accessory to the new development.

Alleged Phylogeny of Aphaniptera.¶—Dr. B. Wandolleck criticises Dahl's theory ** that *Puliciphora lucifera* g. et sp. n. is a connecting link between Pulicidæ and Phoridæ. A comparison of the adults and the larvæ reveals insurmountable difficulties against any such conclusion. The Aphaniptera are indeed not far from the Diptera, but cannot be derived from them. Prof. Dahl,†† who handed over his material to Dr. Wandolleck, makes a brief rejoinder.

Defensive Glands of some Beetles.‡‡—L. Bordas has studied the anal glands of *Cybister Rœselii* Fabr., *Dytiscus marginalis*, &c. They are large but simple glands, with a pyriform collecting vesicle and an excretory duct. The secretion is green and has a sickening smell. As the glands do not open into the gut, they can have nothing to do with digestion. They may have some excretory significance, but there is no doubt that they are defensive.

* Trans. Entom. Soc. London, 1898, pp. 121–32 (1 pl.).
† Ann. Nat. Hist., ii. (1898) pp. 30–40.
‡ Annot. Zool. Japon., ii. (1898) pp. 33–40 (1 pl.).
§ CR. Soc. Phys. Nat. Genève, in Arch. Sci. Phys. Nat., v. (1898) pp. 577–9.
‖ Riv. Patol. Veg., vi. (1897) pp. 111–4 (1 pl. and 1 fig.).
¶ Zool. Anzeig., xxi. (1898) pp. 180–2. ** Op. cit., xx. (1897) pp. 409–12.
†† Op. cit., xxi. (1898) pp. 308–9.
‡‡ Comptes Rendus, cxxvi. (1898) pp. 1824–5.

Larva of Pelophila.*—The Rev. W. F. Johnson and Mr. G. H. Carpenter describe the habits and structure of the ground-beetle *Pelophila borealis* Payk. It has a twofold interest, as a typically Arctic species ranging in Ireland far to the south, and because of the primitive and generalised characters of the larvæ compared with other Carabidæ.

Drowning of a Water-Beetle.†—Herr E. Frey-Gessner calls attention to the case of a quite uninjured and lively water-beetle (*Hydrophilus piceus*) which, after being some time out of water, was drowned in about two hours when replaced in the (quite fresh) water.

Spermatophagous Organ in Bed-Bug.‡—Sig. A. Berlese describes a special organ or bursa associated with the spermatheca in *Acanthia lectularia* L. Its cells seem to be adapted to ingesting and destroying the excess of spermatozoa, and may be described as "spermatophagous."

Classification of Coccidæ.§—Dr. G. Leonardi begins a discussion of the vast genus *Aspidiotus*, which must be split up into eight:—*Aspidiotus*, *Chrysomphalus*, *Spatheaspis*, *Hemiberlesia*, *Aonidia*, *Aonidiella*, *Targionia*, and *Chentraspis*. A useful international glossary of the terms applied to the external structures is given.

Dr. P. Buffa ‖ gives a detailed description of a new coccid—*Aclerda Berlesii* sp. n.—living on the reed, *Arundo donax*.

Rare Dermatosis.¶—Dr. S. Cannarsa describes some cases of a "rare dermatosis" in peasants who had been carrying reeds (*Arundo donax*), and suggests that the cause is probably to be found in *Aclerda Berlesii*.

Thermometer Crickets.**—Messrs. C. A. and E. A. Bessey agree with Dolbear that the rate of chirping in crickets is very closely dependent on the temperature. The form they observed was *Œcanthus niveus*, the tree-cricket. The authors give a formula and a plotted curve.

Australian Termitidæ.††—Mr. W. W. Froggatt publishes the third and concluding part of his monograph on the Australian Termitidæ. It contains detailed descriptions of the different forms of termite in many species belonging to the genera *Termes* and *Eutermes*, with notes on the habits and habitat of each, and includes several new species.

Cleavage in Apterygota.‡‡—Dr. Agnes M. Claypole finds in *Anurida maritima* several interesting points which connect the centrolecithal cleavage of most insects with the simpler holoblastic type. In *Anurida* nearly equal cleavage exists in the early stages; at a later stage holoblastic division is lost, and the formation of the blastoderm takes place by the peripheral migration of the nuclei, surrounded by small masses of protoplasm; no secondary yolk-cleavage occurs. The authoress makes these observations the basis of a discussion as to the variety of ovum-cleavage in Arthropods.

* Trans. Entom. Soc. London, 1898, pp. 133–40 (12 figs.).
† MT. Schweiz. Entom. Ges., x. (1898) pp. 133–4.
‡ Ex Rivista Patol. Veg., vi. (1898) 16 pp. and 3 pls.
§ Riv. Patol. Veg., vi. (1897) pp. 102–34 (8 figs.), 204–36 (9 figs.).
‖ Tom. cit., pp. 135–59 (3 pls. and 18 figs.).
¶ Riv. Patol. Veg., vi. (1897) pp. 21–3.
** Amer. Nat., xxxii. (1898) pp. 263–4 (1 fig.).
†† Proc. Linn. Soc. N.S. Wales, xxii. (1898) pp. 721–58 (2 pls.).
‡‡ Trans. Amer. Micr. Soc., xix (1897) pp. 74–82 (1 pl.).

Myrmecophilous Animals.*—M. Charles Janet adds to his previous studies on myrmecophilous animals a list of those animals whose relations with their hosts are best known, and classifies them under different categories. Regarding as truly myrmecophilous only those which really seek the society of the ants, and come of themselves to live in their nests, he enumerates a large number, and discusses their relations to their hosts under the following headings:—"*Parasitism*, *Phorésie*, *Myrmécocleptie*, *Synechtrie*, *Synœkie*, and *Myrmécoxenie*." In conclusion the writer points out the various conditions which attract so many different animals, e.g. convenience and security of the nests, abundance of vegetable food in ligneous nests, abundance of animal food, heat generated in the nest, the tendency of ants to bestow as much care on the young of other species in the nest as on their own, &c.

Researches of Charles Janet.†—M. Charles Janet has compiled a useful illustrated summary of over thirty papers which he has published during the last few years. Most of them deal with insects, and many have been reported in this Journal.

β. Myriopoda.

Fertilisation in Pachyiulus communis.‡—Sig. F. Silvestri shows that in this Myriopod the spermatozoa are immobile and cap-shaped, and are passed by the male into the two *receptacula seminis* of the female. The egg emits a pseudopodium, comparable to the attractive or receptive cone in other ova, which actively draws a spermatozoon through the micropyle. In short, the ovum here plays an active *rôle*, while the spermatozoon is passive.

γ. Protracheata.

Distribution of Peripatus.§—E. L. Bouvier describes *Peripatus Tholloni* sp. n. from Africa (Gaboon). It seems to be intermediate between the American species and those of the Cape, and the author makes it the starting point in a discussion of the geographical distribution of the genus. It seems fairly certain that Central America and the Caribbean region was the centre of origin and migration. Some went west to Australia and adjoining regions, others eastwards to Africa.

New Species of Peripatus.‖—E. L. Bouvier describes *P. tuberculatus* sp. n., found at Popayan, in New Grenada (Columbia). Its very numerous (37 pairs) flattened appendages, the complex armature of its mandibles, the four papillæ and five spinous ridges on the appendages, are regarded as primitive characters. More than any other species it approaches the supposed Annelid-like ancestor. The specific title refers to the large tubercular papillæ on the dorsal surface.

δ. Arachnida.

Agrarian Acarids.¶—Sig. A. Berlese begins a memoir on the mites which occur on cultivated plants. He gives a general account of their

* Limoges, 1897, 98 pp.

† 'Notice sur les Travaux scientifiques présentés par M. Charles Janet,' 1896, 94 pp., 105 figs.

‡ Atti R. Accad. Lincei (Rend.), vii. (1898) pp. 129–33 (5 figs.).

§ Comptes Rendus, cxxvi. (1898) pp. 1358–61.

‖ Tom. cit., pp. 1524–5.

¶ Riv. Patol. Veg., vi. (1897) pp. 1–65 (40 figs.).

structure and their habits, their means of offence and defence, and their modifications by the environment.

Mouth-Parts of Mites.*—A. Brucker describes in *Trombidion*, &c. —(1) a rostrum bearing the cheliceræ, and (2) a pharyngeal proboscis fused to the pedipalps. The same is true of the Gamasidæ, but the rostrum coalesces with the apparatus formed by the proboscis and pedipalps, and forms a complete tube within which the cheliceræ are movable.

Spider and Pitcher-Plant.†—Mr. R. I. Pocock gives an account of an interesting observation by Mr. A. Everett. It concerns *Misumena nepenthicola*, one of the Thomisidæ, which invariably takes up its abode in the pitcher of a North Bornean (Labuan) *Nepenthes*, probably *N. phyllamphora*. The web is a thin carpet spread over a small portion of the conductive area, and enables the spider to maintain its hold on the slippery surface. Here the spider lives and rears its young, no doubt feeding upon the insects which the *Nepenthes* attracts. The peculiar habitat doubtless helps the spider to escape the attacks of the mason wasps which are so fatal to spiders. Moreover, when the pitcher is torn open, the spiders plunge into the liquid and retreat to the very base among the débris of captured insects. The adoption of water as a city of refuge is known in some spiders, such as *Dolomedes*, *Thalassius*, some species of Lycosidæ, and *Araneus* (*Epeira*) *cornutus*, but it does not seem to have been previously recorded of any member of the Thomisidæ. It appears to be a new instinct acquired by the species in connection with its peculiar habitat.

ε. Crustacea.

Pœcilogony in Alpheus minor.‡—H. Coutière notes that the larval development in this species may be abridged or lengthened according to the individual environment. In specimens from the Antilles the larval development is much abbreviated; in those from the Gulf of California the newly hatched larvæ are much less advanced. This should be compared with the observations of Boas on *Palæmonetes varians* in fresh water and in the sea.

New Parasitic Copepods on Fishes.§—Staff-Surgeon P. W. Bassett-Smith adds considerably to his previous discoveries. He describes ten new species, and establishes a new genus *Pseudoclavella*, near Oken's *Clavella* in the family Dichelesthina. He directs attention to the constancy with which particular parasites are found on particular hosts.

Parastacus.‖—Dr. E. Lönnberg communicates some welcome biological and anatomical notes on *Parastacus Hassleri* Faxon, which has long been a puzzle to zoologists. Sexual dimorphism is well marked, and the animals are completely diœcious, but every individual of both sexes is provided with two pairs of genital ducts, two anterior ones leading to the "orifices" on the coxopodites of the third pair of legs, and two posterior ones on the fifth pair. In reality, the posterior pair in the female are too narrow to allow the passage of an egg, and the "orifices"

* Comptes Rendus, cxxvi. (1898) pp. 1821–3. † Nature, lviii. (1898) pp. 274–5.
‡ Comptes Rendus, cxxvi. (1898) pp. 1430–2.
§ Ann. Nat. Hist., ii. (1898) pp. 77–103 (4 pls.).
‖ Zool. Anzeig., xxi. (1898) pp. 334–5, 345–52 (3 figs.).

are "only sham." In the male, similarly, the only true orifices are on the fifth pair of legs, those on the third pair being closed. There is some but not adequate evidence that the testis shows hints of eggs. The author goes on to notice the subterranean habits of the animal and its autotomy.

South African Phyllopods from Dried Mud.*—Prof. G. O. Sars describes *Apus numidicus* Grube, hatched out as a nauplius from the egg; *Streptocephalus gracilis* sp. n.; *Str. purcelli* sp. n.; *Branchipodopsis hodgsoni* g. et sp. n., which approaches *Branchipus* and *Branchinecta*; *Estheria elizabethæ* sp. n.; and *Leptestheria siliqua* sp. n.

Annulata.

Cell-Lineage in Annelids and Polyclades.†—Prof. E. B. Wilson returns to an interesting suggestion which he made some years ago, that a pair of rudimentary cells observed in the early embryos of *Aricia* and *Spio* were to be regarded as vestiges of an ancestral type of development in which they were represented by a group of larger functional cells, such as are still found in the embryo of *Nereis.* The vestigial cells in question represent the posterior part of the entoblast-plate.

Fresh investigations show that the three forms—*Crepidula*, *Nereis*, and *Aricia*—form a progressive series in which the entoblastic part of the mesentoblast cell is reduced from more than half the bulk of the cell to an insignificant vestige; and the facts support the view that the primary mesoblasts or mesoblastic pole-cells of Annelids and Molluscs must be regarded as derivatives of the archenteron. "The vestigial cells of *Aricia*, *Spio*, *Amphitrite*, and *Planorbis* would seem to represent the last traces of such archenteric origin of the teloblasts;" and the bearing of this on the possible relation between the teloblastic and enterocœlic modes of mesoblast-formation is obvious.

After discussing the micromere-quartets in Annelids, Molluscs, and Polyclads, and in *Leptoplana* in particular, the author indicates the general interest of the phenomena. (*a*) They suggest that development may exhibit ancestral reminiscence as clearly in the cleavage of the ovum as in the later formation of tissues and organs. (*b*) They seem on the whole to emphasise the importance of cell-formation in development, recent reaction notwithstanding.

Nervous System of Polychæta.‡—Miss M. Lewis has studied this in two of the Maldanidæ, *Axiothea* (= *Clymenella*) *torquata* and *Clymene producta* sp. n. She finds that Leydig's fibres in Annelids are true nerve-fibres, the sheath being comparable to the medullary sheath of nerve-fibres in Vertebrates, and the contents to the axis-cylinder. The fibres result from the union of the direct processes of giant ganglion-cells. The cells which give rise to Leydig's fibres show peculiar structural conditions, in the possession of a nucleus always eccentric in position, and of other structures more central in position, the centrosome and the attractive sphere. Parts of the peripheral nervous system end

* Arch. Math. Naturvidenk. Christiania, xx. (1898) 43 pp., 4 pls., and 23 pp., 3 pls. See Zool. Centralbl., v. (1898) p. 456 and p. 508.
† Ann. New York Acad. Sci., xi. (1897) pp. 1–27 (7 figs.).
‡ Proc. Amer. Acad. Sci., xxxiii. (1898) pp. 225–68 (8 pls.).

in abundant multicellular sense-organs in the integument. These are sometimes definitely arranged, and are composed of bipolar nerve-cells.

Nervous System of Nereis.*—Mr. J. J. Hamaker has made a detailed study of the central nervous system in *Nereis virens* Sars. The system lies deeper than in most Polychæta, is separated from the hypodermis by the circular muscles, and is protected by a spongy (ectodermic) neuroglia and an outer (mesodermic) neurilemma.

The "mushroom bodies" of insects and Decapod Crustacea are represented in the brain of *Nereis* by the anterior masses of small nuclei. The optic ganglion, which in some species of *Nereis* lies beneath the anterior eye, may in other species lie within the brain-capsule. There is no neuropil in the ventral nerve-cord. Three longitudinal connectives run between each two successive ganglia, one small median and two larger laterals. The sheaths of the nerve-fibres have no nuclei, and must therefore be a product of the fibres. The cells have commonly one or more centrosomes. The giant fibres are nervous, and are put into relation with peripheral organs through ordinary centrifugal fibres. The giant fibres give off no fibrillations, and nervous relation with other fibres is established directly between the axis cylinders. Certain decussating fibres are always united in pairs by anastomoses between the axis cylinders where they cross each other. Certain centripetal fibres of the same set are always united by anastomoses between the ends of the branches. Contact between axis-cylinders may possibly be one of the means of bringing nerve-fibres into functional relation with each other.

Heart-body and Cœlomic Fluid in Polychæta.†—Mr. L. J. Picton has investigated *Audoinia filigera*, *Pectinaria belgica*, *Siphonostoma diplochætos*, *Polymnia nebulosa*, *Amphitrite variabilis*, &c. The mesoblastic origin of the heart-body is shown in *Polymnia*; it is not homologous with the diverticulum of the gut which projects into the dorsal vessel in some Oligochæta. The organ may be regarded, as Eisig suggests, as of the nature of intra-vascular chloragogen, that is, as modified peritoneal tissue, primitively clothing the outside of the dorsal vessel, but becoming folded so as to lie within it. It may be in part compared to the liver of Vertebrates, but there is no glycogen. Fat and iron are present, and the latter is probably associated with hæmatopoietic function. With regard to the mechanical functions of the heart-body, we are on surer ground. The vessel wall contracting upon it obliterates the heart cavity at systole, the whole of the blood passing to the gills.

Owenia.‡—Prof. G. Gilson has continued his study of *Owenia fusiformis*, and has reached the following results. There is no peritoneal membrane on the parietal surface of the cœlomic cavity. The body-wall is formed of musculo-glandular elements, and not by separate layers of muscular and glandular cells. The internal portion of these musculo-glandular elements secretes albuminoid substances, fatty matter, and uric products. The albuminoid substances form the spermatic plasm in the male and an envelope for the eggs in the female. As the nephridia have lost excretory function, this is discharged by the

* Bull. Mus. Comp. Zool. Harvard, xxxii. (1898) pp. 89–124 (5 pls.).
† Quart. Journ. Micr. Sci., xli. (1898) pp. 263–302 (4 pls.).
‡ La Cellule, xiv. (1898) pp. 89–107 (1 pl.).

musculo-glandular wall, and the uric granules are swept out by the genital funnels which are modified nephridia.

Notes on Annelids.*—Prof. W. C. M'Intosh points out the specific distinctness of *Lepidonotus Wahlbergi* Kinberg and *L. clava* Montagu, which Baron de Saint-Joseph has recently united. He also shows that *Sigalion squamatum* Delle Chiaje, *S. Mathildæ* Aud. and Ed., and *S. Buskii* M'Intosh, are distinct.

Epitokous and Polymorphic Forms of Dodecaceria concharum.†—MM. F. Mesnil and M. Caullery continue their study of the "polymorphic development" of this Cirrhatulid. They distinguish five forms which differ (1) structurally (in the form of the setæ); (2) as to their parasites (*Gonospora* is constant in two of the forms, and always absent in three); and (3) in their mode of development. There seems little doubt that there is but one species, but a satisfactory solution of the relations of the different forms requires that the development of each be traced *ab ovo*.

Early Stages in Development of Serpulidæ.‡—M. Albert Soulier has studied this in *Serpula infundibulum* and *Hydroides pectinata*, with special reference to the formation of the mouth and anus in the trochophore. He finds that the blastophore gives rise to both, and that its apposed lips form the longitudinal cellular strand which extends between them on the ventral surface of the trochophore.

Proboscis of Glyceridæ.§—M. Ch. Gravier describes (*a*) the pharyngeal sheath, (*b*) the pharyngeal proboscis, and (*c*) the ventriculus, which compose the massive proboscis-organ of *Glycera convoluta* and allied forms. He gives an account of the complex innervation and the highly developed sensory structures. The proboscis has a veritable nervous autonomy, accessory to that of the body generally.

Regeneration in Earthworms.‖—Dr. K. Hescheler continues his study of regenerative phenomena in *Allolobophora terrestris* Sav., *All. caliginosa* Sav., and *Lumbricus herculeus* Sav., especially the first. The first five segments were removed, and the re-growth observed.

The earlier stages, lasting until about the end of the first week, were somewhat as follows. A scar-tissue, consisting of lymph-cells, is first formed; in a few hours spindle-shaped cells appear and are arranged in regular rows, continuing the longitudinal musculature. The scar-tissue is covered in a few days by a new and homogeneous epidermis, apparently formed from the old one. The gut closes by the fusion of the cut surfaces, and is always separated from the epidermis by the scar-tissue. Most of the other organs end with their stumps in the scar-tissue, and a special cap of this covers the end of the nerve-cord. Mitoses are rarely to be seen, and the elements with large nuclei which afterwards occur are still absent.

In the next stages the new-formation of the central nervous system and the fore-gut are the great events. Mitoses occur abundantly, and

* Ann. Nat. Hist., ii. (1898) pp. 103–18 (1 pl.).
† Comptes Rendus, cxxvi. (1898) pp. 1069–72.
‡ Tom. cit., pp. 1666–9. § Tom. cit., pp. 1817–20.
‖ Jenaische Zeitschr. f. Naturwiss., xxxi. (1898) pp. 521–604 (6 pls.).

the scar-tissue abounds in regeneration-cells with large nuclei. These regeneration-cells seem to spring both from the epidermis and from the gut-epithelium. Nerve-fibres grow out from the old cord, and cells, hardly distinguishable from regeneration-cells, form by multiplication little nests in the cord.

The nerve-fibres and the gut grow further into the regenerating area; the fibres surround the gut at that spot where it is nearest the epidermis; and along the whole stretch of the new nervous rudiment, cells are apposed from the young epidermis, especially at a dorsal spot just over the end of the gut (the future cerebrum).

A funnel-like invagination of the epidermis forms a new stomodæum, but the epithelium of the pharyngeal region arises from the cells of the old gut. Meanwhile, aggregations of cells with many mitoses are to be seen on the whole nerve-cord, as far back as the 15th segment. Most are like ganglion-cells, others seem to be non-nervous.

The author refrains from generalisations and theoretical conclusions, for which there is not yet a sufficiently strong foundation of facts.

Development of Nephridia of Earthworms in Regeneration and in Ontogeny.* — A. Michel describes the single and somatopleural origin of the nephridium in *Allolobophora fœtida*, and has convinced himself as to the remarkable parallelism between the embryonic and the regenerative development.

Chilian Earthworms.†—Dr. W. Michaelsen has investigated Plate's Chilian collection. The results correspond with what previous collections have shown in regard to the earthworms of this region. There were two new forms:—*Acanthodrilus platei* and *Microscolex pallidus*—belonging to the two genera which have been already shown to be predominant in Chili.

Rotatoria.

Asplanchna in Britain.‡—Mr. W. T. Calman points out that if the occurrence of *Asplanchna* as a conspicuous member of the pelagic fauna of lakes has not hitherto been recorded in Britain, it can only be attributed to the lack of attention in this country to the systematic investigation of our fresh-water fauna. He has found *A. priodonta* in lochs near Dundee, and Mr. John Hood has long been familiar with its occurrence.

Rotifera of Ceylon.§—Dr. E. V. Daday gives a list of 42 species of Rotifers collected in Ceylon by Dr. J. V. Madarász in 1896, and brought home in spirit. Among these, one new species, *Cathypna macrodactyla*, and two new varieties, *Asplanchna brightwelli* var. *ceylonica*, and *Salpina macracantha* var. *ceylonica*, are named and figured.

The total number of species known from Ceylon is only 46. Is there no microscopist in the island who would take up the study of these creatures and make a fairly complete list?

* Comptes Rendus, cxxvi. (1898) pp. 1820–1.
† Fauna Chilensis, Heft ii. Supplement iv., Zool. Jahrb., 1898, pp. 471–80 (1 fig.).
‡ Nature, lviii. (1898) p. 271.
§ 'Mikroskopische Süsswasserthiere aus Ceylon,' Budapest, 1898, pp. 1–20 (4 figs.).

Reproduction in the Rotifera.*—Mr. W. T. Calman in this paper gives a very useful summary of the progress of recent researches in this direction by Maupas, Lauterborn, Nussbaum, and others. The various memoirs have already been noticed in these pages.

Nematohelminthes.

Centrosomes in Ascaris megalocephala.†—Dr. E. Fürst finds that there are still many obscure phenomena in the behaviour of the much-investigated ovum of *Ascaris megalocephala*. He found, for instance, that directive-spindles may occur quite like cleavage-spindles with two large astrospheres. The remarkable divergence of the typical directive-spindles is not disposed of by the alleged presence of centrosomes. Unless the whole directive-spindle is to be interpreted as a centrosome, Fürst finds none. His observations show clearly that the constitution of the achromatin division-figure may be very varied in the object under discussion. To face these divergenes may lead to an understanding of the different types of indirect nuclear division.

American Gordiacea.‡—Dr. T. H. Montgomery, jun., describes 17 species from American collections, including 5 new species of *Gordius*, *Paragordius* g. n., with Leidy's *Gordius varius* as type, and 5 new species of *Chordodes*. The paper was sent to press before the author received Camerano's monograph, in which the new genus *Paragordius* was also established.

Phagocytic Structures in Strongylus armatus.§—Prof. N. Nassonow describes three pairs of unicellular stellate structures on the ventral surface near or on the middle line. Schneider noted the first pair in 1866. The author has found experimental proof of their phagocytic power. He could detect no other structures with this capacity, and no leucocytes.

Eustrongylus gigas in Dogs.‖—Herr J. Rotstadt reports the occurrence of this parasite in over 10 per cent. of 340 dogs at Warsaw. The copulation in the kidney was observed and photographed. Those found in the body-cavity were mostly in the region of the liver. The history of the parasite's behaviour remains obscure.

Platyhelminthes.

Phylogeny of Cestodes.¶—Herr E. Lönnberg derives Trematodes and Cestodes from a common stock among the Rhabdocœle Turbellaria. The primitive Cestodes are most nearly represented by the Diphyllida. From the main stem there diverged on the one hand the Pseudophyllida —*Bothriodium*, *Bothrimonas*, *Triænophorus*, *Bothriocephalus*, *Schistocephalus Ligula*, *Cyattiocephalus* (?) and *Archigetes* (?)—and, on the other hand, the Tetraphyllida (all other forms).

* Natural Science, July 1898, pp. 43–51.

† Arch. Mikr. Anat., lii. (1898) pp. 97–133 (2 pls.).

‡ Bull. Mus. Comp. Zool. Harvard, xxxii. (1898) pp. 23–59 (15 pls.).

§ Zool. Anzeig., xxi. (1898) pp. 360–3 (1 fig.).

‖ Arbeit. Lab. Zool. Univ. Warschau, 1897, pp. 147–51 (1 pl.) [Russian]. See Zool. Centralbl., v. (1898) pp. 407–8.

¶ Centralbl. Bakt. Par., xxi. (1897) pp. 674–84, 725–31 (54 figs.). See Zool. Centralbl., v. (1898) pp. 365–6.

Helminthological Notes.—Dr. M. C. Francaviglia * gives an account of the parasitic worms found in *Gobius avernensis* Canestr.:—2 Cestodes, 1 Trematode, 3 Nematodes (including *Filaria Carruccioi* sp. n.), and 4 Acanthocephala.

Dr. G. Lepri † discusses the parasites found in birds of prey in the Roman province:—9 Nematodes, 3 Cestodes, and 3 Acanthocephala.

Dr. Galli-Valerio ‡ describes a case in which *Cysticercus cellulosæ* was found in human muscle. One of the two specimens was without rostellum or hooks. The experiment of swallowing six living specimens of *Cysticercus pisiformis* had no results. Experiments show the great power of resistance possessed by the embryos of *Strongylus apri* to heat, drought, and some reagents.

Gonads of some Species of Tænia.§—Dr. F. Holzberg describes the reproductive organs in *Tænia tetragona* Mol., *T. madasgascariensis* Dav., and *T. cesticillus* Mol. (non Duj.), which belong to the group *Davainea*. He gives some notably clear semi-diagrammatic figures.

Tænia nana.‖—Dr. K. Miura and F. Yamazaki record an occurrence of this human tapeworm in Japan, where it has not been previously observed. A short description of the worm and its eggs is given.

Incertæ Sedis.

Enteropneusta of Funafuti.¶—Mr. J. P. Hill has given a detailed description of *Ptychodera hedleyi* sp. n., from the atoll Funafuti.

Echinoderma.

Echini of the 'Albatross.'**—Prof. A. Agassiz makes a preliminary report on the Echini collected by the 'Albatross' off the west coast of Central America to the Galapagos, to the west coast of Mexico, and in the Gulf of California. "As regards the distribution of Echini in the Pacific, we have at the present day a condition of things very similar to that which must have prevailed in the Atlantic when the species of Echini living in the Crag and in the Maltese beds had their representatives in the West Indies, having, as has been suggested, found their way from the Mediterranean along the shores of an ancient continent. Some of the species living on the west coast of Central America have a very extended geographical distribution in the Pacific, and yet no one claims that this great range has been brought about by their migration along the shores of a continent, or continental islands, existing between Panama and the Sandwich Islands or the Marquesas. The great equatorial current gives us a cause fully efficient to effect such a wide distribution, and that in a comparatively short time." Even when there are no Plutei, the young are capable of being transported long distances by currents. The young and embryos of the Echinoderms

* Bull. Soc. Rom. Stud. Zool., vii. (1898) pp. 1–17 (1 pl.)

† Tom. cit., pp. 52–69 (1 pl.).

‡ CR. Soc. Vaudoise Sci. Nat., in Arch. Sci. Phys. Nat., v. (1898) pp. 572–3.

§ Zool. Jahrb., xi. (1898) pp. 153–92 (2 pls.).

‖ MT. Med. Fac. Univ. Tokio, iii. (1897) pp. 239–58 (1 pl.).

¶ Mem. Austral. Mus., iii. (1897) pp. 205–10, 335–46 (5 pls.). See Zool. Centralbl., v. (1898) pp. 452–5.

** Bull. Mus. Comp. Zool. Harvard, xxxii. (1898) pp. 71–86 (13 pls., 1 map).

and Polyps of the West Indies have been carried to the Bermudas; and "we can well imagine an equatorial current taking during Miocene and Eocene periods the young of the Echini flourishing in the Crag and in the Mediterranean, and in the southern extension of that fauna perhaps only from the Cape Verd Islands, and bringing them to the shores of Northern South America or into the Caribbean Sea."

Holothuroidea of the 'Travailleur' and 'Talisman'.*—M. Rémy Perrier makes a second report on this collection, dealing with 31 species, 15 of which are new. The whole collection included 46 species, 26 new. The family Holothuriidæ is divided into two tribes,—Synallactinæ and Holothuriinæ (Ludwig), the former mostly abyssal, the latter mostly littoral. The Synallactinæ, diverging at an early date from the Holothuriinæ, as their primitive characters suggest, migrated to great depths, and gave rise to the specialised group of Elasipoda.

Chilian Holothuroids.†—Prof. H. Ludwig reports on Plate's collection. There were only six species, which suggests the sparseness of the Chilian littoral fauna.

Descriptions of *Holothuria platei* sp. n., of *Chiridota fernandensis* sp. n. (from Juan Fernandez), and of some previously recorded forms, are given.

A comparison of the Chilian and the Magellan Holothurians yields the surprising result that the number of genera and species increases towards the South.

Variation in Ambulacral System.‡—Mr. H. L. Osborn describes the test of a specimen of *Arbacia punctulata* in which the number of ambulacral systems was four instead of five. One entire ambulacral system and the neighbouring inter-ambulacrals had failed to appear, but the apical organs were not included in the suppression.

Larval Stage of Luidia.§—Prof. W. C. M'Intosh gives a brief account of the remarkable *Bipinnaria asterigera*, the larval stage of a species of *Luidia*, specimens of which were obtained in St. Andrews Bay.

Hybrid Echinoid Larvæ.‖—Mr. H. M. Vernon has made experiments on the hybridisation of *Strongylocentrotus lividus*, *Sphærechinus granularis*, and *Echinus micro-tuberculatus*, and other Echinoids, his object being to determine the exact relationship of structure and size between certain of the hybrid and parent larval forms. One of the most important of his results is stated as follows:—The *Strongylocentrotus* ♀—*Sphærechinus* ♂ hybrid is only formed at a time when the *Strongylocentrotus* ova have reached their minimum of maturity; whilst in the case of the reciprocal hybrid, it follows that, as the maturity of the *Strongylocentrotus*-sperm increases, it is able to transmute first a portion and then the whole of the hybrid larvæ from the *Sphærechinus* to its own type. In other words, the characteristics of the hybrid offspring depend directly on the relative degrees of maturity of the sexual products.

* Comptes Rendus, cxxvi. (1898) pp. 1664–6.
† Fauna Chilensis, Heft ii., Zool. Jahrb., Supplement iv. (1898) pp. 431–54 (1 pl.).
‡ Amer. Nat., xxxii. (1898) pp. 259–61 (1 fig.).
§ Ann. Nat. Hist., ii. (1898) pp. 103–18 (1 pl.).
‖ Proc. Roy. Soc., lxiii. (1898) pp. 228–31.

Cœlentera.

Peculiar Phenomena of Growth and Reproduction in Campanularia.*—Prof. A. Giard finds that the stolons of *Campanularia* (*Agastra*) *caliculata* alter their mode of growth and become long coiled branched threads without hydranths when they are made to grow on the free edge of a seaweed in moving water, instead of being allowed to spread over the surface of their support. Though it usually produces fixed medusoid-like gonothecæ, it may liberate free medusoids; but as these have no manubrium or food-canal, they are very imperfect. A similar fact was observed by Agassiz in *Syncoryne mirabilis.* Giard calls the first abnormality "rhizomanie" and the second "allogonie."

Sarcostyles of Plumularidæ.†—Mr. C. C. Nutting uses the word nematophore for the receptacle, and the word sarcostyle for the modified hydranth within each. Development, minute structure, and transition forms, make it certain that the sarcostyles are morphologically members of the colony. They are of use in defence, in the prehension of food, in removing refuse and decomposing organic matter, and in holding together adjacent corbula ("fruit-receptacle") leaves until the edges unite.

Law of Budding in Physophora.‡—Prof. C. Chun maintained in a former paper that each swimming-bell in the series is younger than its distal neighbour and older than its proximal neighbour, and that in the biserial arrangement the buds diverge alternately to right and left. This was criticised by K. C. Schneider, who maintained that the stem was twisted through 180° between each two swimming-bells, and that the arrangement was a right-handed spiral. Chun entirely denies any spiral twisting of the stem of *Physophora*, which is really quite straight. There is spiral twisting in *Forskalia* and in *Apolemia*, but not in *Physophora*, where the final grouping of the swimming-bells depends upon their original grouping as they are constricted off from the budding zone.

New Zealand Actiniaria.§—Mr. H. Farquhar describes a number of new species, and erects a new genus *Halcampactis*, which by its strange combination of characters forms a link between the two families Sagartidæ and Halcampidæ. He calls attention to apparent distinctness of the northern and southern littoral marine faunæ.

Larva of Edwardsia claparedii.‖—Sig. F. S. Monticelli describes the minute structure of a larval Actinian found attached to the test of *Bolina hydatina* Chun. It appears to be almost certainly the larva of *Edwardsia claparedii* Panceri, and to be the same as that which Mark found associated with another Ctenophore—*Mnemiopsis leidyi.*

Irregularities in Number of Directive Mesenteries in Hexactiniæ.¶—Prof. J. Pl. M'Murrich describes the great variety observed in seven specimens of *Sagartia spongicola* Verr. The plan was hexamerous

* CR. Soc. Biol., x. (1898) pp. 17–20. See Zool. Centralbl., v. (1898) pp. 396–7.
† Amer. Nat., xxxii. pp. 223–30.
‡ Zool. Anzeig., xxi. (1898) pp. 321–7 (2 figs.).
§ Journ. Linn. Soc. (Zool.), xxvi. (1898) pp. 527–36 (1 pl.).
‖ MT. Zool. Stat. Neapel, xiii. (1898) pp. 325–40 (1 pl.).
¶ Zool. Bull., i. (1897) pp. 115–22 (figs.). See Zool. Centralbl., v. (1898) p. 504.

in two, heptamerous in two, octamerous in three; one had two directive pairs separated only by one septal pair of the first order; five had three; one had four. Other cases are discussed. The absence of directive mesenteries must not be used in establishing groups; the tendency to increase or decrease the number is in most cases at least a purely individual feature.

Porifera.

Classification of Rossellidæ.*—Prof. J. Ijima discusses this family, which he divides into four sub-families, defined in relation to the characters of the parenchymal microscleres, and, as far as possible, of the megascleric elements as well. These sub-families are Leucopsacinæ, Lanuginellinæ, Rossellinæ, and Acanthascinæ.

Calcareous Sponges from Chili.†—Herr L. L. Breitfuss has studied Plate's collection, and finds ten species, of which five are new, one species of *Leucosolenia*, one of *Sycon*, and three of *Leuconia*,—a result which may be contrasted with what was known when Hæckel published his '*Kalkschwämme*' (1872), in which only three cosmopolitan species were recorded from the Chilian region.

Protozoa.

Spore-Formation in Amœba villosa.‡—Mr. J. C. Smith observed the emergence of spherical masses from an encysted *Amœba*, which collapsed thereafter. After the ejection, the membranous coverings of the units were ruptured and the contained nucleus-like bodies were freed. The connection of these with the parent nucleus was not discovered, but the observation is a very useful one, since reports as to spore-formation in Amœbæ are few.

Adriatic Foraminifera.§ — Sig. A. Silvestri gives an account of over 150 Adriatic Foraminifera. The three most abundant species are *Planorbulina mediterranensis*, *Pulvinulina vermiculata*, and *Polystomella macella*. Among the most interesting Adriatic forms are the following:—*Vertebralina striata*, *Peneroplis pertusus* var. *cristata*, *Cyclammina cancellata*, *Nodosaria papillosa*, *N. obliquata*, *Sagrina columellaris*, and *Truncatulina tenera*.

Fertilisation-Processes in Rhizopods.‖ — Herr L. Rhumbler has sought to trace back the fertilisation-process in Metazoa to a beginning in Rhizopods. The first step is found in cytotropism, in which chemotropic substances are secreted between cells. The next step is plastogamy; the two apposed naked cells fuse. Selection would favour those cells which effected the most advantageous exchanges of material with other cells. Plastogamy would be most advantageous shortly before or shortly after nuclear division. Gradually cytogamy led on to karyogamy, which has also its degrees of specialisation. Reduction-bodies and polar-bodies may be interpreted primarily as due to the exhausted (*krüppelhaft*) divisions of cells which require karyogamy, but they

* Annot. Zool. Japon., ii. (1898) pp. 41–55.
† Fauna Chilensis, Heft ii., Zool. Jahrb., Supplement iv. (1898) pp. 455–70 (1 pl.).
‡ Trans. Amer. Micr. Soc., xix. (1897) pp. 69–73.
§ Atti e Rend. Accad. Zelanti, viii. (1896–7), published 1898, pp. 1–114.
‖ Biol. Centralbl., xviii. (1898) pp. 21–6, 33–8, 69–86, 113–30 (14 figs.).

secondarily acquire another significance. But this is only a very general indication of the conclusions reached in this interesting paper, which, though very speculative, is also full of concreteness.

Conjugation and Karyokinesis in Actinosphærium.* — Prof. R. Hertwig first describes the processes which precede encystation, corroborating Brauer, except that the latter thought the nuclei were reduced in number by fusion, while Hertwig thinks they dissolve. However it is effected, the number is reduced to about 1/50. Round each remaining nucleus a "primary cyst" is formed; the nucleus of each of these divides by mitosis, and the "secondary cysts" are formed. The nuclei of the secondary cysts then divide twice in succession by mitosis, and each time one daughter-nucleus is thrown off as if it were a polar body; then the two associated cysts fuse, nucleus with nucleus and plasm with plasm. It seems an extreme case of autogamy, and can only be of use in bringing about a reconstruction of the nuclear material. The karyokinesis concerned in the getting rid of the polar bodies is "heteropolar," and differs also from the ordinary mitosis of *Actinosphærium* in the presence of a centrosome.

Fossil Radiolarians.†—Sig. P. E. Vinassa de Regny gives a list of 109 fossil Radiolarians from the "ftaniti titoniane" of Carpena near Spezia. Of the 109 only 13 have been previously recorded as fossils. The abundance of Sphæridea and Cyrtidea is remarkable. Several genera, e. g. *Spongolonche*, *Exastylarium*, *Pipetella*, *Tripodictya*, and *Carpocanistrum*, are for the first time recognised as being represented in fossil form.

Peneroplis.‡—Herr F. Dreyer has made this Foraminifer (*P. pertusus*) the basis of a discussion of morphological principles and the question of species. He deals with the variations observed in about 25,000 specimens,—a broad basis for induction. It is by studies of actual facts, he says, and not by phylogenetic speculation, that progress will be made. The selection theory is false; and even if it were true, it does not touch the heart of the problem. "Wenn sie richtig wäre, wäre sie nichtig." It is time that biology should try to recover from "its English disease"!

New Infusorian Genus.§—R. Sand describes *Nematopoda cylindrica* g. et sp. n., a new Peritrichous Infusorian found on algæ at Roscoff. The new genus resembles *Cothurnia*, but it is the only member of the Dexiotricha which has both a case and a stalk. It is also the only genus in which the contractile stalk consists of a single undifferentiated filament.

* SB. Ges. Morph. München, xii. (1897) pp. 83–90, and xiii. pp. 36–41. See Zool. Centralbl., v. (1898) pp. 394–6.

† Atti R. Accad. Lincei (Rend.), vii. (1898) pp. 34–9.

‡ 'Peneroplis. Eine Studie zur biologischen Morphologie und zur Speciesfrage,' Leipzig, 1898, 4to, 119 pp., 5 pls. See Zool. Centralbl., v. (1898) pp. 357–64.

§ Ann. Soc. Belge Micr., xxii. (1898) pp. 85–99 (6 figs.).

BOTANY.

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

α. Anatomy.

(1) Cell-Structure and Protoplasm.

Histology of the Vegetable Nucleus.*—From a study of the phenomena connected with the sickle-stage of the nucleole in vegetable cells, Dr. B. Lidforss comes to a conclusion adverse to that of Strasburger and Humphrey, that it is an artificial phenomenon, due to the mode of treatment. Out of 21 species examined, belonging to three different natural orders, he finds it in 17; in the remaining four there is at the corresponding stage only a movement of the nucleole towards the periphery of the nucleus. In any one ovary either all or none of the embryo-sac nuclei showed the sickle structure of the nucleoles; it was exhibited also with the most various fixing materials. As far as the embryo is concerned, it was observed only in the primary embryo-sac nucleus when mature; not in its daughter-nuclei, nor in those of the surrounding tissue of the nucellus. The author records also the occurrence of the sickle-stage in the nucleoles of pollen-mother-cells, where it is probably a widely distributed phenomenon.

To elucidate the question of the chromatophily of the vegetable nucleus, Dr. Lidforss cultivated pollen-tubes of *Agapanthus umbellatus* in distilled water and in sugar-pepton solution. He found, in the latter case, the tubes to be filled, from their base to their apex, by a dense mucilage, composed of proteids, presenting, therefore, a favourable condition of nutrition for the nuclei. The vegetative nucleus and the cytoplasm were then found to be strongly erythrophilous; while the generative nucleus was distinctly cyanophilous. The cyanophilous reaction of the male sexual cells in Angiosperms cannot, therefore, be dependent, as has been suggested, on a deficient supply of nutriment.

Structure of the Nucleus.†—Sig. F. Cavara has studied the structure and function of the nucleoles, and their relation to the chromosomes during and after karyokinesis. Resting nuclei are of two kinds—those which for the moment only are not dividing, and those which are no longer capable of division; these latter are found in sieve-tubes, vessels, and in all elements which are not capable of division but which manifest an active growth. The nuclei are then very large, and contain large nucleoles. In embryo-sac nuclei the nucleoles exhibit a special structure.

Specially important is the study of the phenomena which immediately precede division; the nucleoles are not expelled, but break up and are absorbed by the nuclear threads.

The nucleoles consist of an inner homogeneous slightly stainable substance (plastin or pyrenin), and an outer stainable substance, varying in density and often spongy, comparable to chromatin. During division

* Act. Univ. Lund, xxxiii. (1897) 29 pp. and 1 pl. (German).

† Atti Ist. Bot. R. Univ. Pavia, v. (1898) 49 pp. and 2 pls. See Bot. Centralbl., lxxiv. (1898) p. 239.

the nucleoles lose their structure, their stainable property diminishes, they become smaller and break up, their separate portions having no power of absorbing stains. The substance of the nucleoles is therefore probably used up in the formation of the chromosomes; they must hence be regarded as bodies for the concentration of the nutrient material in the nucleus, i.e. of plastin, chromatin, and similar substances. This theory explains the peculiar and variable capacity of the nucleoles to absorb stains. It also favours the possibility of an absorption of the chromatin from the framework of the nucleus. Chromatolysis is therefore not always a pathological phenomenon.

Reduction-Division of the Vegetable Nucleus.*—Herr W. Belajeff maintains that the negative results hitherto obtained in attempting to establish a reduction-division in the vegetative nucleus, similar to that which obtains in the animal nucleus, depend on inaccurate observation. From the U, V, and X forms of the chromosomes in the condition of daughter-aster, he finds, in addition to the heterotypic and vegetative, a third mode of division in the nucleus (pollen-mother-cells of *Fritillaria* and *Lilium*), corresponding completely to the reduction-division in animal organisms; in this mode of division the form of the chromosomes is that of a J.

Kinoplasm and Nucleole in the Division of Pollen-mother-cells.†—Mr. W. C. Stevens has studied the behaviour of the kinoplasm and the nucleole in the division of the pollen-mother-cells of *Asclepias Cornuti*. At the time when this division takes place, the relatively large nucleoles entirely disappear, and the chromatin breaks up into twelve small chromosomes. The bulk of the nucleolar substance of the pollen-mother-cell appears to remain in a state of solution after the daughter-nuclei have gone into the resting state, and is used, at least in part, in the formation of the cell-plate. The daughter-nuclei enter into the resting state and lose all connection with the spindle at an early stage in the formation of the cell-plate, so that the growth of the plate proceeds without any kinoplasmic connection of the nucleus with the region of growth. This is the reverse of what occurs in the spore-formation of *Peziza* and *Erysiphe*, and shows that kinoplasmic connection with the nucleus is not always necessary to the formation of the cell-plate; and that if the daughter-nuclei exert an influence on the formation of the plate, it is through the medium of the cytoplasm.

Blepharoplasts in Spermatogenous Cells.‡—After a review of the observations on these bodies by the author himself and by others, Herr W. Belajeff gives further details of their formation and structure in the case of a fern, *Gymnogramme sulphurea*. In those cells in which the spermatogenous cells are produced by division, he observed two stainable bodies at two opposite points, the poles of the future nuclear spindle. After the division of these cells, each of these bodies takes up a position corresponding to that of the centrosomes. In opposition to the statements of Guignard, he finds only one of these bodies in the mother-cells

* Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 27–34 (11 figs.).
† Kansas Univ. Quarterly, vii. (1898) pp. 77–85 (1 pl.).
‡ Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 140–4 (1 pl.). Cf. this Journal, *ante*, p. 316.

of the antherozoids, but one each at the polar and antipolar sides of the nucleus in the primary mother-cells of the antherozoids, before their division. During karyokinesis the stainable body was not seen in the form of a centrosome, from which the achromatin-threads proceed. It is possible that, in the karyokinetic division of the nucleus, a large number of centrosomes may be found on the poles of the nuclear spindle, which subsequently unite to form one of the stainable bodies. The author has observed a number of the small stainable granules on the broad polar ends of the nuclear spindle in the embryo-cells of *Larix*.

Reaction of Protoplasm to Thermal Irritation.*—The result of a series of experiments on the effect of different temperatures on the activity of protoplasm leads Dr. K. L. Schaefer to the law that at temperatures between 10° and 31° C., the sensitiveness increases very nearly in geometrical proportion with arithmetical increases of temperature.

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

Leptomin, a new Cell-content of Leptome.†—In the leptome of a large number of plants Herr M. Raciborski finds a new substance, to which he gives the name *leptomin*, the function of which appears to be the conveyance of oxygen. It occurs especially in the sieve-tubes and laticiferous vessels, but also in many parenchymatous cells.

Leptomin is destroyed in solution by short heating to 95° C.; it is soluble in water and glycerin, insoluble in alcohol; in the dry state it is an amorphous white powder, which is not attacked by dilute alkalies, but is destroyed by dilute acetic or picric acid. A solution of guaiacum-resin with addition of hydrogen peroxide turns blue in the presence of leptomin, as in the presence of hæmoglobin or hæmocyanin. In the life of vascular plants leptomin appears to play a part analogous to that of hæmoglobin in the higher or hæmocyanin in the lower animals, facilitating, as a substance rich in oxygen, the internal respiration, i.e. an interchange of oxygen between the sieve-tubes, laticiferous vessels, and other cells in which it is contained, and the surrounding tissues.

A list of the plants in which leptomin has been found is given, including Gymnosperms and Vascular Cryptogams. Its presence was detected in every vascular plant examined, but not in fungi; it was found in parasitic, saprophytic, and aquatic flowering plants.

Oxydases and the Guaiacum Reaction.‡—Herr J. Grüss confirms his previous statement that an intense blue stain is produced in the phloem by guaiacum-hydrogen-peroxide; also that of Raciborski of the presence in the leptome of the hypothetical substance which he calls leptomin. His experiments lead him to the conclusion that the substance which causes this reaction is in a transitional condition in the walls of the vessels.

He finds three catalytic enzymes, corresponding to the three diastases, secretion-diastase, translocation-diastase, and cytase, and distinguished from one another by their behaviour when heated. The enzyme of *Penicillium* is not a diastase.

* Flora, lxxv. (1898) pp. 135–40.
† Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 52–63, 119–23.
‡ Tom. cit., pp. 129–39. Cf. this Journal, 1896, p. 652.

Saccharose and Glucose in Sugar-cane.*—Herr F. A. F. C. Went has carried out an elaborate series of experiments on the conditions most favourable for the formation of saccharose and glucose in the sugar-cane. The largest amount of glucose is always found near the apex of the stem, while the apical meristem itself contains no reducing sugar. In the stem and roots, glucose is especially abundant in the parts which are growing most rapidly, decreasing as they grow older. Fructose occurs also in the unripe sugar-cane. Saccharose is to be found, especially in parts where growth in length has ceased, gradually increasing in all the internodes. In the apex of the root there is but little accumulation of saccharose, the sugar being here inverted in order to serve for the growth of the root. During growth the greater part of the saccharose is therefore found above ground. In the leaves of the sugar-cane, saccharose, glucose, fructose, and starch are formed.

New Organic Substance in Woody Tissue.†—In sawdust which has been agitated for several days with 1 per cent. potassium hydrate, filtered, and treated with a slight excess of hydrochloric acid, M. G. Guérin finds a copious flocculent precipitate. This substance is entirely free from iron, but contains appreciable amounts of manganese, phosphorus, and sulphur. The author regards it as a nuclein-like substance, and believes that in this form manganese is always present in wood.

Peculiar Cell-contents in Potamogeton prælongus.‡—Dr. B. Lidforss has studied the peculiar bodies found in the epidermal cells of this plant by Lundström, and described by him as oil-bodies or elaioplasts. He finds Lundström's account to require correction in several points. They are composed of a substance which has a greater specific gravity than water, and which cannot, therefore, belong to the ordinary class of oils, whether fixed or essential. This substance occurs also in the cell-sap in a nearly saturated solution. Dr. Lidforss investigated with great care the microchemical reactions of the substance, which are given in detail, and comes to the conclusion that it belongs to the class of aromatic aldehydes.

Proteolytic Enzyme of Yeast Extract.§—Herren M. Hahn and L. Geret confirm the statement of Buchner of the presence in yeast extract of an enzyme which has the power of rendering albumin soluble. Different kinds of yeast yield solutions containing this proteolytic enzyme, and similar solutions can be obtained from tuberculosis and typhus bacilli. The yeast extract, as obtained by Buchner's method, is an opalescent liquid, and even after several filtrations through paper and Kieselguhr filters, contains isolated yeast-cells.

(3) Structure of Tissues.

Fundamental Tissue of the Leaf.||—Prof. F. W. C. Areschoug discusses several questions connected with the anatomy, development, and physiology of the mesophyll of the leaf, basing his results mainly on an examination of the leaves of *Iris neglecta*, *Sambucus nigra*, *Asarum*

* Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxi. (1898) pp. 289–344 (1 pl.).

† Comptes Rendus, cxxv. (1897) pp. 311–2.

‡ Bot. Centralbl., lxxiv. (1898) pp. 305–13, 337–43, 372–7.

§ Ber. Deutsch. Chem. Gesell., xxxi. (1898) p. 205. See Journ. Chem. Soc. Abstr., pp. 245–6. Cf. this Journal, 1897, p. 414.

|| Act. Univ. Lund, xxxiii. (1897) 46 pp. and 5 pls. (German).

europæum, *Ribes alpinum*, *Tilia parvifolia*, *Pinus sylvestris*, and *Taxus baccata*. He points out that the distribution of labour is not so strongly marked in the organs of plants as in those of animals; thus, the epiderm often becomes an assimilating or aquiferous tissue. The palisade-parenchyme and the spongy parenchyme of the mesophyll may both perform the same function, or one may replace the other. The author regards transpiration as always essential for the existence of a current for the supply of nutrient salts to the plant.

Formation and Structure of Lenticels.*—According to M. Devaux, in the formation of lenticels the tissue produced on the outside of the generating layer always consists exclusively of true bark; the rounded cells which enter into the composition of the bark represent cells of the phelloderm which have increased more or less in size, and have become separated from one another; they are developed from a phellogen situated at the internal limit of the layer of bark which lies above them. The generating layer which is found below the rounded cells is a new layer of phellogen intercalated within the phelloderm and regenerating it.

The generating layer of lenticels is not usually a permanent layer. It ceases to be active as soon as a new layer is formed lower down in the phelloderm, or often also in the primary cortex. The only true bark of lenticels, with centripetal development, is represented by the layers known as the intermediate rays or closing layers; that is to say, by suberised cells much more closely united and having the essential characters of true bark.

Assimilating Tissue of Polygonum Sieboldii.†—Dr. L. Montemartini describes the assimilating system in the stem of this plant. The cortex is divided into two layers, the outer one consisting of cells with collenchymatous walls, the inner of rounded thin-walled cells with large intercellular spaces. Both layers contain abundance of chlorophyll. The red spots on the stem are caused by the epidermal cells adjacent to the stomates being filled with anthocyan which protects the chlorophyll in the subjacent layers from too strong insolation.

Alterations in the Tissue produced by a Parasite.‡—M. A. Daguillon describes the changes produced in the leaves of *Hypericum perforatum* by the attacks of a dipterous gall-insect *Oligotrophus Giardi*. They are in the following directions. The leaf itself becomes thicker; the epidermal cells increase in size and lose their wavy cell-walls; the upper epiderm becomes thinner; the mesophyll becomes less differentiated; the veins acquire a simpler structure, the collenchyme which usually accompanies them disappearing; the secreting glands become completely enveloped in the mesophyll, losing their transparency; a red pigment soluble in the cell-sap is formed in the cells near the under surface.

(4) Structure of Organs.

Teratology of Flowers.§—Herr H. Vöchting gives details of a very large series of observations on the anomalies in the structure of flowers,

* PV. Séances Soc. Sci. Phys. et Nat. Bordeaux, 1897, pp. 27–8. Comptes Rendus, cxxvi. (1898) pp. 1432–5.
† Malpighia, xii. (1898) pp. 78–81 (1 pl.).
‡ Rev. Gén. de Bot. (Bonnier), x. (1898) pp. 5–14 (11 figs.).
§ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxi. (1898) pp. 391–510 (6 pls. and 1 fig.).

and deduces from them some general laws, comparing these with the conclusions of previous observers, with which they do not always agree. He contests the theory that each specific abnormality in structure is the result of some specific abnormality in the external conditions, referring them rather to internal causes.

Hydathodes.—Herr O. Spanjer * gives a *résumé* of the present state of our knowledge with respect to the exudation of water from leaves, with a list of the orders and species of Phanerogams and Pteridophyta in which it has at present been observed. With regard to the function of the secreting organs, he considers that it cannot be primarily the exudation of water, since even in those plants in which it is most active (the Rosaceæ), the amount of water given off is trifling compared to that eliminated by transpiration. It is probably rather the promotion of the transport of mineral and other food-materials through the plant. The different forms of structure are arranged under several types, each in most cases belonging to a number of nearly allied genera. The apparatus for the exudation of water is described by the author as consisting of the following elements:—the terminations of the vascular bundles; the epithelial sheath; the epithele; the aquiferous chamber; the fissure.

Some of the controversial points in this paper are vigorously combated by Herr G. Haberlandt,† who charges Spanjer with misrepresenting his statements on some points; with ignoring well-known observations of competent authorities; and with bringing forward no new facts in support of his theories. In particular he contests Spanjer's assertion that there is no active secretion of water through hydathodes of a glandular nature. These have been observed by Haberlandt in *Phaseolus multiflorus* and *Anamirta Cocculus*; by Goebel and Groom in *Lathræa* and other Rhinantheæ; as well as by Treub and Koorders.

Herr A. Meyer‡ defends the conclusions arrived at by Spanjer against the attacks of Haberlandt.

Size of the Leaves of Conifers.§—According to observations made by Mr. E. P. Copeland on American conifers, the variation in the size of leaves of the same season is a rhythmic one, and displays great regularity. Those formed at first are very short; they are afterwards longer; and at the end of the season again short, generally shorter than the earliest. This is attributed by the author either to the direct or to the hereditary influence of the variations in the vital activity at different periods of the year, as the plant gradually arouses from its winter rest in spring and sinks again into it in late summer and autumn.

Double Root-cap of Tropæolum.‖—M. C. Brunotte has investigated the structure of the double root-cap of *Tropæolum*, and states that the supernumerary sheath originates from the proliferation of the cells of the suspensor.

Structure of Myristicaceæ.¶—Herr O. Warburg publishes a detailed monograph of this order, preceded by a description of the anatomical

* Bot. Ztg., lvi. (1898) 1te Abt., pp. 35–81 (1 pl.). Cf. this Journal, *ante*, p. 95.
† Op. cit., lvi. (1898) 2te Abt., pp. 178–81. ‡ Tom. cit., pp. 241–5.
§ Bot. Gazette, xxv. (1898) pp. 427–36.
‖ Comptes Rendus, cxxvi. (1898) pp. 277–9.
¶ Nova Acta Acad. Cæs. Leop.-Carol., lxviii. (1897) pp. 1–680 (25 pls.).

characters of the order and of the genera, among which the following may be mentioned. The order is characterised by the presence of sacs containing a reddish astringent kino which becomes blood-red on exposure to the air. The hairs are very characteristic, being branched sympodially. Oil-cells containing an essential oil are invariably present. The oil originates before the flower opens or fertilisation takes place. It is at first nothing but a thickening of the integument in the region of the hilum, the exostome taking part in its formation. It contains an essential oil, a resinous substance, crystals of calcium oxalate, also in many species a substance intermediate between dextrin and starch. It is greedily devoured by birds, the ripe seeds passing uninjured through the intestinal canal. The Myristicaceæ appear to be cross-pollinated by the agency of insects.

β. Physiology.

(1) Reproduction and Embryology.

Orientation of the Plant-Egg.*—Under this term Prof. C. MacMillan describes the origin and development of the embryo, which he has followed out in the Hepaticæ (*Riccia*, *Sphærocarpus*, *Marchantia*, *Anthoceros*, Jungermanniaceæ), and in Pteridophyta (*Equisetum*, *Angiopteris*, *Isoetes*, *Marsilia*, *Pteris*, *Lycopodium*. The following is his summary of the general conclusions arrived at.

The orientation of the "plant-egg" is fundamentally a phenomenon of adaptation. The conception of a basal wall is founded upon facts of phylogeny so profound that it is necessary to recognise that wall as basal which separates morphologically distal from morphologically proximal regions. The first wall formed may or may not be the basal wall. Three principal types of egg-orientation are recognised:—the primitive or bryophytic, characteristic also of *Equisetum* and *Angiopteris*; the semi-inverted, characteristic of *Isoetes* and the leptosporangiate ferns; and the inverted, characteristic of *Lycopodium* and Spermatophyta. The origin of the primitive type is in adaptation to the peripheral position of the archegones and to the plane of the substratum; the origin of the semi-inverted type is in adaptation to derived archegonial positions and resistance of prothallial areas, interfering with the direct normal growth of the embryo; the origin of the inverted type is in adaptation to repeated archegonial displacement, and nutritive areas of prothallial areas adjacent. The phylogenetic sequences derived from such an ecological investigation of embryos do not materially differ from those derived by a study of pure morphology.

Structure of the Female Organ and Apogamy in Balanophora.†—Prof. M. Treub describes the female organ of *Balanophora elongata* as originating from a papilla consisting of a single cell covered by the single layer of epidermal cells. This single cell is the mother-cell of the embryo-sac; the upper portion elongating into a structure resembling a style. The embryo-sac often develops from this mother-cell without further division; the epiderm divides into about four layers of cells. The primary embryo-sac nucleus divides into two; it is from the basal one of these two that the whole of the egg-apparatus is

* Bot. Gazette, xxv. (1898) pp. 301-23 (10 figs.).
† Ann. Jard. Bot. Buitenzorg, xv. (1898) pp. 1–25 (8 pls.).

derived; no coalescence takes place with the polar nucleus; this latter divides into two or four, corresponding to the antipodals. Finally, the whole egg-apparatus—oosphere and synergids—disappears, except the polar nucleus, which undergoes division, dividing the embryo-sac into a small upper and a large basal cell, of which the former only develops, dividing into a small number of endosperm-cells. One of these becomes the pseudo-embryo. The endosperm-cells form a large amount of oil, and become frothy. The number of cells of which the embryo is composed is not more than from five to ten while it is still enclosed in the mother-plant. Pollen-tubes were never seen to enter the female organ, and the phenomenon is therefore one of pure apogamy, resembling that of *Pteris cretica.*

Embryogeny of Euphorbia.*—According to observations made by Florence M. Lyon on *Euphorbia corollata*, each single so-called "flower" is an inflorescence of the same type as the general inflorescence. This inflorescence (cyathium) tends to become further reduced by the abortion of the terminal (female) flower. The development of the ovule is marked by an elaborate outgrowth of the nucellus in the form of a long neck, whose direction of growth is guided by placental hairs which exert an attractive influence, causing it to bend toward them, thus making a complete connection between the stigmatic cells and the embryo-sac for the passage of the pollen-tube. Ovules appear before there is any trace of carpel, being clearly of cauline origin. There is nothing unusual in the development of the embryo-sac. The synergids are remarkably long, and the antipodals very ephemeral. As a rule a single cell is the ancestor of all the spore-mother-cells in each pollen-sac. The tapete may be clearly differentiated, at least one division preceding the pollen-mother-cells; it is developed from the wall. The synapsis stage was observed with great regularity. There are indications that the generative cell may not divide.

Embryogeny of the Pontederiaceæ.†—Mr. W. R. Smith has studied the biology of this order, chiefly in *Pontederia cordata* and *Eichhornia crassipes*, but finds no special ordinal characteristics. The two genera agree in the ephemeral nature of the antipodals and in the structure of the endosperm. Such irregularities as occur in *Eichhornia* appear to be correlated with its enormous power of vegetative multiplication.

How Flowers attract Insects.—Dr. P. Knuth ‡ subjects Plateau's conclusions on this subject to a critical examination, and arrives at a result that they are based on an erroneous interpretation of the facts. While admitting that insects may at first be attracted to flowers from a distance by their scent, Dr. Knuth still regards colour as the chief source of attraction at smaller distances; the markings on the corolla itself being in many cases the final guide-post to direct the insects to the ovary.

Sir John Lubbock § has repeated some of Plateau's experiments, and has arrived at the same result:—that his conclusion that insects are attracted mainly by the sense of smell is not substantiated.

* Bot. Gazette, xxv. (1898) pp. 418–26 (3 pls.).
† Tom. cit., pp. 324–37 (2 pls.).
‡ Bot. Centralbl., lxxiv. (1898) pp. 39–46. Cf. this Journal, *ante*, p. 191.
§ Journ. Linn. Soc. (Bot.), xxxiii. (1898) pp. 270–8.

Prof. Kienitz-Gerloff* comes to the same conclusion as the two other observers, summing up his criticism on Plateau's results with the remark that what is new is not true, and what is true is not new.

Herr Tiebe,† while agreeing in the main with the conclusions of Müller and Lubbock, points out that Plateau has, after all, made a useful addition to the controversy in insisting on the important part played by scent in the attraction of insects.

Pollination of Cistus.‡—M. C. Gerber points out that in *Cistus albidus*, immediately after flowering, the calyx (with the involucre formed of the two so-called outer sepals) completely closes round the pistil and stamens, forcing the open anthers on to the stigma, and thus ensuring self-pollination. The large size and bright colour of the flowers are, therefore, not here a contrivance for attracting insects and ensuring cross-pollination.

Pollination of the Cactaceæ.§—M. L. G. Seurat points out a remarkable difference between the floral biology of *Opuntia* and *Cereus*. In *Opuntia* the flowers are expanded for many days, and the stamens are endowed with a well-marked irritability. The flower is cross-pollinated by the agency of bees. In *Cereus* the flowers remain open only for a very short time, and the stamens are quite immotile. They may be pollinated by insects, but the part played by them is very much less important than in *Opuntia*.

Parthenogenesis in Antennaria.—Dr. H. O. Juel ‖ confirms the observation of the late Dr. Kerner v. Marilaun of a production of fertile seeds in *Antennaria alpina* without impregnation. The male plants are very rare, and produce no functional pollen-grains. In the earliest stages, up to the production of eight nuclei, the divisions of the embryo-sac exhibit nothing special. From the antipodals a parenchymatous mass of cells is formed at the upper end of the embryo-sac. The position of the oospheres and synergids is normal. The two polar nuclei become closely attached, but do not coalesce. The oosphere then elongates, divides, and developes into an embryo without any access of a pollen-tube. The polar nuclei then separate, divide, and produce the endosperm, which is subsequently reduced to a single layer of cells.

Mr. E. L. Greene ¶ calls attention to the production of fertile seeds without impregnation in *A. plantaginifolia*.

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

Influence of Nutrition on the Evolution of Plants.**—M. A. Dangeard traces the origin of the differentiation between animals and plants to a difference in the mode of nutrition. With a sphere the proportion between surface and contents increases with the decrease of radius; the smaller the cell, the larger are the contents in proportion to the size

* Biol. Centralbl., xviii. (1898) pp. 417–25. † Tom. cit., pp. 465–9.
‡ Comptes Rendus, cxxvi. (1898) pp. 1734–7.
§ Rev. Gén. de Bot. (Bonnier), x. (1898) pp. 191–2.
‖ Bot. Centralbl., lxxiv. (1898) pp. 369–72.
¶ 'The Plant-World,' i. (1898) p. 102. See Bot. Gazette, xxv. (1898) p. 376.
** Le Botaniste, vi. (1898) pp. 1–63.

of the cell. Sexual reproduction is regarded by the author as a consumption by the organism of its own substance (autophagy).

Function of Calcium Salts.*—Herr O. Loew lays stress on the fact that, although the presence of some salt of calcium appears to be essential to the growth of most plants, this is not the case with the lower Fungi or with one lowly organised Alga (*Palmella*). He holds that the nucleus at a certain period of development, and the chlorophyll-bodies except at their very earliest stage, require calcium, and make use of its protein-compounds. Salts of strontium produce no injurious effect so long as the plant is supplied with sufficient salts of calcium. Different fungi exhibit different results as to the possibility of substituting rubidium for calcium.

Power of Isolated Chlorophyll-Grains to give out Oxygen.†—Dr. L. Kny replies to the strictures of Ewart ‡ on his previous paper, and maintains the correctness of his former conclusions. In the same examples as those employed by Ewart—*Vallisneria spiralis*, *Selaginella helvetica*, *Catharinea undulata*, *Funaria hygrometrica*—he was never able to detect any evolution of oxygen from the chlorophyll-grains when completely separated from the surrounding cytoplasm.

In reply Dr. A. J. Ewart § claims that Kny's results practically coincide with his own.

Growth of Lilium Martagon.‖—Herr A. Rimpach has studied the growth of *Lilium Martagon* from the seed. The first foliage-leaf appears in the second spring; its basal portion swells, and becomes filled with starch; for several successive years only one fresh foliage-leaf is produced annually by the small bulb, which is gradually dragged downwards by the contractile roots, always in an erect position. After the ascending stem has begun to develop, no fresh root-leaves are produced. The ordinary mode of reproduction of the plant is by seed. In the contractile roots the contractile tissue is the whole of the inner cortex; the outer cortex, the central vascular cylinder, and the endoderm taking no part in the contraction. The mature plant produces also a rosette of small roots which extend horizontally, and are densely covered with root-hairs. They serve to sustain the stem in an erect position, as well as performing a nutritive function.

Growth of Root-hairs and Rhizoids.¶—Herr C. Sokolowa has studied the phenomena connected with the growth of the root-hairs in seedlings of flowering plants—*Sinapis alba*, *Brassica Napus*, *Cucumis sativus*,—and the rhizoids of cryptogams—*Marchantia polymorpha*, *Lunularia vulgaris*. In all these cases not only is the growth limited to a special region, the apical cap, but in this region only a particular spot is in active growth at any one moment, the whole cap bending towards the side on which this spot is located.

With regard to the physiology of growth, the author holds—as the

* Bot. Centralbl., lxxiv. (1898) pp. 202–5, 257–65.
† Op. cit., lxxiii. (1898) pp. 426–39. Cf. this Journal, *ante*, p. 101.
‡ Cf. this Journal, *ante*, p. 206. § Op. cit., lxxv. (1898) p. 33.
‖ Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 104–10 (1 pl.).
¶ Bull. Soc. Imp. Nat. Moscou, 1897, pp. 167–277 (3 pls. and 22 figs.) (German).

result of experiments dependent on the use of congo-red as a staining reagent—that the cellulose-membrane is formed out of the outermost layer of protoplasm on the surface of the protoplast, in the form of a loose pellicle, which, remaining in contact with the protoplasm, grows in surface and becomes thicker and denser. The granular protoplasm, the parietal layer, and the cellulose membrane, form a connected whole with no sharp line of demarcation between them. The author supports Pfeffer's view that the formation of cellulose is directly connected with the process of respiration and the breaking up of proteids.

The nucleus takes no direct part in the growth of the cell-wall, although it is usually found in proximity to the growing wall, near the apex of the root-hair or rhizoid. In the epidermal cell from which the hair springs, the nucleus has usually a roundish form, and is situated near the spot where the hair originates. After a time it passes into the hair and gradually assumes a fusiform shape.

(3) Irritability.

Nyctitropic Movements.*—Herr L. Jost supplements his previous observations on nyctitropic movements in plants with the following:— The movements of the perianth-leaves of the tulip and dandelion depend on changes in the temperature, and not, to any appreciable extent, on changes in the light. The closing of the flowers is not, however, caused by an increase of temperature, but by the maintenance, for a considerable time, of the same high temperature which brings about the opening of the flower. The opening of the flower is caused by a rapid growth of the inner surface of the perianth-leaves; its closing by the cessation of this, and the more rapid growth of the outer surface. The phenomena are the same in the crocus.

The author differs somewhat from Pfeffer † in his theoretical explanation of the phenomena of nyctitropic movements. He thinks it more probable that in these movements, and in those of nutation, the two antagonistic halves of an organ react differently, that the concave side exhibits an active retardation of growth or contraction, while the convex side displays an acceleration of growth or expansion. The movement of reflexion must, he thinks, be attributed to interior causes.

With regard to the influence of changes in temperature on the movements of foliage-leaves (*Phaseolus*, *Acacia*, *Desmodium*, *Robinia*, *Mimosa*), he states the general rule that in the dark a slow elevation of temperature causes opening, a quick elevation closing of the leaflets; slow depression of temperature induces a closing of the leaflet, rapid depression a more rapid closing.

Nutation of the Sunflower.‡—Mr. J. H. Schaffner has studied the phenomena connected with the diurnal nutation of the flower-heads of *Helianthus annuus* (in Kansas). From shortly after sunrise, when the plant is nutating about 60° E., until sunset, there is a gradual movement westward until the terminal bud faces W., and the upper part of the stem

* Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxi. (1898) pp. 345–90 (2 figs.). Cf. this Journal, 1897, p. 312. † Cf. this Journal, 1894, p. 370.
‡ Bot. Gazette, xxv. (1898) pp. 395–403 (1 fig.).

nutates 90°. From sunset until about 10 p.m., the plant regains its vertical position, and the leaves droop so that their apices point vertically downward. From 10 p.m. to 1 a.m. is the period of repose. From 1 a.m. till sunrise there is a gradual turning eastward, accompanied by a rising of the leaves, their upper surfaces being brought again at right-angles to the light.

The period of repose cannot be entirely due to the fall of temperature; since, although there is a rapid fall from sunset till midnight, there is also a rapid fall from midnight to sunrise, when the change of position is very marked. The drooping of the leaves cannot be explained entirely as a means of protection against excessive radiation; for when the temperature is lowest, the leaves are already standing up rigidly and turning towards the east.

A moderate wind or cloudy weather has but little effect on nutation; continual drought and excessive moisture both act prejudicially. Decapitation and wounding do not interfere with the nutation, while, on the other hand, the removal of the leaves entirely destroys the power.

Helianthus rigidus exhibits similar phenomena, but more strongly developed.

Tendrils of Entada scandens.*—Prof. D. T. Macdougal describes the structure and irritability of the leaf-tendrils of this plant belonging to the Mimoseæ. They appear to be equally sensitive over their entire length, and are in a state of rapid circumnutation, and more or less curved into a hook form. The sensory zone consists of the single layer of epidermal cells, in which the nucleus occupies a central position. The curvature of the tendril is due to the contraction of the cells that become concave, resembling that of the pulvinus of *Mimosa*. The author concludes, from the phenomena presented by this plant, that the efficiency of the tendril is by no means dependent on the degree of dorsiventrality exhibited, those of *Entada* being isodiametric.

Influence of Low Temperatures on the Direction of Shoots.†—Herr K. Vöchting had previously established that, in the case of flower-stalks (*Anemone stellata*), high temperatures cause an elongation of curved stalks and an erect growth; low temperatures, on the other hand, a curving of straight stalks. He now shows that in herbaceous plants this law operates, probably very generally, in vegetative shoots also. They become orthotropous or plagiotropous according to the temperature. The species on which the experiments were chiefly made was *Mimulus Tilingii.* Although this law probably accounts for the prostrate direction of the stems of many plants, especially of arctic shrubs, it cannot be regarded as the only cause; there are also heliotropic and geotropic factors.

Contraction-Movements of Anther-lobes, Sporanges, and Moss-leaves.‡—From a series of experiments on the bursting of anthers (*Tulipa, Crocus, Lilium, Gladiolus*), and of sporanges (*Equisetum arvense*), and on the rolling up of dried moss-leaves (*Rhynchostegium murale*), Herr C. Steinbrinck supports the view of Kamerling that the pheno-

* Bull. Torrey Bot. Club, xxv. (1898) pp. 65–72 (1 fig.).

† Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 37–52 (1 fig.). Cf. this Journal, 1894, p. 227.

‡ Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 97–103.

mena are due to a hygroscopic mechanism, at least as probably as that which attributes them to a shrinking of the cell-walls.

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

Functional Metabolism in the Plant.*—In the Croonian lecture delivered before the Royal Society, Prof. W. Pfeffer discusses the nature and significance of functional metabolism in the plant. The true aërobic functional metabolism is the same in principle in plants and in animals. This process runs its course within the living protoplasm, not merely on its surface, or in particular portions of it, but in and between all its constituent parts. The distinction between aërobic and anaërobic organisms is one of degree only; the two are connected together by intermediate links. Among aërobes life is maintained for a limited time by the action of intramolecular respiration.

Influence of Sodium and Magnesium Salts on the Growth of Plants.†—According to a series of experiments made by M. H. Coupin, maritime plants (*Beta maritima*, *Atriplex hastata* var. *maritima*, *Cakile maritima*) are very closely adapted to the proportion of sodium chloride contained in sea-water, a very small increase in the proportion of that salt in the water killing them. This, however, is not the case with magnesium salts; the proportion of magnesium chloride may be trebled or even quadrupled.

Depletion of the Endosperm of Barley during Germination.‡—According to experiments made by Mr. H. J. Brown and Mr. F. Escombe on the germination of barley, the separation of the "aleurone-layer" or *Kleberschicht* is due to cytohydrolysis, i.e. to the absorption of water by the hyaline portions of the cytoplasm, and the disintegration due to this cause extends centripetally into the endosperm. They affirm that the normal phenomena of endosperm solution and depletion are not due to the action of extraneous micro-organisms, but to the metabolic activity of the endosperm itself; and not to its amyliferous cells, but to the aleurone-layer alone. This layer is the only part of the endosperm which can be recognised as taking part in the preparation of the food-material for the embryo, since no evidence can be obtained of any changes being initiated by the amyliferous cells themselves. The "aleurone-cells" share with the scutellum the power of eroding starch-grains, but their principal function is to break down the cell-membranes of the amyliferous endosperm.

Chemical Processes in the Germination of Seeds.§—Mr. F. Escombe supports the view of Gorup-Besanez that during germination amides and amido-acids perform different functions. The former result in only small amounts from direct hydrolysis, being chiefly formed synthetically from the further transformation of amido-acids, and of nitrogenous substances derived from the reserve-carbohydrates. This synthesis of amides occurs in the dark; and the further stages of proteohydrolysis, at any rate, are due to enzymic action. It is also most probable that

* Proc. Roy. Soc., lxiii. (1898) pp. 93–101.
† Rev. Gén. de Bot. (Bonnier), x. (1898) pp. 177–91 (3 figs.).
‡ Proc. Roy. Soc., lxiii. (1898) pp. 2–25 (1 pl.). Nature, lviii. (1898) pp. 332–4 (2 figs.).
§ Science Progress, vii. (1898) pp. 219–36.

proteins cannot be regenerated from amides in darkness, and nothing can yet be said as to the rationale of their regeneration in light. The author emphasises the importance of this inquiry by the consideration that the metabolism of germination is doubtless, in the main, chemically similar to that metabolism which occurs in mature plants throughout the whole vegetable kingdom.

Respiration of the Embryo of Wheat.*—Herr G. Burlakow compares the respiration of the embryo and of the endosperm of wheat during germination. In the early stages the respiration of the embryo is much (up to 20 times) more active than that of the endosperm. This is due to the large amount of proteids and carbohydrates; the slight respiration of the endosperm being the result of the small amount of active albumen. The temperature has a great influence on the energy of the respiration of all the parts, especially of the embryo.

Soluble Ferment in Wine.†—According to Sig. G. Tolomei, contact with air causes the oxidation of the colouring matter of wine, rendering it insoluble, and developing a characteristic odour. This is due to the presence of a soluble enzyme resembling laccase. On adding a muscatel ferment to a sterilised wine must, the latter developes, after a few days, a crop of *Saccharomyces ellipsoideus*. During this process a soluble ferment is elaborated, which, remaining dissolved, is capable of producing all the modifications which constitute the maturing of wines.

γ. General.

Lacustrine Biology.‡—Prof. R. Chodat distinguishes between the pelagic and the limnetic plankton flora of the Swiss lakes. Green algæ are not frequent in the pelagic plankton, not being able to support the strong and continuous illumination; those algæ which do occur, as *Botryococcus Braunii*, are protected by a red pigment. In most of the Swiss lakes the water contains but little nitrogenous matter, or mineral salts in solution. Among diatoms, *Asterionella* and *Fragilaria crotonensis* are abundant, while *Melosira* is rare. In the lake of Neuchatel the water and the ice are coloured red by immense quantities of *Botryococcus Braunii*.

Flora of Trout-tanks.§—Herr E. Lemmermann has investigated the relation to the breeding of trout of the algæ found in the trout-tanks at Sandfort, near Osnabrück. The diatoms are of great value to trout-culture, since they check the growth of the injurious Saprolegniaceæ and bacteria, and serve as food for rotifers, crustacea, &c. The Oscillatoriaceæ appear to have no injurious effect on the water. The diatoms develop especially in cold and shady tanks; the Chlorophyceæ in those exposed to the sun. The large floating masses of *Cladophora*, *Spirogyra*, and

* Arb. Naturf.-Ges. k. Univ. Charkow, xxxi. (1897) Beil., pp. i.–xv. See Bot. Centralbl., lxxiv. (1898) p. 323.

† Atti R. Accad. Lincei, 1896, pp. 52–6. Cf. Journ. Chem. Soc., 1898, Abstr., p. 247.

‡ Bull. Herb. Boissier, vi. (1898) pp. 49–77, 155–88. See Bull. Soc. Bot. France, xlv. (1898) p. 88. Cf. this Journal, 1897, p. 568.

§ Forschungsgeb. a. d. Biol. Stat. Plön, v. (1897) pp. 67–117. See Bot. Centralbl., lxxiv. (1898) p. 347.

flowering plants, afford a protection against too strong insolation, as well as a nidus for the breeding of the animals on which the trout feed.

A new genus is described, *Richteriella*, belonging to the Ulotrichaceæ, nearly allied to *Nordstedtia*, but distinguished by the absence of the stellate chromatophores, and by its strongly developed gelatinous envelope.

Resistance of Seeds to Immersion in Water.* — M. H. Coupin finds, as the result of a series of experiments, that different seeds display very different powers of resistance to the disintegrating effects of long immersion in water. Some seeds display greater resisting powers to water which is from time to time renewed than to unchanged water; with others the reverse is the case; while others again are equally affected by water in both conditions. One important agent in the disintegration of the seeds is *Bacillus amylobacter*, which sets up butyric fermentation.

Heat of Germinating Seeds.† — Mr. G. Macloskie gives experimental reasons for believing that the rise of temperature of germinating seeds is not due entirely to the oxidation of carbon, but partly also to the heat set free by imbibition, the law which Sachs illustrates in phenomena attending the ascent of water in trees.

Action of Anæsthetics on Vegetable and Animal Protoplasm.‡— Prof. J. B. Farmer and Dr. A. D. Waller have experimented on the effects of various anæsthetics on *Elodea* and *Chara*, and find it to be the same as on animals. The action of carbon dioxide was to produce an initial slight acceleration, followed speedily by a complete cessation of the movement of the protoplasm, as indicated by that of the chlorophyll-bodies. Ether vapour in air passed over the plant for two minutes caused a speedy arrest of all movement, and the quiescent condition lasted for some minutes longer. The action of chlorophyll was far more deadly than that of ether.

B. CRYPTOGAMIA.

Biology of Spores.§—From an examination of the structure of the spores in Lycopodiaceæ, Ophioglossaceæ, Gasteromycetes, Myxomycetes, and *Tuber*, Herr G. Lüstner classifies these structures under two heads, dependent on the nature of the outer coat, reticulate or pitted, though they are connected by intermediate forms. The former—e. g. spores of *Lycopodium clavatum* and *annotinum*—are incapable of being wetted, not on account of being oily, but because of the air-chambers formed by the ridges on the outer surface. They can penetrate deep into the soil without being injured, and belong especially to such species as germinate underground or carry on in their early stages a saprophytic existence. The second class—e. g. spores of *Lycopodium Phlegmaria*—belong to species for whose germination water is necessary. The chlorophyll which they contain shows that they germinate rapidly and in the light.

* Comptes Rendus, cxxvi. (1898) pp. 1365–8.
† Bull. Torrey Bot. Club, xxv. (1898) pp. 272–4.
‡ Proc. Roy. Soc., lxiii. (1898) pp. 213–6 (2 figs.).
§ Jenenser Inauguraldiss. Wiesbaden, 1898. See Bot. Ztg., lvi. (1898) 2te Abt., p. 198.

Characeæ.

Shoot-Nodes of the Characeæ.*—Pursuing his investigation on this subject, Dr. K. Giesenhagen now describes in great detail the structure of the shoot-nodes in the following species:—the rare *Nitella cernua*, where, in accordance with its gigantic size, the nodes are composed of a very large number of cells, *Tolypella*, in all the species of which genus the development of the nodes corresponds closely to that in *Nitella syncarpa*, *Lamprothamnus alopecuroides*, and *Chara stelligera*.

Muscineæ.

Propagation of Mosses by Gemmæ.†—Herr C. Correns gives further details respecting the propagation of mosses from nematogenous cells. In those species which have no persistent growing point, there are certain cells which alone possess the property of forming protonemes. These occur in all parts of the plant which do not become spontaneously detached;—in *Hypnum stramineum* on the under side of the leaves; in *Leucobryum vulgare* especially on the upper side of the leaf and on the margins of the apex; in many species from the meristematic cells of the base of the leaf. In dissected moss-stems the rhizoids are usually produced from nematogenous cells. This property does not appear to belong to all the cells of the plant indifferently.

Gemmæ of Aulacomnium androgynum.‡—Herr A. Y. Grevillius supports the view that the clusters of gemmæ or bulbils found at the apex of the naked pseudopodes of this moss are modified leaves. A complete series of transitional forms occurs between them and typical foliage-leaves, and the author cannot confirm the view of Correns § that in this species these organs are modified paraphyses, while in *A. palustre* they are modified leaves. In both species neither the apical cell nor the rows of cells immediately beneath it takes any part in their germination.

Dwarf Male Plants of Dicranum.‖—Herr C. Warnstoff finds the dwarf male plants which grow from the stem of the female plant in the following species of *Dicranum*:—*spurium*, *undulatum*, *Bonjeani*, *majus*, and *scoparium*. They are not produced on a protoneme which springs from a spore, but on the weft of roots which serves as a protoneme. They carry on their existence in direct connection with the female plant, and replace male "flowers"; and the author proposes for this "inflorescence" the term "pseudo-autœcious." He has found ordinary male plants in *D. scoparium* and *majus*, but not in *D. spurium*, *Bergeri*, *undulatum*, *Bonjeani*, *neglectum*, or *Mühlenbeckii*.

Algæ.

Food-Materials of Algæ.—Herr W. Benecke ¶ confirms the statement of Molisch of the indispensability of calcium for the active growth of the lower algæ; potassium he also finds to be essential, but the proportion in which this element is present is comparatively indifferent.

* Flora, lxxxv. (1898) pp. 19–65 (2 pls. and 18 figs.). Cf. this Journal, 1897, p. 416.

† Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 22–7 (1 fig.). Cf. this Journal, *ante*, p. 105.

‡ Tom. cit., pp. 111–18 (1 pl.).

§ Cf. this Journal, *ante*, p. 105.

‖ Allg. Bot. Zeitschr., 1898, pp. 40–3. See Hedwigia, xxxv. (1898) Rep., p. 129.

¶ Bot. Ztg., lvi. (1898) 1te Abt., pp. 83–97. Cf. this Journal, 1895, p. 545.

His experiments were carried out on species belonging to three different families,—Protococcaceæ, Ulothrichaceæ (*Ulothrix*, *Hormidium*, *Stichococcus*), and Chætophoraceæ (*Microthamnion*).

Herr O. Loew * contests the accuracy of one or two statements made by Benecke, and the latter replies.†

Germination of the Cutleriaceæ.‡—M. C. Sauvageau compares the structure of the thallus of *Cutleria* or *Zanardinia* to that of filaments of *Ectocarpus* united laterally. Two modes of germination have been observed in the family:—the parthenogenetic development of the oospheres of *Cutleria multifida*, observed by Thuret; and the germination of impregnated oospheres described by Falkenberg. The former give rise to plants resembling a young *Ectocarpus*, the latter to the form known as *Aglaozonia*. M. Sauvageau confirms the occurrence of both these modes of germination in the case of *Cutleria adspersa*, and states that the two modes are not due to differences of habitat, season, or temperature, but that they occur side by side on the same substratum. There are no intermediate conditions between these two modes of germination.

Bangia pumila.§—Mr. O. V. Darbishire describes this endemic species of the eastern Baltic. Besides the vegetative mode of propagation, he was able to follow out in this species a sexual mode. The antherids consist of cells in which the contents have divided into a large number of "spermatia" by repeated quadripartition. The "spermatium" enters the procarp through a small orifice. Cystocarps are formed on branches on which the procarps have been impregnated.

Laminariaceæ.‖—Prof. N. Wille has studied in detail the anatomical structure of *Alaria esculenta*, which he regards as the highest northern type of the Laminariaceæ, especially in the following points:—the intercalary zone of growth in the stipe; the structure of the stipe; the formation and structure of the rhizoids; the structure of the mid-rib, of the sterile surface of the leaf, and of the sporophyll. The assimilating tissue is confined to a single outermost layer of cells. The conducting elements are partly sieve-cells formed from the meristematic cells, partly sieve-hyphæ. The former may lose their function with age, and become closed by plugs of cellulose. The rhizoids are formed from the superficial layer in the lower part of the stipe. The sporophyll may persist for a whole year, and the stipe may live for several years. In the formation of the sporanges there is a great increase in the number of chromatophores. The trichomic structures contribute to the nourishment of the plant. The intercellular substance consists, in the opinion of the author, essentially of calcium pectinate; while the inner lamella of the cell-wall shows the reactions of cellulose.

Centrosome of Dictyota.¶—After a summary of what is at present known as to the existence of centrosomes in the vegetable kingdom, Mr. D. M. Mottier describes his discovery of them in *Dictyota dichotoma*,

* Op. cit., 2te Abt., pp. 235–6. † Tom. cit., p. 236.

‡ Comptes Rendus, cxxvi. (1898) pp. 1435–8. Cf. this Journal, *ante*, p. 453.

§ Komm. wiss. Unters. d. Deutsch. Meere in Kiel, iii. (1898). See Hedwigia, xxxvii. (1898) Rep., p. 106.

‖ Beitr. z. Phys. Anat. d. Laminariaceen, Christiania, 1897, 70 pp. and 1 pl. See Bot. Centralbl., lxxxiii. (1898) p. 388.

¶ Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 123–8 (5 figs.).

in connection with the tetraspore-mother-cells. They are rod-shaped and somewhat curved, and are larger than those of *Stypocaulon*, and probably also than those of *Fucus*; the convex side always faces the nucleus. They are usually parallel, but may also be at right-angles to one another. They are not altogether homogeneous, but appear to consist of small granules. From the centrosome radiate very delicate threads of protoplasm which lose themselves beneath the chromatophores and granules which have collected round the nucleus in a somewhat dense zone. In the daughter-nuclei resulting from the first division of the tetraspore-mother-cells, the centrosome and its rays are found on the polar side, the greater number of the rays running in a tangential direction to the nucleus.

From the remarkable similarity in the structure of the cells to those of *Fucus* and *Stypocaulon*, and the fact that it possesses motile swarm-spores, the author is induced to place *Dictyota* among the Phæosporeæ.

Sexuality of the Tilopterideæ.*—M. C. Sauvageau denies to the monosporous sporanges of the Tilopterideæ the designation of oogones, maintaining their non-sexual character. He proposes to remove *Ectocarpus pusillus* from that genus and from the Ectocarpaceæ, and to place it in the Tilopterideæ under *Acinetospora*, to which genus *Heterospora Vidovichii* should also be referred. In *A. pusilla* he has found unilocular sporanges containing bodies which present all intermediate stages between aplanospores and zoospores. The monospore of *A. pusilla* contains only a single nucleus; it is an organ of vegetative propagation, a propagule. Before escaping from the sporange it is enclosed in a delicate membrane, preventing all possibility of impregnation. In the other Tilopterideæ the monospores are sometimes uninucleated, sometimes multinucleated. Although some species have antherids, no sexual process is known, and the monospores germinate directly. The Tilopterideæ have, therefore, no very near alliance to the Cutleriaceæ; their nearest allies are the Ectocarpaceæ, which they closely resemble in their vegetative structure.

Sexuality of the Sphacelariaceæ.†—M. C. Sauvageau has discovered male sexual organs, antherids, on *Sphacelaria hystrix*. They resemble the multilocular sporanges in form and size, but have smaller chambers, and are orange-red, while the sporanges are dark brown. No unilocular sporanges were observed, and the "multilocular sporanges" are probably oogones and their "spores" oospheres. The dehiscence of the antherids takes place in precisely the same way as that of the "sporanges," each loculus bursting separately. The antherozoids are pear-shaped, with a red spot, while the "zoospores" are oval and much larger. No conjugation with the supposed oospheres was detected.

The antherids of the Sphacelariaceæ closely resemble those of the Tilopterideæ; and the author now regards the Ectocarpaceæ, Tilopterideæ, and Cutleriaceæ as forming an alliance not only among themselves, but also with the Sphacelariaceæ.

Conjugation of Swarm-spores in Scytosiphon.‡—Herr P. Kuckuck has been able to establish the occurrence of conjugation between swarm-

* Comptes Rendus, cxxvi. (1898) pp. 1581–3. † Tom. cit., pp. 1672–5.
‡ Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 35–7 (7 figs.).

spores of *Scytosiphon lomentarius*, similar to that recorded in the case of *Ectocarpus siliculosus*, though by far the larger number come to rest without being impregnated. After conjugation the zygote rounds itself off, and contains two distinct chromatophores, each with an eye-spot.

Division of the Nucleus in Spirogyra.*—After a review of the extensive literature of the subject, Herr L. Mitzkewitsch gives an account of his own observations on several species of *Spirogyra*, which differ in some important respects from those of previous observers, the species examined presenting no essential differences. The point which the author especially desired to clear up was the part played by the nucleoles in the division of the nucleus. In his description of the process of nuclear division, he agrees in important points with that of Strasburger and Tangl; but in the *rôle* of the nucleoles he is rather in accordance with those observers who ascribe to them a more important function than that which belongs to the nucleoles in the higher plants. He especially insists on the part played by them in the formation of the nuclear disc. They do not disappear in the process of division; and may be regarded as a concentration of the stainable substances of the nucleus. The nuclear disk stage in the karyokinetic process is remarkably accentuated in *Spirogyra*. The material out of which it is formed is made up of two substances, chromatin in the form of roundish or elongated granules, coloured a bright red by safranin, each with a light-coloured border, and a second substance, possibly linin, coloured by safranin a light rose-colour.

Conjugation of Binucleated Cells in Spirogyra.†—By rapid cooling or the action of anæsthetics, Herr J. J. Gerassimoff obtained, in the division of the cells of *Spirogyra majuscula*, two cells, of which one contained no nucleus, the other either two of ordinary size, or one very large or compound nucleus. From these latter cells entire filaments were obtained by division, each cell of which contained either two nuclei, or one very large one; these cells also increasing greatly in diameter. Germination of zygotes produced from these binucleated cells resulted in the production of filaments, the cells of which contained only one nucleus, but which were of abnormally large diameter. In the conjugation of binucleated cells, parthenospores were sometimes observed. Two female conjugated with one male cell; but the protoplasm of the latter coalesced only with that of one female cell, a parthenospore being formed in the other female cell. Double zygotes are apparently produced when two adjoining female cells are separated by an imperfect septum.

Rhizoclonium.‡—From the cultivation of two species of *Rhizoclonium* (*R. hieroglyphicum* and *profundum*) Dr. F. Brand comes to the conclusion that neither the relative length of the cells nor the formation of rhizoids is a trustworthy character for the separation of species, these characters being largely dependent on external conditions. Long-continued cultivation gave no countenance to the view of a genetic connection between *Rhizoclonium* and *Cladophora*. The formation of propagating organs of the nature of akinetes was confirmed. The following diagnosis of the genus is proposed:—Unbranched filamentous algæ (or only with rudi-

* Flora, lxxxv. (1898) pp. 81–124 (1 pl.). Cf. this Journal, *ante*, p. 454.
† Bull. Soc. Imp. Nat. Moscou, 1897 (1898) pp. 484–503 (9 figs.) (German).
‡ Bot. Centralbl., lxxiv. (1898) pp. 193–202, 225–36 (1 pl.).

mentary branching) belonging, according to the structure of their cells, to the Cladophoreæ, but not referable to any other genus of the order.

Fungi.

Lipase in Fungi.*—From *Penicillium glaucum* M. E. Gérard has extracted a ferment which he finds to be identical with lipase, or at all events very nearly related to it.

Protoplasm of the Mucorineæ.†—Pursuing his researches on the structure of the protoplasm and the seat of the protoplasmic currents in *Mortierella*, M. L. Matruchot states that in the Mucorineæ the protoplasm is differentiated into a transparent mass of hyaloplasm and a certain number of granular protoplasm cords ("enchylema") enclosed and distributed regularly at the periphery. With increase of age the protoplasmic cords become distributed throughout the mass, and finally become transformed into a more and more watery hyaloplasm. This final condition is not due, as has been stated in the case of the higher plants, to the extension of the vacuoles.

Biology of Uredineæ.‡—Dr. H. Klebahn reviews the present position of our knowledge respecting the biology of the Uredineæ, and gives a summary of the most recent additions to that knowledge. He lays especial stress on the existence of "biological species" or "*species sorores*," groups in which the æcidioforms are scarcely distinguishable, while the uredoforms and teleutoforms present appreciable differences. Of these groups of biological species the following may be regarded as established. *Peridermium Pini* f. *acicola* comprises at least 9 or 10 morphologically indistinguishable or scarcely distinguishable species belonging to the genus *Coleosporium*, recognised only by cultivation on the teleutospore hosts. *Cæoma Laricis* consists, in the same way, of 4 or 5 species whose teleutoforms are species of *Melampsora* parasitic on poplars, birches, and willows. On *Phalaris arundinacea* are a series of puccinioforms of the type of *P. sessilis*, distinguished from one another according as the æcidioforms are parasitic on species of *Arum*, *Leucojum*, *Allium*, *Orchis*, or *Convallaria*. Several series of biologically different forms occur among the Uredineæ of cereal crops and other grasses. The same is the case with the rusts of *Carex*.

Germination of Æcidiospores.§—Dr. P. Nypels calls attention to the fact that some Uredineæ belonging to the genus *Endophyllum* produce æcidiospores which germinate in an unusual manner, similar to that of teleutospores. This occurs abnormally in *E. Sempervivi*, much more commonly in *Æcidium leucospermum* parasitic on *Anemone nemorosa*. Some of the æcidiospores of this species germinate in the ordinary way; others form secondary spores at the apex of the germinating filament; these appear to pass through a period of rest before germinating.

Parasitic Fungi.—M. L. Mangin ‖ has established the truly parasitic nature of *Septoria graminum*, which attacks the leaves of wheat.

* Bull. Soc. Mycol. France, 1897, p. 182. See Bot. Centralbl., lxxv. (1888) p. 76.

† Comptes Rendus, cxxvi. (1898) pp. 1363–5. Cf. this Journal, 1897, p. 219.

‡ Bot. Ztg., lvi. (1898) 2te Abt., pp. 145–58.

§ Ann. Soc. Belge Microscopie, xxii. (1898) pp. 101–11 (5 figs.). Ann. de Micrographie, x. (1898) pp. 214–19 (1 fig.).

‖ Comptes Rendus, cxxvi. (1898) pp. 1438–40.

A detailed description is published * of the injury caused in various Leguminosæ —*Trifolium pratense*, *T. incarnatum*, *Medicago lupulina*, and others—by the attacks of the clover-fungus, *Sclerotinia Trifoliorum*. The injury is chiefly produced by sclerotes in the leaf or stem which frequently fall to the ground; but there is also a saprophytic conidial or *Botrytis* form in which infection may be conveyed to other host-plants.

M. F. Debray † distinguishes between the *anthracnose maculée* and the *anthracnose ponctuée* of the vine. The former is due to the attacks of *Sphaceloma ampelinum*, the latter to those of *Pseudocommis Vitis*, the latter distinguished by its cancer-like appearance.

Herr H. Klebahn ‡ gives the results of a series of experiments on the cultivation of the species of *Puccinia* parasitic on species of *Carex*, the æcidioforms of which are found on species of *Ribes*.

M. M. Molliard § describes the proliferation of the flowers of *Bromus erectus* caused by *Ustilago bromivora*; the action of *U. longissima* on the structure of the vascular bundles of *Glyceria aquatica*; and the anatomical modifications produced in a species of *Symplocos* by *Exobasidium Symploci*.

Prof. B. D. Halsted || describes the mildew of the lime-bean due to the attacks of *Phytophthora Phaseoli*. On plants of asparagus he finds diseased tufts similar to the witch-broom of cedar and cherry trees, apparently caused indirectly by the asparagus rust, *Puccinia Asparagi*. Black specks on the leaves of roses were the result of *Pilobolus crystallinus* derived from the manure by which the bed was covered.

Although almost uniformly free from the attacks of any similar parasite in Europe, the lilac is, in N. America, infested by a species of Erysipheæ, generally described as *Microsphæra Friesii*. Herr P. Magnus ¶ has studied this fungus, and has found it very nearly allied to or identical with *M. Alni* and *M. Betulæ*. It has probably infected the lilac in America from *Ilex decidua*, *Betula lutea*, or *Corylus americana*. The only allied species known on the lilac in Europe is *Microsphæra Ehrenbergii*, which has probably reached it from *Lonicera tatarica*.

Parasites of the Vine.**—Mr. D. M'Alpine and Mr. G. H. Robinson give a detailed account of the Fungi which attack the vine in Australia. A complete list comprises 43 species—28 parasites and 15 saprophytes. Of these 24 (15 parasites, 9 saprophytes) have not been previously noted, and their structure and life-history are described in detail. The disease known as *brûnissure* is ascribed to climatal conditions, not to the attacks of *Plasmodiophora Vitis*.

Fungus Parasitic on Zygnema.††—M. E. de Wildeman describes a fungus endophytic in *Zygnema cruciatum*, causing great enlargement of

* Journ. Board of Agriculture, v. (1898) pp. 39–50 (2 figs.).
† Bull. Agric. Algérie et Tunisie. See Bull. Soc. Bot. France, xlv. (1898) p. 92.
‡ Zeitschr. f. Pflanzenkrank., viii. (1898) pp. 11–30. See Hedwigia, xxxvii. (1898) p. 115.
§ Rev. Gén. de Bot. (Bonnier), x. (1898) pp. 87–93, 96–101 (1 pl. and 4 figs.).
|| Bull. Torrey Bot. Club, xxv. (1898) pp. 161–2 (1 fig.), 232–4 (1 fig.).
¶ Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 64–70 (1 pl.).
** 'Additions to the Fungi of the Vine in Australia,' Melbourne, 54 pp. and 10 pls.
†† Bull. Soc. Belge Microscopie, xxii. (1898) pp. 113–24 (1 pl.).

the cells which it attacks. It consists of a single cell surrounded by a membrane. Its systematic position was not determined.

Stromatopogon, a New Genus of Lichens.*—From the Sandwich Islands, Herr A. Zahlbruckner finds a lichen which he makes the type of a new genus, with the name *Stromatopogon Baldwini* g. et sp. n., growing on the trunks of trees. It resembles *Usnea*, but belongs to the Coniocarpei with a strongly developed thallode, but greatly reduced fructification. The author regards the genus as the representative of a new type of the Sphærophorei.

Reticulations of Ramalina reticulata.†—Mr. G. J. Peirce has investigated the cause of the perforations which produce the netted appearance in all thalli, whether old or young, in this lichen, probably the largest known in size. They are not produced simply by the unequal expansion in three directions, although this is the main factor in the older parts; it is also the curving and consequent straining longitudinally of the softest and least coherent portions of the thallus, near the tip, by the folding over of the apex, and the concentration, owing to the narrowness and circinate curving of the apex, of the greatest transverse strain in that zone where the longitudinal strain is also greatest. The ordinary mode of propagation of the lichen is a vegetative one, the rain softening the thallus, and causing the detachment of large pieces which are carried to a great distance by the wind.

New Text-book of Lichenology.‡—Dr. A. Schneider's new Text-book of Lichenology is intended primarily for the use of students in colleges and universities. It is divided into two parts, the first treating of the history, general morphology, and physiology of lichens; the second, of their classification and special morphology. The phenomena of symbiosis are classified under antagonistic symbiosis (parasitism), nutricism, and mutualistic symbiosis. Five families of Fungi are given as probable ancestral groups of fungal symbionts; and nine genera of algæ are named, which are known to enter into symbiotic relationship to form lichens. The structure of the thallus and apothece is adequately described.

The author proposes a system of classification of lichens, founded on their fungal ancestry, the primary division being into the three orders, Ascolichens, Basidiolichens, and Gasterolichens, based on the method of spore formation of the fungal element. As generic characters, those of the spore are given as of primary importance, then the development of the thallus, the apothece, the exciple, the colour of the apothecial disk, and the colour of the thallus. A number of genera are based upon algal differences. Seventy-seven genera of Lichens are recognised.

Cytological Researches on the Yeast-Cell.§—The results of a careful examination into the cytological characters of the yeast-cell by Prof. F. A. Janssens and M. A. Leblanc are summed up as follows. In the quiescent condition every yeast-cell contains a nucleus, which is made up

* Ann. k. k. Naturh. Hofmuseums, xii. pp. 99–102 (2 pls.). See Hedwigia xxxvii. (1898) Rep., p. 72.
† Bot. Gazette, xxv. (1898) pp. 404–16 (8 figs.).
‡ Schneider, A., 'A Text-book of General Lichenology,' Binghampton, N.Y., 230 pp. and 6 pls. See Bot. Gazette, xxv. (1898) p. 284.
§ La Cellule, xiv. (1898) pp. 203–41 (2 pls. and 67 figs.).

of a membrane, a caryoplasm, and a nucleole. In the early stage of fermentation the nucleus becomes vacuolated, and shortly afterwards the protoplasm follows suit. When fixed at this stage, the nucleus is found to have returned to its original condition, while the protoplasm has acquired a characteristic and typical reticular appearance.

Substances of nucleo-albuminous nature may be deposited in the protoplasmic portion, and may be so abundant as to form definite aggregates (granules). These granules always disappear before spore-formation takes place. Vacuolisation of nucleus and cytoplasm may occur a second time in old cells.

During budding of *S. Ludwigii* and *Schizosaccharomyces octosporus*, there is indirect division of the nucleus. In *S. cerevisiæ* and some others the division is direct. In the latter case, one of the nucleoles passes into the bud.

In cells about to spore two nuclei are observable. These two bodies fuse together, and the resulting single nucleus contains about twice as much nuclein as the ordinary nucleus. Thus a fecundated ovum is produced. At the same time the granules disappear and the protoplasm becomes profoundly altered. The new nucleus divides by a kind of very modified kinesis, though some of the stages are observable. In the second division similar, though still more modified, appearances are evident.

During the maturation of the spores the nucleoles become invested with a membrane, and thus the nuclei are re-formed. During germination, owing to the swelling of the spore, the nucleus becomes more evident. When the spore of *Saccharomyces Ludwigii* germinates, the nucleus passes into the promycele of Hansen. Sometimes the two nuclei destined for fecundation do not fuse, and in this way false spores are produced which are sterile.

Vitality of Alcoholic Ferments.*—Herr E. C. Hansen made a number of experiments and observations as to the vitality of alcoholic ferments kept in nutritive media and in the dry condition. The principal result of these investigations, which have been carried on for years, is that the greater number of the Saccharomycetes retain their vitality indefinitely in a 10 per cent. solution of saccharose, provided there be access of air. Much the same may be said for ferments resembling *Saccharomyces* and *Mucor*.

Those which died were *Saccharomyces Ludwigii*, Carlsberg yeast number 2, the asporogenous variety of the latter, and *Schizosaccharomyces*.

In beer-wort, some of the yeasts were still alive after 10, 11, and 12 years. In water, *S. pastorianus* i. was alive after $11\frac{1}{2}$ years, *S. pastorianus* iii. after 10 years, *S. ellipsoideus* after 10 years.

The experiments on the dried cells were carried out on filter paper, cotton, and platinum wire. The cells on the filter papers were dead in less than 12 months; of those on cotton, some were alive after 2 and 3 years, but dead in less than 3 and 4 years; while those on the platinum wires (dried in exsiccator) did not as a rule survive longer than a few

* Résumé du Compte-rendu d. Trav. d. Lab. de Carlsberg, iv. (1898) pp. 93–121 (3 figs.).

days or weeks. In the dried condition the retention of vitality appeared to depend upon spore-formation.

Winter Habitat and Dissemination of the Alcoholic Ferments.*—Dr. A. Berlese has demonstrated that the alimentary canal of flies forms a suitable and important conservatory for *Saccharomyces ellipsoideus* and *S. pastorianus* during the winter. It is owing to flies that the yeast-cells are transported from one place to another, and are deposited on ripe fruits. The air plays little or no part in the dissemination of yeasts. The yeasts are preserved in the intestines of the pupa of certain diptera, and proceed to multiply in the perfect insect. Yeasts may be preserved in the fæces of animals and in putrefying flesh for considerable periods, and it is possible that they may be transported therefrom by flies.

Action of Oxygen on Beer Yeast.†—M. J. Effront has found that if beer yeast be finely fragmented and exposed to the air, there takes place an absorption of oxygen which is accompanied by considerable elevation of the temperature. The author considers this oxidation of the yeast to be due to the presence in the cells of an oxidising enzyme.

Saccharomyces guttulatus Rob.‡—Drs. L. Buscalioni and O. Casagrandi, in some recent observations, state that *S. guttulatus* is a *Saccharomyces* which exists normally in the stomach and intestine of rabbits; though it develops only in the stomach of these animals, it is cultivable on various media. Its shape on artificial media differs slightly from that observed in the fæces. On solid media (agar) it is usually oval; on other substrata it is much elongated, though oval cells are still formed.

It contains a nucleus which during budding and spore-formation divides by fragmentation. In this way secondary nuclei are produced, and these are frequently united by an intermediary piece which, however, is rarely seen in the cultivated forms. The nucleus in the elongated cells of old cultures degenerates by a process of irregular fragmentation, or assumes various forms. In budding cells the nucleus passes to the pole from which the bud is arising, while in the resting state it occupies the middle part of the elements if they be elongated; and if the cells be ovoid, it approaches more or less to one of the poles.

Its protoplasm contains glycogen, which is especially abundant in the cells found in the intestines and in the large ovoid cells of cultures. The cultural characters vary somewhat for the different media, but are fairly constant for the same substratum. It multiplies both by buds and spores. Spores are formed in fæces, whether dry or moist; but the exact conditions of their formation are at present obscure. *S. guttulatus* has the power of forming alcohol from glucose and of inverting saccharose. It is pathogenic to rats, rabbits, and guinea-pigs when injected into the subcutaneous tissue or into the peritoneal sac; rabbits die in 15–30 days, guinea-pigs in 10–20 days, and rats in 10–16 days. Endovenous injection of rabbits kills the animals in 6–8 days. At the injection sites nodules with purulent contents are formed.

Fungi intermediate between Trichophyton and Achorion.§—M. E. Bodin has observed in man and in animals cutaneous lesions of which

* Rivista Patologia Veg., vi. (1897) pp. 1–20, 24–44.
† Comptes Rendus, cxxvii. (1898) pp. 326–7.
‡ Malpighia, xii. (1898) pp. 59–75 (1 pl. and 15 figs.) Cf. this Journal, 1897, p. 60.
§ Comptes Rendus, cxxvi. (1898) pp. 1528–9.

the clinical aspect and the microscopical appearances resemble those of *Trichophyta* of animal origin, while pure cultures present the morphological characters and the biological affinities of *Achoria*. He therefore concluded that there exists a group of parasites intermediate between the *Trichophyta* and *Achoria*.

This intermediate group also includes,—(1) Mucedineæ, the mycological characters of which are those of *Achorion*, while their clinical aspect resembles that of certain *Trichophyta*; and (2) parasites which are *Trichophyta* morphologically and biologically, but which produce favus lesions.

Trichophyton producing Herpes on the Horse.*—MM. Matruchot and Dassonville describe a new *Trichophyton* which infested the horses and men of an artillery regiment. The fungus was easily cultivated on Sabouraud's medium, on carrot and on potato. The cultures showed a mycele 2–8 μ broad, relatively rarely septate, and frequently branched at right angles. Oval spores, 3–4 μ by 2–3 μ, are formed by the side of joints, and, besides these lateral spores, chlamydospores (3–10 μ by 2·8 μ) are also produced. Examination of the hairs showed numerous oval spores (4–6 μ by 2–4 μ), and also mycele. The authors consider the fungus should be classed among the Ascomycetes of the group Gymnoascaceæ. The cultures were successfully inoculated on man and guinea-pigs.

Pseudo-Lupus Vulgaris caused by a Blastomyces.†—Mr. T. C. Gilchrist and Dr. W. R. Stokes record a case, the clinical aspect of which simulated the appearance of lupus vulgaris (tuberculosis of the skin). In sections from the cutaneous lesions, almost typical tubercles were found, and these were associated with the presence of apparently budding Blastomycetes. These organisms were chiefly spherical unicellular bodies, varying from 10–20 μ in diameter, were inclosed in a doubly contoured membrane with finely granular protoplasmic contents, and sometimes contained a vacuole. No nucleus was discovered. There were many budding forms, but no mycele or hyphæ.

Pure cultures were easily obtained on the ordinary media. These exhibited budding forms and a fairly profuse mycele.

Dogs, guinea-pigs, a horse, and a sheep, were successfully inoculated. In the lungs were found nodules, sometimes of considerable size, resembling cancerous deposits.

Microscopically these nodules were found to be of a chronic inflammatory nature, and they contained the parasites.

As the organism did not ferment sugar, and produced a mycele in cultures, it may belong to the Blastomycetes or to the Oidia: but in conformity with the present nomenclature the authors have designated it *Blastomyces dermatitidis*.

Protophyta.

a. Schizophyceæ.

Culture-forms of Diatoms.‡—In pure cultures of diatoms in water containing a little straw and clover, Herr J. Bürger obtained specimens

* Comptes Rendus, cxxvii. (1898) pp. 279–81.
† Journ. Exper. Med., iii. (1898) pp. 53–78 (5 pls.).
‡ Zeitschr. f. angew. Mikroscopie, iv. (1898) pp. 61–2.

of *Gomphonema acuminatum* without a stalk, and associated in a spiral resembling *Meridion circulare*; the protoplasm yellow-brown. A small species of *Synedra* multiplied within an oval transparent envelope, in which the frustules lay side by side.

Changes of Form of Sceletonema costatum.*—Herr G. Karsten has studied the movements of this diatom, belonging to the Coscinodisceæ, a plankton-alga associated in chains, and concludes that the multiplication and development are regulatad by internal forces dependent on external conditions. The propagation takes place only half as rapidly in flowing as in standing water.

Nostoc punctiforme.—Following out his observations on the development of this organism, M. R. Bouilhac † has established that it is a plant which can develop in absolute darkness if it be supplied with an organic substance such as glucose. It can develop both like a green plant by decomposing carbon dioxide, and as a non-chlorophyllous plant by assimilating an organic substance.

In another paper MM. A. Etard and R. Bouilhac ‡ state that this organism preserves, in the dark, the power of forming chlorophyll.

β. Schizomycetes.

Bacterial Diseases of Plants.—Prof. J. C. Arthur § summarises the reports in the Bulletins of the various experimental stations in the United States, respecting diseases of cultivated crops and fruit-trees due to the attacks of Schizomycetes. A new bacterial disease of sweet-corn is described, attacking the plant chiefly at the time of flowering, clogging the fibrovascular bundles of the stem. The olive-knot or tuberculosis of the olive is ascribed to the attacks of *Bacillus Oleæ*.

Sig. F. Cavara ‖ describes the following bacterial diseases of the grape-vine:—Tuberculosis, produced by *Bacillus Ampelopsoræ*; necrosis, by *B. cubonianus*; also necrosis of the mulberry, due to two different Schizomycetes, one of them resembling *B. vitivorus* and identical with *B. cubonianus*, the other a new chromogenous species, *B. Mori carneus*; tuberculosis of the peach, caused by an undescribed species, *Clostridium Persicæ tuberculosis* sp. n.

According to Prof. B. D. Halsted,¶ bacteriosis of the "bush-bean" is due to the attacks of *Bacillus Phaseoli*.

Herr W. Schostakowitsch ** describes the remarkable changes produced in *Mucor proliferus* by a bacterium, rendering the species almost unrecognisable.

Pathogenic Streptothrix in Sputum.††—Herr Rullmann found a pathogenic streptothrix in sputum, supposed to be derived from a lesion near the root of the lung. The fungus stained easily, and was not

* Wissensch. Meeresunters., iii., Heft 2, Kiel, 1898. See Bot. Ztg., lvi. (1898) 2te Abt., p. 203.

† Comptes Rendus, cxxvi. (1898) pp. 1583–6. Cf. this Journal, *ante*, p. 225.

‡ Op. cit., cxxvii. (1898) pp. 119–21. § Bot. Gazette, xxxv. (1898) pp. 461–3.

‖ Le staz. sperim. agrar. Ital., xxx. (1897) pp. 482–509. See Hedwigia, xxxvii. (1898) Rep., p. 100. ¶ Bull. Torrey Bot. Club, xxv. (1898) pp. 329–31 (1 fig.).

** Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 91–7 (1 pl.).

†† Münch. Med. Wochenschr., July 19, 1898. See Brit. Med. Journ., 1898, ii. Epil. 180.

decolorised by Gram's method. The sputum contained hard masses composed of a pure culture of the fungus in which branching was rare. On some media it grew in spindles and in rods with clubbed ends resembling the diphtheria bacillus. On Loeffler's serum and on egg albumen it produced threads. General infection followed on injection of cultures into animals. Sometimes it excited suppuration of the lymphatic glands.

Beetroot Jaundice.*—During the past few years the beet cultivated in the Pas-de-Calais and near Paris has been attacked by a disease called, from the yellow aspect of the leaves, beetroot jaundice. The malady not only turns the leaves yellow, but causes them to wither. The plant stops growing, and the amount of sugar may be diminished by at least 50 per cent. When examined microscopically, the cells in the diseased parts are found to contain numerous short stumpy bacilli which whirl about rapidly in the cell fluid. Pure cultivations of the bacterium, when inoculated on healthy plants, reproduce the disease.

Biochemical Production of Sorbose.†—According to M. G. Bertrand, sorbose, the formula for which is $C_6H_{12}O_6$, does not exist as such in the juice of sorbus trees (*S. aucuparia*, *S. latifolia*, *S. intermedia*), but is developed therein by oxidation of the sorbite through the agency of a bacterium very closely resembling, if not identical with, *B. xylinum* of Brown.

When a pure culture of this bacterium is inoculated on a medium containing sorbite, the latter is converted into sorbose, the yield not unfrequently amounting to 80 per cent. The bacterium is a motionless rodlet 2–3 μ long and about $0 \cdot 5$ μ thick. The rodlets, which are easily stained, are united together by a gelatinous substance. Like *Mycoderma aceti* it is an oxidising organism capable of living in an acid medium.

The sorbose bacterium is imported by a little red fly, *Drosophila cellaris.*

Branched Form of the Tubercle Bacillus.‡—Dr. C. F. Craig describes and depicts specimens of the branched form of the tubercle bacillus. The specimens were obtained directly from the sputum, and stained in the ordinary way. The illustrations clearly show typical branching and its early or budding stage.

Bacillus graminearum.§—In some parts of southern Italy certain reeds (*Arundo donax*, *Phragmites vulgaris*, and *Calamagrostis epigejos*) become mouldy and dry after having been cut and stacked. Handling of these reeds gives rise to irritation, sometimes severe, of the skin and mucous membranes. The lymphatic glands may be enlarged, and the temperature rise to 100–104° F. In the dry and mouldy reeds is found a copious whitish pink fine powder which consists of spores and filaments of various species of Hyphomycetes and Schizomycetes, numerous spores of *Dendrochium microsorum*, and colonies of a bacillus 5–6 μ long and 1–2 μ broad. This bacillus is called *B. graminearum.*

* Comptes Rendus, cxxvii. (1898) pp. 338–9.
† Ann. Inst. Pasteur, xii. (1898) pp. 385–99 (2 figs.). Cf. also Comptes Rendus, cxxii. (1896) pp. 900–3.
‡ Journ. Exper. Med., iii. (1898) pp. 363–70 (1 pl.).
§ Melfi, 1898, 20 pp. Lancet, 1898, ii. p. 486.

Botriomyces.*—Mr. J. B. Wolstenholme states that Bollinger has recently come to the conclusion that the causative agent of scirrhous cord in horses is a micrococcus which has also been found on certain cereals and grasses. These scirrhous cords are dense masses of fibrous tissue, of a pale pink hue on incision, and are often found to be riddled with abscesses. Microsections show fibrous tissue, granulation tissue, and collections of cocci. The cocci are about 3 μ in diameter.

Nature of the Antagonism between Toxins and Antitoxins.†—Prof. C. J. Martin and Dr. T. Cherry made experiments to determine whether the action of antitoxins was direct or indirect. Both views have been strongly supported, the latter by Calmette, Wasserman, Buchner, Metchnikoff, and others; the former by Behring, Ehrlich, Kanthack, and others. If the action be direct, then it is to be regarded in the light of a chemical reaction; if indirect, then the result is brought about through the intervention of the cells of the body. While the supporters of the indirect view interpreted the facts, as far as they went, correctly, yet they had altogether left out of consideration a factor of prime importance in investigations of this nature; they had failed to appreciate the value of time. The authors, who support the direct or chemical reaction view, point out that every chemical reaction has a certain definite velocity coefficient, and the rapidity of action under any circumstances where the reacting compounds are in solution, depends upon this coefficient, and also upon the product of the active masses of the reacting bodies present. They further point out that, by modification of the factors time, temperature, and active masses, very discrepant results may be obtained.

The authors' experiments were conducted with the toxin of diphtheria and one of the constituents of the poison of the Australian tiger snake (*Hoplocephalus curtus*). The antitoxins used were Behring's No. 1 and serum from the Pasteur Institute, Paris. The antivenomous serum was obtained from the Pasteur Institute, Lille. It was first shown, by means of the gelatin filter, that the association of toxin and antitoxin for a certain length of time had resulted in an amalgamation, and that the mixture had become after two hours a harmless fluid. The results of the experiments with snake venom are given in tabular form. These are quite in accord with the filtration experiments with diphtheria toxin and antitoxin, and are diametrically opposed to the results obtained by Calmette.

Microbe of Progressive Cirrhosis.‡—Prof. J. G. Adami has discovered in cases of portal cirrhosis in man a microbe which, according to the strength of the staining, presents itself as a diplococcus or as an ovoid bacterium. In the infective cirrhosis of cattle a very similar microbe is demonstrable; this is a polymorphic organism appearing as a diplococcus in liquid media and a bacillus on solid substrata. It is pathogenic to laboratory animals. From one case of human atrophic cirrhosis, the author was able to isolate a microbe quite similar in appearance and in cultural characters to that of the diplococcus found in the infective cirrhosis of cattle.

This microbe, from cultures obtained from spleen, kidney, lymphatic gland, and blood, was found to be highly polymorphic; on agar plates

* Trans. Manchester Micr. Soc., 1897 (issued July 10, 1898) pp. 23–8 (2 figs.).
† Proc. Roy. Soc., lxiii. (1898) pp. 420–32.
‡ Lancet, 1898, ii. pp. 396–400 (1 pl. and 6 figs.).

there were long chain-like bacilli interspersed with shorter forms, as well as the diplococcus and diplobacillus forms. The organism is extremely small, and very difficult to stain. The most successful stainings were obtained with phenol-fuchsin and decolorising in the sun.

Astasia asterospora Meyer.*—Herr W. Migula has found, by using Loeffler's mordant and van Ermengem's method, that *Astasia asterospora* is covered all over with flagella. He is of opinion that the genus *Astasia* should be suppressed, and the organism described as *Bacillus asterosporus*.

With regard to the granules which Meyer considers to be nuclei, the author is of opinion that neither in *Astasia* nor in any other of the species examined can they be held to be true nuclei.

Bacillus tartaricus.†—MM. L. Grimbert and L. Ficquet describe a new bacillus which produces a ferment capable of splitting up tartrate. It is 1–2 μ long, is actively mobile, stains by Gram's method, and is a facultative anaerobe. It quickly renders bouillon turbid, forming a scum thereon. On gelatin plates the colonies resemble those of the coli bacillus. The liquefaction of the gelatin is slow, and begins from the 10th to the 15th day. It does not form indol in pepton solution; milk is coagulated in about eight days; starch is not dissolved; nitrates are converted into nitrites. The bacillus attacks glucose, lactose, maltose, sucrose, dextrin, and mannite, and has no effect on dulcite and glycerin. On tartrate of lime both are aerobic; and in anaerobic cultures the bacillus exerts a strongly disintegrating action. As nutrient medium, a saline solution containing two per thousand pepton and kept at 36° was used. The fermentation products were acetic acid, succinic acid, carbonic acid, hydrogen, and alcohol.

With tartrate of ammonia no gas development took place, nor was a trace of alcohol detected, but succinic and acetic acids were both recognised. The bacillus therefore decomposes tartrates with the production of succinic, acetic, and carbonic acids, and hydrogen.

The Fatty Substance in the Tubercle Bacillus.‡—Starting from the observation of Unna that the tubercle bacillus contained a fatty substance, Dr. Aronson made giant cultures in glycerin-bouillon, thereby obtaining 300 grm. of tubercle bacilli. The mass of bacilli was treated with alcohol and ether. In the culture there remained a thin brown substance which amounted to 20–25 per cent. of the whole bacillary mass. Chemical examination showed that this substance was composed of 17 per cent. free fatty acid, the rest being wax. From the latter, one of the higher alcohols was obtained. The wax was also obtained, though in less quantity, when tubercle bacilli were grown on mineral media. This wax stains deeply with carbol-fuchsin, and only gives up the colour with great difficulty when treated with hydrochloric acid alcohol. The wax lies partly between and partly in the tubercle bacilli. That inside the bacilli is only extracted with difficulty. A similar substance with similar staining reaction was obtained from diphtheria bacilli.

* Flora, lxxxv. (1898) pp. 141–50 (3 figs.). Cf. this Journal, *ante*, p. 120.

† Journ. de Pharm. et de Chim., July 6, 1897. See Zeitschr. f. angew. Mikr., iv. (1898) pp. 79–80.

‡ Münch. Med. Wochenschr., 1898, p. 642. See Zeitschr. f. angew. Mikr., iv. (1898) pp. 71–2.

By treating tubercle bacilli from which the wax had been removed with caustic soda (0·02 per cent.), under a pressure of 130, a substance was extracted which was strongly poisonous to guinea-pigs, producing death from marasmus.

Agglutinative Power of Tuberculous Serum produced by Chemical Substances.*—M. S. Arloing states that he has produced the phenomenon of agglutination in goats' serum by means of eucalyptol, guaiacol, creosote, and corrosive sublimate. The animals received injections of these substances for periods varying from one to two years. The creosote, guaiacol, and eucalyptol were suspended in olive oil.

Microbes of Turned Wine.† — MM. F. Bordas, Joulin, and de Rackowski now give an account of the bacillus associated with *B. roseus vini* previously described by them. The bacillus was isolated from the sediment on a pepton-mineral medium, and afterwards on gelatinous media; the gelatin was not liquefied. Under the Microscope the bacillus is seen as filaments of variable length, being 8 to 12 μ long and about 0·8 μ broad. It does not stain by Gram's method; it slowly transforms nitrates into nitrites; coagulates milk after eight days; does not form spores, nor produce indol. It withstands desiccation for 6 months; is killed in a minute at 65°. When cultivated in wine, the fluid becomes cloudy, loses colour, and at the end of about 20 days causes a sensible diminution in the tartar and glucose, and a slight increase of acidity.

The differences between this bacillus and *B. roseus vini* cultivated under identical conditions are interesting. The former produces no scum, developes in media containing more than 3 grm. of tartar per litre, acts feebly on glucose and glycerin, produces succinic acid with the former, and does not form dioxyaceton with the latter. On the other hand, *B. roseus vini* always develops on the surface; is not cultivable in media containing that proportion of tartar; acts energetically on glucose and glycerin, forming lactic acid in the first case, and dioxyaceton in the second.

Agglutination of the Tubercle Bacillus.‡—M. S. Arloing finds that Koch's bacillus may be agglutinated by the action of certain serums. Thus the serum of goats which have been injected with tuberculin or with tubercle bacilli produces the phenomenon in a complete and satisfactory manner. This serum also agglutinates avian tubercle bacilli very well.

The agglutinating power of normal blood is inversely to the power of the species for contracting or resisting tuberculosis. Thus it is nil for the guinea-pig and rabbit, slight for the goat, more marked in the ox and ass, well marked in the horse. The agglutinative power was found to develop in a comparatively short time, less than a fortnight.

This agglutinative power was applied to the diagnosis and prognosis in cases of human tuberculosis, and positive results were obtained in over 90 per cent. of the cases.

Mobile Variety of the Tubercle Bacillus.§ — M. S. Arloing has obtained cultures of the tubercle bacillus which are easily emulsioned

* Comptes Rendus, cxxvi. (1898) pp. 1550–2.
† Tom. cit., pp. 1443–6. Cf. this Journal, *ante*, p. 464.
‡ Tom. cit., pp. 1398–1400.
§ Tom. cit., pp. 1319–21.

by breeding on cooked potato. The success is quite subordinated to the quality of the potato and to the constant impregnation of the nutritive medium with glycerinated water. By means of the foregoing, homogeneous cultures in glycerin-bouillon were obtained. Any of these cultures at any period of their growth contain mobile organisms. Such bacilli are isolated, rarely in groups, are straight or slightly curved, a little larger than the bacilli found in sputum, and give the characteristic colour reaction. The immobility of the tubercle bacillus is therefore not a constant characteristic of this organism.

Aerobism of the Tetanus Bacillus.* — Dr. J. Ferran supports the view upheld by Grixoni with regard to the tetanus bacillus. Grixoni contended that this bacillus is an essential aerobe and only occasionally an anaerobe, that it thrives in the upper layers of the earth and is non-virulent, and that its pathogenic properties are acquired by association with other bacilli under conditions not accurately known.

Ferran states that by making a series of cultures of the tetanus bacillus it may be shown that this presumed essential anaerobe is really an aerobe. The first cultures are made in an atmosphere of acetylen gas; and this, in the succeeding ones, is more and more diluted with air until the bacillus lives entirely in air, forming thick tufts on the surface of the bouillon, and having undergone no morphological change. Only the first cultures, however, are virulent. The author therefore concludes that the common conception, viz. that the tetanus bacillus is a strictly anaerobic organism, is erroneous.

Bacillus Gangrænæ Pulpæ.†—Prof. J. Árkövy describes a polymorphic organism, *B. gangrænæ pulpæ*, which he considers to be the main cause of pulp-gangrene and of chronic alveolar abscess. The material was first inoculated in bouillon, and then transferred to gelatin and agar plates. On the former the organism grew as a bacillus, on the latter at first as a bacillus, but in about ten days a coccus form appeared. From the gelatin plate-cultures, stick subcultures in gelatin and agar were made. In the gelatin a bacillus grew; in the agar, after about ten days a coccus appeared. When the last was transferred to gelatin plates, the organism reverted to the bacillus form. The results were quite similar when subcultures were made from the first agar plates.

The bacillus was found in the mouth, teeth, saliva, and in gangrenous tissue. It is about 4 μ long, with sharply cut-off ends. It may occur singly, or in short chains. It has a fish-like movement, and occasionally forms spores. It is easily stained by Gram's method, but not with methylen-blue. The colonies on gelatin are at first white, then yellow, and exhale a stinking cheese-like odour. The gelatin is liquefied with a strong alkaline reaction. It grows well on agar, potato, and serum, but best on tooth pulp. It is a potential anaerobe, and its optimum temperature is 37°·5–39°·5 C. Cultures inoculated on healthy teeth reduced the teeth to a carious condition in two months.

Growth of Bacteria on Media made from Animal Organs.‡—Dr. L. E. Livingood finds that there are substances in all organs of animals

* Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 28–9.
† Op. cit., xxiii. (1898) pp. 917–29, 962–74 (1 pl. and 12 figs.).
‡ Tom. cit., pp. 980–4, 1002–7, 1013–54.

which exert an inhibitory influence on the growth of bacteria; that there is some slight difference in this inhibiting action in different organs; that there is no essential difference in the appearance of the growths on the various media; that the organisms grown on the media used show no marked variation in morphology; and that the inhibiting property is invariably lost on heating the extracts. It was also found that there is a certain uniformity in the composition of organs in different animals, so far as the nutritive value to bacteria is concerned.

The viscera used in the experiments were the liver of certain domestic animals and of man, the spleen of the sheep, dog, ox, and pig, and the adrenals of the ox, sheep, and pig. The juice of the organ was passed through a Pasteur-Chamberland filter, and one portion of the fluid poured into a test-tube containing an equal bulk of 2 per cent. agar melted and cooled down to 45° C. Another portion was made up as a bouillon-agar (1 per cent. pepton, 5 per cent. NaCl, 2 per cent. agar) by means of heat. The control tubes contained plain bouillon agar. The micro-organisms selected were *B. coli*, *B. typhosus*, *B. anthracis*, *B. diphtheriæ*, and *B. pseudodiphtheriæ*.

Mineral Constituents of Tubercle Bacilli.* — Drs. E. A. de Schweinitz and M. Dorset analysed 1·453 grm. of ash obtained by incinerating tubercle bacilli. The results were as follows:—Na_2O, 13·62 per cent.; K_2O, 6·35 per cent.; CaO, 12·64 per cent.; MgO, 11·55 per cent.; carbon and silica, 0·57 per cent.; P_2O_5, 55·23 per cent. The high percentage of phosphoric acid and the absence of other acid radicals are very noticeable.

New Chromogenic Bacillus.† — Herren F. W. J. Boekhout and J. J. Ott de Vries describe a chromogenic bacillus which they designate *B. fuchsinus* on account of the iridescent pigment. The bacillus was isolated from tap-water, and cultivated on potato. The growth, at first reddish, had in two days a bronze shimmer. The organism was cultivated on several kinds of nutrient media, the most suitable for the production of pigment being a sodium-tartrate-pepton-agar. In shape *B. fuchsinus* resembles *B. prodigiosus*; it is from 1–1·5 μ long and about half as broad. It is easily stained.

Oxygen is necessary for the production of pigment, but the bacillus can vegetate in the absence of this gas. The optimum temperature lies between 22° and 25° C. The shape of the organism was found to vary with the medium; for while ordinarily it is a short rodlet with rounded ends, yet, when cultivated in malt extract or malt-agar, it forms pretty long rodlets. Other slight variations were also noticed. When cultivated at 36° no pigment was formed, but when the temperature was lowered the colour reappeared. It does not produce gas, and imparts to the medium a strongly acid reaction. Besides the pigment and the acid, *B. fuchsinus* secretes a peptonising ferment. The pigment is soluble in alcohol, chloroform, and carbon bisulphide, less so in ether, and with difficulty in water.

Action of Cider on the Typhoid Bacillus.‡—Dr. E. Bodin, who has made experiments to test the duration of the vitality of the typhoid

* Centralbl. Bakt. u. Par., 1te Abt., xxiii. (1898) pp. 993–5.
† Op. cit., 2te Abt., xxiv. (1898) pp. 497–501.
‡ Ann. Inst. Pasteur, xii. (1898) pp. 458–84.

bacillus in cider, finds that this organism is destroyed in from 2 to 18 hours after the liquid has been infected. This destruction is due to the acidity of the cider, provided that there are at least 2 grm. of malic acid per thousand. If the acidity be 0·8–1 per thousand, the organism may exist in malic acid for 3 or 4 days, and more than 20 if it be neuter. As cider usually possesses an acidity over 2 per thousand, the typhoid bacillus cannot live therein longer than 18 hours. If, however, cider be diluted with typhoid-infected water, this beverage may become the means of imparting the malady if drunk during the first day.

Bacteria of Sorghum Blight.* — M. F. F. Bruyning jun. describes two new bacteria which he has discovered in blighted sorghum.

B. ruber ovatus sp. n. is somewhat oval in shape, 0·9–1·2 μ long by 0·7–0·8 μ broad, sometimes in pairs or triplets. It is aerobic and does not form spores. It is slowly decolorised by Gram's method. There are indications of a capsule. The optimum temperature is 20° C. On potato the colour of the growth is bright red or vermilion. Growth in bouillon is slow, the medium becoming somewhat opalescent and a scanty colourless sediment being deposited. Gelatin is not liquefied, and litmus-gelatin remains unaltered.

M. aurantiacus sorghi sp. n. is round to oval in shape, with a diameter of 0·7–0·9 μ. It forms chains. On potato the growth soon assumes a bright yellow colour. Milk is coagulated in about seven days. Bouillon soon becomes turbid. All the substrata sooner or later present an acid reaction. On gelatin the growth is yellow, and the medium is not liquefied. The micrococcus is aerobic, but has some tendency to potential anaerobiosis.

The pigment, which is easily obtained from the diseased plant, is extremely soluble in strong alcohol. When dried it is of a dark brown hue, and is found to possess powerful staining qualities. Silk and wool are easily "fast" dyed by dilute spirituous solutions. The author dilates freely on the numerous properties of this pigment, and discusses the differences between it and other bacterial pigments.

The pigment of *M. aurantiacus sorghi* is soluble in weak spirit.

Sporicidal Action of Normal Rabbit Serum.†—From an experimental study on immunity carried out through the agency of *B. subtilis* and rabbits, Dr. Podbelsky concludes that the spores of *B. subtilis* are killed by normal rabbit serum *in vitro*. This sporicidal property appears to be imparted from substances derived from leucocytes. Neither œdema-fluid nor aqueous humour prevents the development of spores nor kills the bacilli. The action of serum rich in leucocytes approaches that of blood-serum. Substances in the blood plasma which are capable of traversing reed-membranes do not prevent the development of spores, and do not kill the bacilli in the body of the living rabbit. Spores of *B. subtilis* introduced into any part of the rabbit are incorporated by leucocytes, and their development is arrested. By careful selection a race was obtained, the spores of which were able to develop in normal serum, and also when injected into the body. The bacilli arising from these spores were, however, incorporated and digested by the leucocytes.

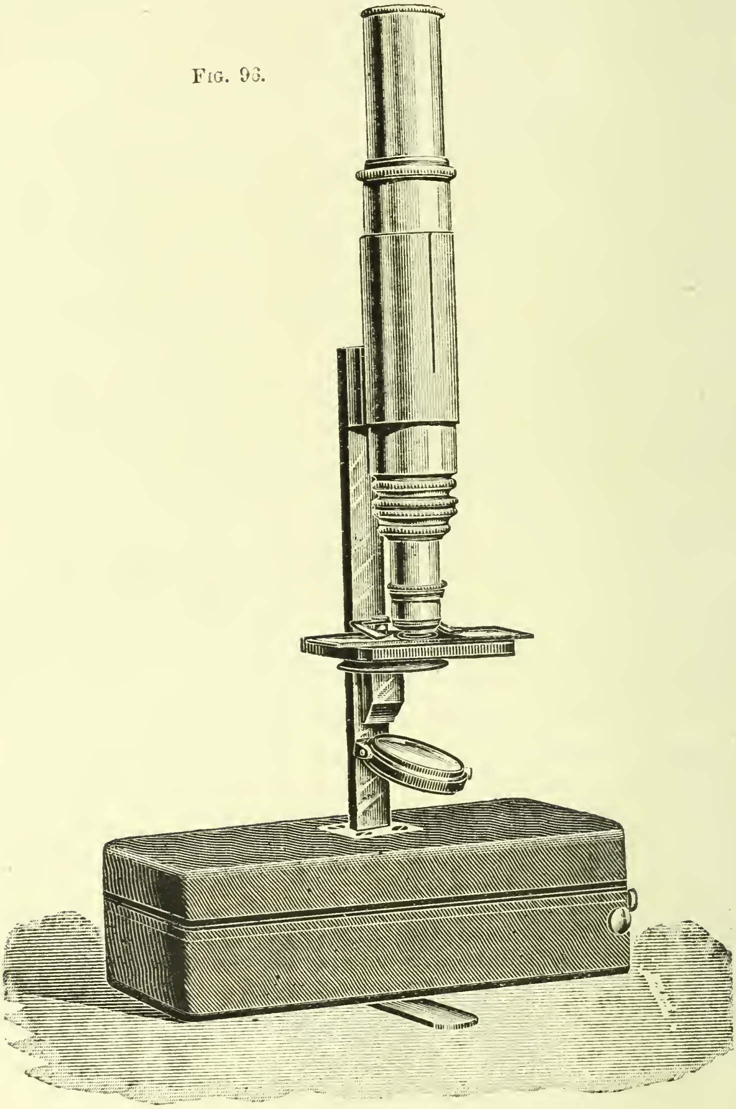
* Archiv. Néerland. Sci. Exact. et Nat., sér. ii., i. (1898) pp. 297–330 (2 pls).
† Ann. Inst. Pasteur, xii. (1898) pp. 427–46.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Fig. 96.

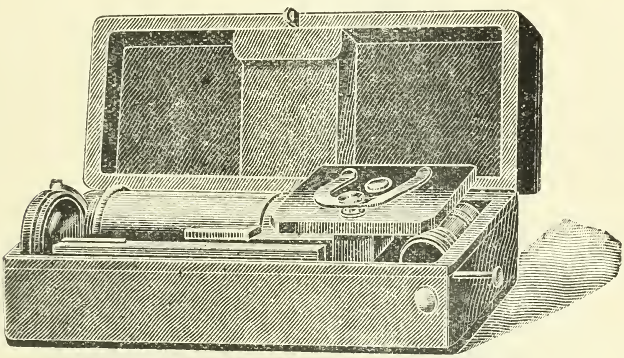


* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

Sticker's Travelling Microscope.*—Under this name Dr. George Sticker describes a new form of portable Microscope made by the firm of Leitz to his design.

The general arrangement will be easily understood from the two figures (figs. 96 and 97). When packed in its leather case it does not exceed $15 \times 5\frac{1}{2} \times 6$ cm. The lid of the case serves as a stand, and a metal rod carries the object-table, mirror, diaphragm, &c. The coarse adjustment is attained by sliding the tube, and the fine by a screw between the tube and the objective. The case contains places for an ocular

Fig. 97.



and two objectives. Only the optical upper part of each objective is packed, and one lower part. The traveller selects the system to suit his purpose. Finer objectives secured in their metal cases can be also packed.

The weight of a waterproof pocket carrying the leather case, and a second case for immersion oil, stain solutions, slides, and cover-glasses, is only 920 grm. (2 lbs.), which weight also includes a leather strap for slinging the whole on one's shoulder like a field-glass.

Berger's New Microscope.†—The novelty in this instrument is entirely confined to the overstage, and is intended to meet the constructional difficulties involved in adapting the adjustments (especially the fine) to Microscopes used for high-power photomicrography. Usually the strain on the fine adjustment caused by the extreme length (and consequent weight) of tube is a decided disadvantage. Herr Berger arranges so that both his coarse and fine adjustments are independent of the draw-out. The Microscope is also suitable for ordinary use.

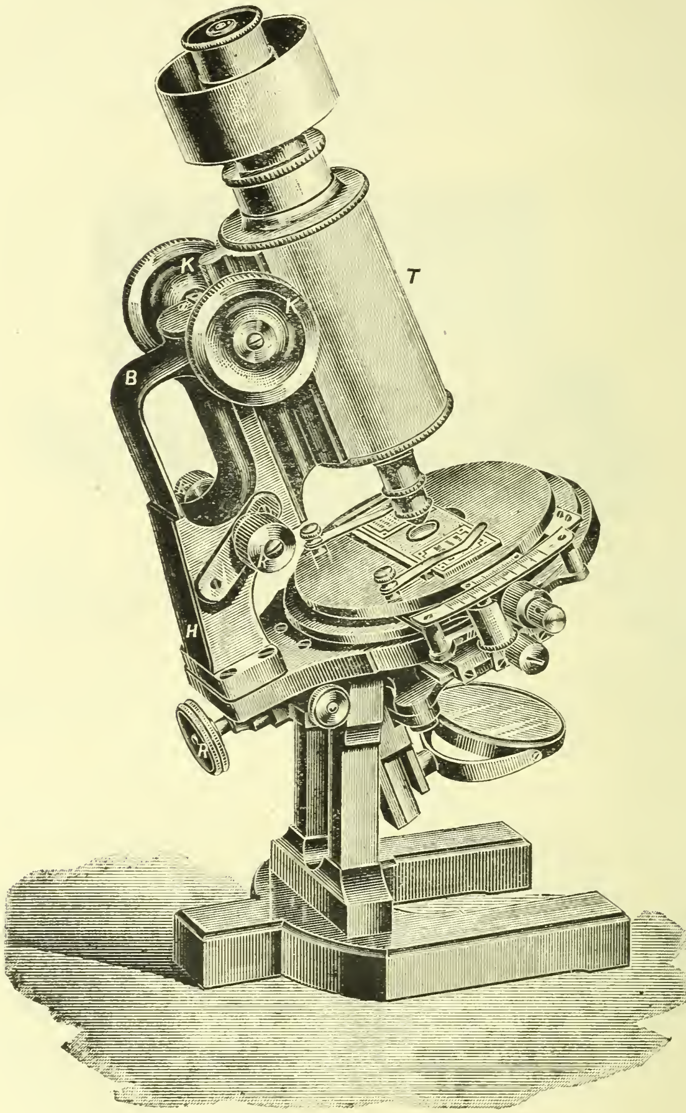
Fig. 98 gives a general view, fig. 99 a vertical section, and fig. 100 a ground plan.

The oval-shaped piece B is arranged as a handle, which affords a strong brace between the fine adjustment path V (fig. 100) of the micrometer work and the special hollow-cast standard H (fig. 99). The fine adjustment differs widely from the general form, and is fitted by means

* Zeitschr. f. wiss. Mikr., xiv. pp. 433–6 (2 figs.).
† Zeitschr. f. Instrumentenk., pp. 129–33 (3 figs.).

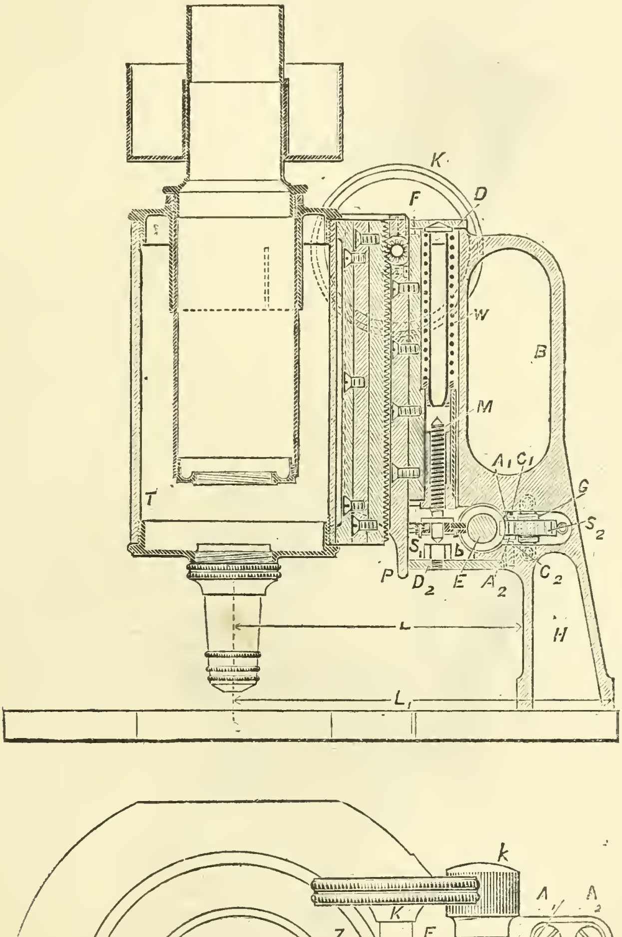
of a very strong dove-tail shaped slide F, so hollowed out in its upper part that it affords the requisite room for the spiral spring W. The

Fig. 98.



under part of F is pierced, and conceals the very long nut for the micrometer-screw M. Contact ensues between the hard-tempered extremity of the micrometer-screw and another also hard-tempered anvil-shaped steel piece which is screwed into the lid D_2, closing dust-tight the under

Fig. 99.



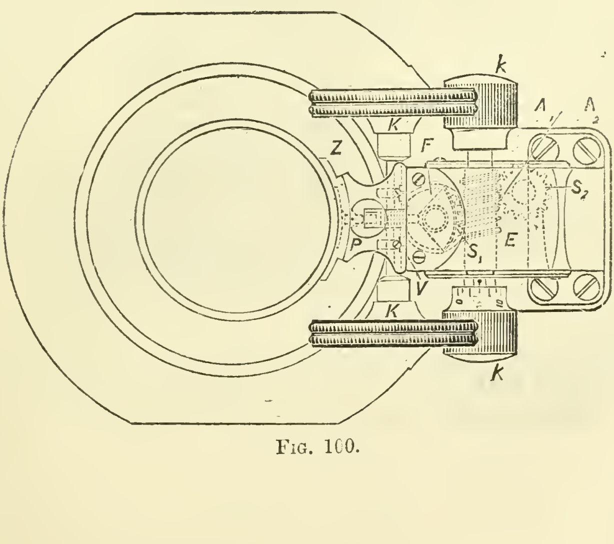
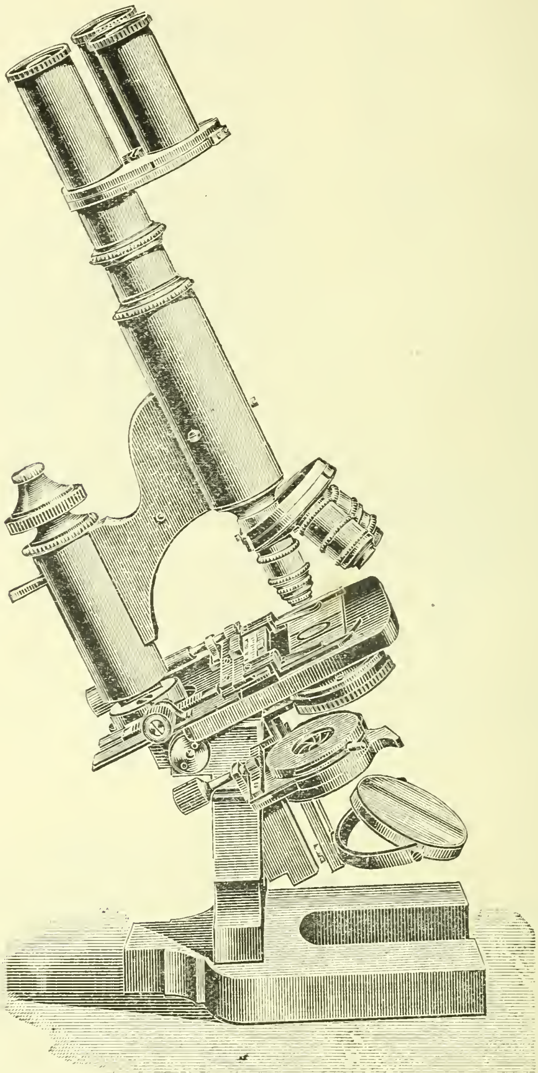


Fig. 100.

opening in the standard H. On the fine adjustment slide F rests, very solidly screwed, the gear P for the coarse movement. The aluminium tube T (fig. 99), in order to avoid undue wear and tear of the mechanism,

Fig. 101.



is connected in the usual way with the tooth-rack by means of a copper companion piece Z (fig. 100). The coarse adjustment follows the usual models. The micrometer-screw is thus seen to be packed away in the hollow stand for protection's sake. It is completely sheltered from direct hand-touch. It is turned by means of an endless screw E (figs 99 and 100) which gears into the toothed wheel S, working on the flange of the screw, and carries the usual micrometer knob. By means of this arrangement two conditions are satisfied: the fine adjustment is slowed in the most desirable way without the necessity of requiring from the micrometer-screw too fine a motion, and the position of the endless screw, so firm and safe in the handle-like stand, renders even rough mechanical operations entirely without effect on the fine adjustment.

In order to avoid injury to the micrometer-screw when the slide F is at its extreme highest or lowest position, a special protection arrangement, limiting the play of the endless screw, is contrived for the fine adjustment. As is seen from fig. 100, the endless screw E engages another toothed wheel S_2 which is a nut working on a vertical screw. This nut S_2 comes into contact with the upper or lower surface of the chamber containing it before the fine adjustment slide F reaches the end of its travel, thus preventing strain on that part of the mechanism.

Messter's Bacteria Microscope.*—The makers of this instrument claim that its specially advantageous construction almost entirely removes troubles arising from loss of time (1) in changes of eye-pieces and objectives; (2) in tedious coarse adjustment for various powers; (3) in laborious picking out of very minute objects with strong magnifications. Investigations can therefore be made, even by a tyro, more quickly, accurately, and conveniently, with this instrument than with any other. It is specially recommended to physicians for diagnosis of urine and sputum. The figure (101) shows clearly the arrangement of the eye-pieces and objectives with their revolvers; and the fitting of these is so perfect that the image is always adjusted for every nine magnifications. [Thus apparently no coarse adjustment is required.—Ed.] An improved central micromillimetre-screw secures the fine adjustment; and a lever under the micrometer-screw effects a raising or lowering of the tube without change of adjustment, which is very convenient in the application of thick-ringed slides, or in the rotation of the objective revolver.

Messter's Compressorium Microscope.†—This is specially designed for the easy and certain discovery of trichinæ and other objects.

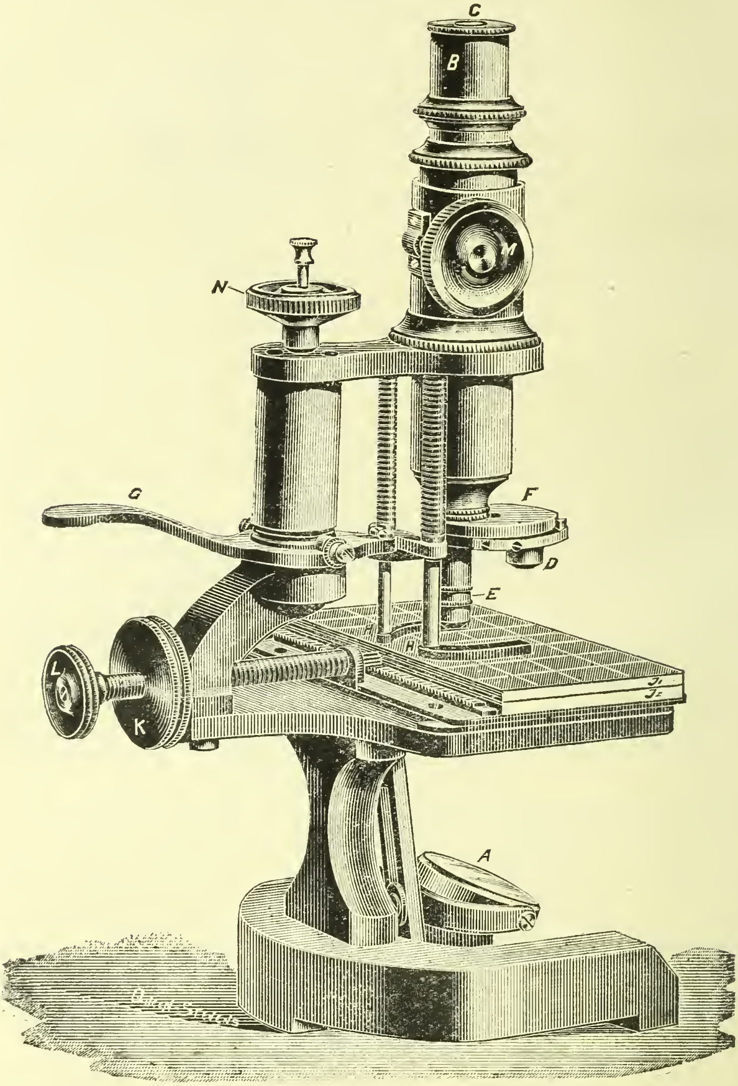
By pressing down the lever G (fig. 102), the pressure of the compressorium H on the glass plates J_1 and J_2 is released, and the table-screw L is drawn back to its fullest extent. This screw withdraws the runners on which rest the glass plates, and these last receive between them the slice of meat to be examined. When the object is ready the compressorium is again brought into play, and inspection is made by transmitted light with the weak objective. The outside corner of the field is at first under the Microscope; then, by rotation of the mother-screw K, the front line of numbered squares are brought one by one into view; L is now turned until the first of the next row is in sight, and, by reversing the mother-screw, the whole of the squares in the second line are inspected; thus in time the whole of the field is examined. When once found the revolver brings the high power into use. As the

* Messter's Catalogue, p. 12.

† Cat. cit., p 21.

objectives are accurately fitted on the revolver, adjustment is obtained by the micrometer-screw.

Fig. 102.

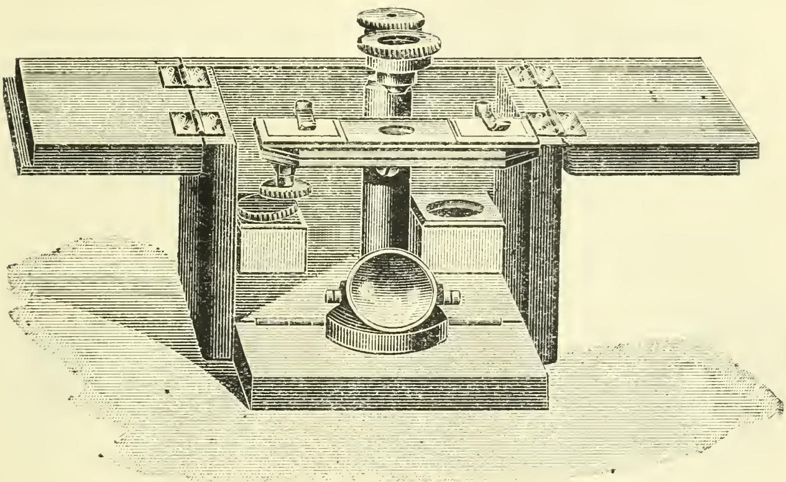


Messter's Preparation Microscope.*—In this class of simple Microscope, which seems intended for dissection or preliminary selection, the image of the object always presents itself in its natural relations. Hence

* Messter's Catalogue, p. 37, No. 16.

difficulties arising from image-reversal are avoided. The lid of the box is constructed with flaps which, when folded back, form supports for the hands of the operator. The front lets down, and thus light is admitted to the mirror. Lenses of 20, 30, and 50 linear magnification are supplied.

FIG. 103.



The stand is fitted with a micrometer-screw, and the general arrangement will be readily understood from fig. 103.

A large size model of this instrument is also made with magnification up to 100 linear, with tooth-and-rack adjustment, and with plane and concave mirror.

(3) Illuminating and other Apparatus.

New Apparatus for Application of Electric Currents to Living Microscopic Objects.*—Dr. Alfred Schaper describes the apparatus constructed to his designs by the firm of Zimmermann, Leipsic. His especial object was to secure that the object-holder should be free from polarising currents. He uses a piece of plate glass 12 by 7 cm., perforated at the centre with a circular hole 20 mm. in diameter. Along each of the narrow sides is cemented a strong nickelled metal plate 6 by 3 cm., furnished with binding screws as shown in fig. 104. This plate, which he calls the conductor, is placed on the object-stage so that the hole is immediately over the Abbe condenser.

The object-holder varies according to the kind of experiment and the nature and size of the object; but its general construction is such as to ensure communication of the current from the pole-plates. For this purpose both ends of the object-holder are mounted with a clamp-like metal piece which surrounds the edges of the holder and firmly unites its broad lower plane to its narrow upper one (figs. 105, 106, *m*).

* Zeitschr. f wiss. Mikr., xiv. (1898) pp. 436–41 (5 figs.).

When arranged as shown in fig. 107, on the conductor plate, the binding screws of the first lie exactly on a pole-plate, and are by means of the metallic contact themselves electrified. The dimensions are so chosen that the pole-plate can be moved as much as 2 cm. without losing contact. In this way the electrified and yet independent object-holder can be moved sufficiently without hindrance, so that Microscope examination can be effectively carried out.

On the upper side of the object-holder arrangements are made for the reception of the electrodes.

Fig. 105 shows a form adapted for the smallest organisms and strongest objectives; fig. 106, one for larger objects such as snails' eggs.

The former of these consists of an object-holder, as described above, with a shallow circular sinking, some 15 mm. in diameter, communicating on each side with a groove 2 mm. wide, in which lie the platinum thread poles of the electrodes. When this sinking and grooves are filled with

FIG. 104.

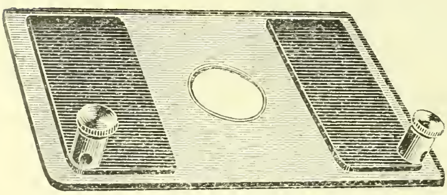


FIG. 105.

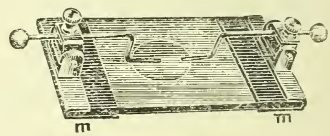


FIG. 106.

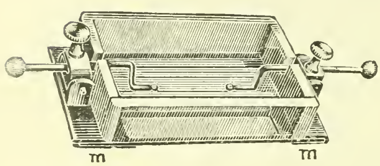
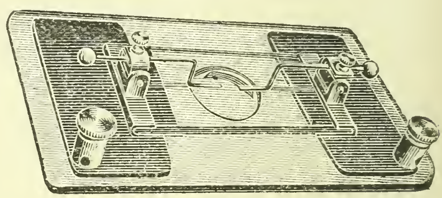


FIG. 107.



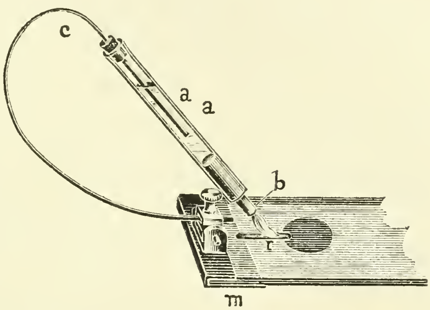
water, and a cover-glass applied, the platinum poles can be placed at any desired distance, and can even be pushed under the cover-glass. This form of pole gives an ellipsoidal electric field; platinum foil poles give a parallel electric field.

The second object-holder is shown in fig. 106, and is of the same size as the former, but bears in addition a glass rectangular trough 11 mm. high. Its sides have an insertion 3 mm. deep, through which the copper wire electrodes project into the interior of the trough. The poles consist of small platinum shanks, and the adjoining parts of the wires are coated with an insulating varnish. Two glass slips 4 mm. high and 6 mm. apart are cemented on to the floor of the trough parallel to the electrodes, so as to fix the object better in the current. The trough contains a relatively large amount of water, which is very desirable for the larger organisms. A glass cover can be adapted to the trough.

The above electrodes are naturally polarisable, but they answer well for even a series of experiments if long exposure is not required or more than weak currents.

For long continuing investigations, especially when absolute exactness is desired, Flfischl's brush electrodes may be advantageously used. A narrow glass tube 4 or 5 cm. long is cemented at its lower end with plastic clay, through which passes a fine short brush (fig. 108, *a* and *b*) and the tube is three parts full of zinc sulphate solution. The upper end is closed with a cork, through which passes a strong zinc wire, so that its lower end dips 1 cm. into the solution. The part of the wire within the tube must be amalgamated. The other end of the wire is bent and connected with the binding screw. The whole arrangement must be so adjusted as to lie exactly central with the groove previously strewn with kaolin, and the kaolin is also slightly sprinkled into the central hollow of the object-holder. The brush point thus lies on the kaolin mass which now forms the unpolarisable poles. When used with the trough, the brush is fitted to the insertions in the side walls.

Fig. 108.



(4) Photomicrography.

Photomicrography.*—Mr. Edmund J. Spitta furnishes a series of papers on this subject, which he treats under three heads:—(1) Low-power work; (2) Medium-power work; (3) High-power work.

(1) *Low-power work.*—After pointing out that in this branch the Microscope is not used, he gives a useful series of practical directions. In discussing the choice of a lens he recommends one of short focal length. Where the object is large and the magnification required small, a diminutive portrait lens of about 3 in. focus, built on the Petzval principle and placed with its shorter conjugate focus towards the object, has given good results; but if the magnification exceeds $1\frac{1}{2}$ to 2 diameters, it is difficult for the operator to reach the milled head. However, Messrs. Dallmeyer have specially constructed a small rectilinear lens of about $1\frac{3}{4}$ in. focus, which, with magnifications over $1\frac{1}{2}$ to 2 diameters, has given really admirable results; its only fault is that it is not constructed to work equally well with red, green, and violet rays. Mr. Spitta has found the finest type of lens to be the planar recently introduced by Zeiss, and constructed from calculations by Dr. Rudolph for the especial purpose of photomicrography. It works equally well on all colours of the spectrum, gives exquisite definition up to the margin of the plate, and is manufactured in several focal lengths. Its expensiveness is a matter for regret. An auxiliary front to the camera, attached where the lens usually fits, gives an increased extension of 6 or 8 in., and still

* Pharm. Journal for 1898, pp. 326–9, 432–3, 474–5, 566–8, 587–9 (16 figs.).

allows focussing if the short-focus "planar" or Dallmeyer lens be used.

Among other details are some special directions for the microphotography of culture tubes.

The formula $F = \frac{L}{M + 1}$ is found to be sufficiently accurate for practical work (F = focal length of lens required, M = magnification, and L = camera-length). Thus, if it be required to produce a magnification of four diameters with a camera-length of 10 in., then $F = \frac{10}{4 + 1} = 2$ in. In the same way, if any two of the three quantities F, L, M be known the third can be calculated.

(2 and 3) *Medium and High-power Work.*—In these sections the various difficulties to be encountered are fully described. The author's favourite Microscope is the Zeiss model I A, although apparently it is so badly balanced that it has to be clamped to the table to prevent it tumbling over.

(5) Microscopical Optics and Manipulation.

Microscopic Images and Vision.*—Mr. Lewis Wright, from the point of view of the microscopist, continues the investigation of this subject on the lines commenced by Lord Rayleigh and Dr. Stoney.† His object is to show that the "spectrum" (i.e. the ordinary Abbe) theory is only true in a conditional and limited sense, while its acceptance in a universal sense is a present cause of positive mischief in microscopy. He begins by discussing some fundamental physical objections to Dr. Stoney's seven propositions, which propositions may be summarised thus:—(A) "All light emitted by an object may be resolved into undulations consisting of uniform plane waves." (B) "We may conceive these reversed in direction (since any dynamical system may be reversed); and when they thus arrive back at the position occupied by the original object, they will then produce an image the most perfect that the light emitted is capable of producing." Hence in general, "plane waves converging inwards" are capable of producing the most perfect attainable image producible from the rays grasped by the objective. Mr. Wright objects that uniform plane waves are not in trustworthy microscopy the actual dynamical system, and therefore cannot, as he afterwards shows they do not, produce the supposed most perfect attainable image by reversal. More specifically, it seems evident that we are debarred from considering the light from a microscopic object as consisting of uniform plane waves, *except on the condition of plane-wave illumination of the object.* (Here, indeed, we have the secret of Abbe's consistent enforcement of illumination by a small luminous cone or pencil, which gives approximately such illumination.) To get the normal wave-surface approximately plane, the beams of rays must be got approximately parallel, which is attained in physical optics by removing the source of light, itself relatively small, to a considerable distance from the grating or other apparatus. Now, in the case of a

* Phil. Mag., June 1898, pp. 480–503 (1 fig.).
† Cf. this Journal, 1896, p. 681, and 1897, p. 71.

microscopic objective of focus 1/50 in., the light would travel a path of perhaps 1/200 in. from the object to the lens, and such light cannot be regarded as consisting of uniform plane waves, except in the case of plane-wave illumination of the object, as in the Abbe theory.

In discussing the supposed dynamical system, Mr. Wright admits that a reversal of the *whole* actual system would produce such an image as described; but it does not seem to follow that mere "coalescence and interference of uniform plane waves" involves such a result. In any case, what the reversal of the supposed dynamical system must really reproduce as an image at the plane of its origin, must be the postulated operative cause of the system. That cause, by the hypothesis, is not an actual object which alone emits luminous waves, but *the object surrounded by an indefinite number of identical replicas, emitting identically similar plane waves.* This does not represent any object in reality; and that fact seems to dispose of such a presentment as a full and complete representation of microscopic vision.

In considering how far the Abbe theory, which possesses more or less undoubted truth, is an adequate representation of microscopic vision, the author states his own opinion thus:—"*The trustworthiness of a microscopic image is in proportion as the object approximates to a self-luminous condition, and diminishes in proportion as it is or has to be* (for it may have to be) *examined by plane-wave illumination.*"

If the object be self-luminous there will be no spectra, and the rays emitted will be quite heterogeneous; yet an image must be possible. Really self-luminous objects can hardly be used with objectives above an inch, but approximations to self-luminosity can be obtained in various ways with high powers. Thus Lord Rayleigh has shown that the wide cone from a condenser introduces a large amount of heterogeneity into the rays from the objects, and practically produces self-luminosity. Dr. Stoney rather seems to regard the function of the condenser as that of providing illumination by plane waves. Thus, according to Dr. Stoney, the ideal is to get absolutely aplanatic systems of plane waves transmitted through the objects, and all conditions short of this impair the image; but according to the author, irregularities of phase add to the *trustworthiness* of the image, though they may impair it in some other features. A very important practical question is therefore at stake.

The following experiment is one of those by which the author proves his view. He takes as his stage object a grating of 3000 or 6000 lines to an inch, illuminated by a narrow cone from the condenser, focussing the flat of a rather distant lamp-flame. Immediately in front of this flame he places a coarse grating of 50 to 100 lines per inch, either photographed or of wire. The several points of these luminous lines emit light-waves, chiefly in the self-luminous manner, indiscriminate in phases and transversals as the points of the flame itself. Arranging the stage grating so as to cover only half the objective field, a condenser can be selected of such a focal length, and other matters so adjusted, that the focal image of the coarse grating formed by the condenser corresponds, both in intervals and focal plane, with the object-grating on the stage, the same illuminating cone being used. R move now the coarse grating, and place the stage grating centrally; then, on removing the eye-piece, and looking down the tube, the dioptric beam or its flanking spectra.

as so often described, will be seen. They interfere, and form the image seen by the eye-piece in the Fresnel and Abbe manner. Removing the stage-grating, and replacing the coarse one over the flame, its focal image is now the object. Owing to the heterogeneity of the rays, this aerial image emits no spectra—there neither are nor can be any such. But it is perfectly resolved. Here we have a resolution of 3000 or 6000 lines per inch that has no place at all in the "spectrum" theory; which, therefore, can be no complete theory of microscopic vision, though it has an important place in it.

It is highly desirable to find out what proportion and value must be assigned to the Abbe image in ordinary research. There are really two factors in the standard image, which is the outcome partly of the features upon the object, and partly of the state of the light by which the object is illuminated; and Dr. Stoney himself says, "It (the image) may be improved by increasing the degree in which the first of these factors, and by decreasing the degree in which the second, contributes to produce, to modify, or to efface detail in the image." With this statement the author cordially agrees, but differs from Dr. Stoney in the estimate of the true relative proportions of the factors. Thus the results of diatom photomicrography on Abbe methods are wofully inferior.

Wherever we have a known periodic structure in transparent objects, plane wave illumination and the consequent interference lines formed by the beams diffracted by that structure have an extraordinary effect in *intensifying* into black and white a more or less accurate representation of the periodic detail. (Two experiments illustrating this are described.) Thus the Abbe method has a most important function in enabling us to see *contrast* in the details of a large class of objects—especially hyaline or transparent objects—which do not present contrast or opacity sufficient to be seen in any other way. The error has been in giving to it the sole or all-important place, not recognising that there is quite another kind of image also available, depending upon Airy's theory; and that the latter—while in the case of transparent details often giving images insufficient, or at least far inferior, in black-and-white contrast—is free from the *contour* errors of the Abbe image, and must be used to correct it so far as is possible in the individual cases. The errors of the "spectrum" image are well known. Its very contrast or "resolution" is a departure from truth, to which the more indistinct self-luminous image is in reality a much nearer approach. It tends to make details, which should be only geometrically symmetrical to a limited extent, perfectly so. All that can be really learnt from it is that there is probably some periodic difference of structure in the object similar in dimensional intervals to "lines" shown; less probably so in regard to "spots," since these are often produced by false diffraction fringes from any long line which may cross the true ones. That the lines are lines, or that the "pattern" is so geometrical as appears, is in the highest degree improbable. That the "spectrum" theory and method so long retained exclusive predominance is because attention has been so concentrated upon either gratings or diatoms of known periodicity in structure, but which only represent to a very small extent indeed any serious kind of investigation.

It thus appears that in Microscopy we have to deal with two characteristics of an image, which often are only to a limited extent compatible; that we have at command two methods of illumination, which respectively promote more especially each of such characteristics; and that in most cases our problem is so to combine and balance these two methods as to produce the best result. *Fidelity of contour* will be secured in proportion as we are able to obtain our image by heterogeneous illumination, approximating the object to a self-luminous condition. But this method may prove utterly unable to give us *contrast*, which we may therefore have to gain at the expense perhaps of infidelity in contour. Thus an opaque object, even of much minuteness, may be best shown by ground-glass illumination, or a very wide cone; while a diatom, unless in a very dense medium, or dry in air, may require narrow pencils of approximately plane waves. Moreover, neither kind of pencil can be obtained absolutely pure. The narrowest pencil will only approximately consist of plane waves, and the widest cone will not be free from them. We thus understand why, in really critical work, a large cone from a good condenser usually gives us the best result; but why it may be impossible, even with a perfect objective, to use a cone of light which will fill its aperture completely. It may be necessary to intensify the image, while using as much heterogeneous light as we can. But this necessity depends on the nature of the object, and does not exist in all cases.

There is a very obvious and simple, yet decisive test as to the correctness of this view. According to the Abbe theory, the amount of cone light which can be used will depend upon the *minuteness* of the structure alone. According to the author's view, the *density or contrast* of the structure is the chief factor in this question. All experience proves that the latter is the case.

In conclusion, the author discusses the effect of these theories on the work of the Microscope optician, and on the prospects of further microscopical research. Devotion to the Abbe theory alone has even led Continental microscopists to challenge the importance of spherical aberration in objectives; but Mr. Wright shows that the perfect correction of spherical aberration of a lens determines how far we may go in the use of the heterogeneous cone with that lens. The well-known fact that individual similar lenses frequently possess marked superiority, shows a more perfectly corrected spherical aberration; and this suggests the direction of further improvements. It is not so much further minuteness, but greater powers of resolution within the limits of our present lenses, that are desiderated.

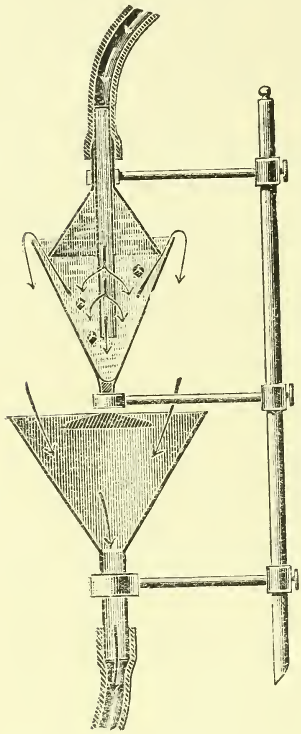
(6) Miscellaneous.

Simple Apparatus for Washing Microscopical Objects.*—Dr. G. Cruz describes an apparatus (fig. 109), which he uses for washing tissues, &c., intended for microscopical examination. The apparatus consists of a glass funnel fixed to the upright of a laboratory stand. Above this is another funnel in the reverse position. The upper funnel, also fixed to the upright, is of less diameter than the lower one. Through its stem passes, to near the bottom of the hopper of the lower funnel,

* Zeitschr. f. wiss. Mikr., xv. (1898) pp. 29-30 (1 fig.).

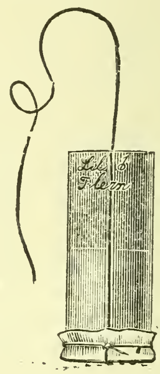
a glass tube, the end of which is perforated in several places. The stem of the upper funnel is connected with the water supply. The overflow is caught in a still larger funnel, and passes away to a sink through the stem.

Fig. 109.



Apparatus for Fixing and Hardening Small Objects.*—Mr. W. C. Stevens recommends the following method for carrying material through the processes of fixing and hardening. For very small objects such as root-tips, sporanges, and young flower-buds, it is specially useful. Small glass buckets are made by cutting up glass tubing 1 cm. in diameter into lengths of 3 cm. By means of heat one end of each piece

Fig. 110.



is turned out so as to form a rim or flange. Over this end a piece of muslin is tied. The little bucket is then provided with a suspender by means of a piece of thread fixed to the middle of the bottom (see fig. 110). If, when the bucket containing the specimen is suspended in the fixative fluid, the bucket does not sink, a weight should be attached, or the air may be removed from the specimen by means of the air-pump.

Thermo-regulated Water-baths for the Bacteriological Laboratory.†—Mr. V. A. Moore describes two water-baths which have been found to work very satisfactorily.

The larger bath (fig. 111), to which a thermostat is connected, is a rectangular copper tank 40 × 50 × 25 centimetres. It is divided into two compartments, each of which has a separate cover and perforated false bottom. The partition consists simply of a top cross-piece which is about 4 cm. wide. Near its centre is a round opening 2 cm. in

* Kansas Univ. Quarterly, vii. (1898) pp. 107–10 (3 figs.).
† Journ. Applied Microscopy, i. (1898) pp. 108–9 (2 figs.).

diameter for a thermometer, which is protected by a perforated copper tube extending to and soldered to the bottom of the tank.

Near the end of the cross-piece or close to the side of the tank there is a second and similar opening and shield for a thermostat. There is a faucet for drawing off the water. The tank stands upon an iron quadruped. Each compartment is heated by a separate burner connected by a T or Y tube to the gas tube leading from the regulator.

The smaller bath (fig. 112) is cylindrical in form, 25 cm. high and of about the same diameter. On one side there is a semicircular projection forming a chamber for the thermostat. This is separated from

Fig. 111.

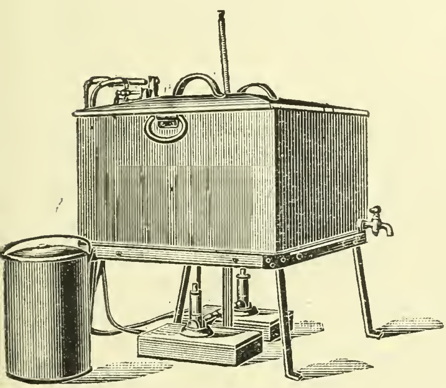
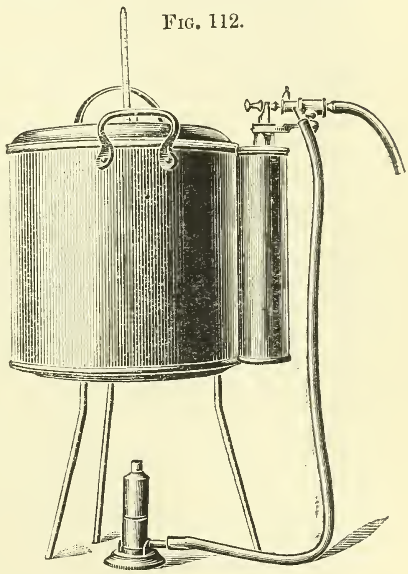


Fig. 112.



the main tank by means of several narrow strips of copper soldered at each side. The tank has a perforated false bottom. The cover has an opening for a thermometer.

The Friedberg burner was found to work very satisfactorily with both baths. The Roux thermostat seemed to be the best regulator; it is constructed of metal, is readily adjusted, and quite as sensitive as spirit or mercury thermo-regulators.

The larger bath can be used for macerating meat at a high temperature (60°–65°), for making culture media, for sterilising, for determining the thermal death-points for different bacteria, and for other purposes.

β. Technique.*

(1) Collecting Objects, including Culture Processes.

New Medium for Bacteriological Diagnosis.†—Sigg. Pacinotti and Municchi have devised a coloured nutritive medium which may aid in

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous. † Zeitschr. f. angew. Mikr., iv. (1898) pp. 106–7.

the diagnosis of different kinds of bacteria. The medium is made by mixing 140 grm. of egg-albumen with 20 grm. of powdered raw coffee. After standing for 2 or 3 days, the mixture assumes an emerald-green hue, which afterwards becomes darker. After filtering through gauze into test-tubes, the medium is sterilised for 2 hours a day for several consecutive days and allowed to set. On this medium the bacteria do not become tinted, but the colour around the colonies becomes altered. Colonies of *Meningococcus* and *Pneumococcus* are surrounded by an orange-yellow zone. Those of *St. py. aureus* produce a pale yellow hue, with slight liquefaction of the medium; while *Proteus vulgaris* strongly liquefies the medium with the formation of a red colour. The staining of the albumen cannot be referred to the chlorophyll contained in the coffee-berries, for this is easily soluble in alcohol, ether, and benzin, and insoluble in water. The green coloration is the more inexplicable as the reaction is not acid. Mineral acids turn the green albumen reddish, but do not decolorise. CO_2 has no action, and O turns it darker. If the cultures be killed by heating to 100°, or moistened with 1 per thousand sublimate solution, the original colour returns.

Use of Acetylene in the Cultivation of Anaerobic Bacteria.*—Dr. J. Ferrán recommends the use of acetylene for cultures of anaerobic bacteria. The air in the culture vessels is driven out by means of the gas, which is easily prepared. The apparatus for making acetylene gas is composed of a 2-litre vessel half filled with water, and closed with a caoutchouc plug having two perforations. Through one of the holes passes a glass rod, having at the end a hook on which is suspended a little basket containing calcium carbide. Through the other hole passes a glass tube, connected with a rubber tube, and this latter with the culture vessel. The culture vessel is also closed with a doubly perforated stopper. Through one of the holes passes a tube for the exit of air, while the other is connected with the rubber tube from the acetylene apparatus. When the connection is made the calcium carbide is immersed in the water, and the gas at once develops. As soon as the air is completely driven out, the two tubes of the culture vessel are closed, and the calcium carbide drawn up out of the water.

Culture of Diatoms.†—Herr J. Burger communicates the following simple method for cultivating diatoms (*Gomphonema*). The material was placed in a glass vessel containing tap-water, some straw, bran, and moss. This vessel was covered with tissue paper, and hung up before the window in a moderately warm room. The culture was started in February, and in April the straw was found to be covered with diatoms.

(2) Preparing Objects.

Detection of Protoplasmic Threads in the Cell-wall.‡—Mr. W. Gardiner gives further details of his two methods for demonstrating the connecting threads which traverse the walls of plant cells.

(1) The Kolossow safranin method, in which the tissue is first killed and swelled with picric acid, picrosulphuric acid, picro-acetic

* Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) p. 29.
† Zeitschr. f. angew. Mikr., iv. (1898) p. 61.
‡ Proc. Cambridge Phil. Soc., ix. (1898) pp. 504–12. Cf. this Journal, *ante*, p. 240.

acid, or in certain cases with sulphuric acid. It is then fixed with Kolossow's mixture of uranium nitrate and osmic acid. The material may be preserved in thymol water (0·5 grm. to 1 litre). The sections are stained with a saturated aqueous solution of safranin or with anilin-oil-safranin, and, after having been washed with water are treated with a 2 per cent. solution of orange G, which dissolves the dye from the cell-wall and leaves the protoplasm and connecting threads stained. The threads may now be further stained by substitution, gentian-violet and Gram's method giving the best results. After either the dye should be removed from the cell-wall by means of a 5 per cent. solution of acid fuchsin. After immersion in dilute glycerin, the sections are mounted in glycerin-jelly.

(2) Iodine-acid violet method. The tissues are killed and fixed with iodo-potassic iodide solution, with an average strength of 0·5 per cent. iodine and 0·75 per cent. potassic iodide. The sections are caused to swell by immersion in sulphuric acid varying in strength according to the tissue from 1 to 30 per cent. The sections to be stained are first mordanted with a solution of iodine in 5 per cent. sulphuric acid. The staining solution is made by mixing equal parts of two stock solutions, the first being a 10 per cent. solution of H_2SO_4, and the second a 0·5–1 per cent. solution of pyoktanin or gentian-violet in water.

To this staining solution the sections are directly transferred from iodo-potassic iodine and sulphuric acid mixture. The staining solution is allowed to act for 10 minutes, and then the sections are removed, and washed in water. The staining may be intensified by repeating the process.

The sections should be mounted in glycerin containing a small percentage of zinc chloride and a trace of iodine.

The mounting medium is made by mixing 30 ccm. glycerin, 60 ccm. water, and 10 ccm. of a 20 per cent. solution of zinc chloride, adding a flake or two of iodine, and heating over a warm bath.

Preparing Agar Media.*—Dr. M. P. Ravenel gives the two following simple and rapid methods for preparing agar media. (i.) To make 1 litre of agar, take (*A*) dried pepton (1 per cent.), 10 grm.; salt (0·5 per cent.), 5 grm.; Liebig's ext. (0·5 per cent.), 5 grm.; water, 500 ccm. Boil for 3 minutes, and neutralise. (*B*) Agar (1·2 per cent.), 12 grm.; water, 500 ccm. Chop the agar and put into autoclave. Run the autoclave up to 2 atmospheres, giving 121·4° heat. As soon as this pressure is reached, turn out the flame and allow the autoclave to cool down to below 100° before opening. The two solutions *A* and *B* are then mixed, cooled to 60°, the whites of two eggs beaten in 50 ccm. of water added, well stirred in, and the whole then boiled, and filtered through paper. Time, an hour and a quarter to an hour and a half.

(ii.) To make permanently clear agar, fresh meat should be used as follows. To make 1 litre take (*A*) chopped meat, 500 grm.; water, 500 ccm. Mix, and place in a cool place over-night, then strain through towel. (*B*) Agar (1·2 per cent.), 12 grm.; water, 500 ccm. Put in autoclave, run up to 2 atmospheres, put out flame, and cool down to below 100° before opening. When the agar solution has cooled down to about 75°, mix

* Journ. Applied Microscopy, i. (1898) p. 106.

A and *B* together, add 10 grm. (1 per cent.) dried pepton and 5 grm. (0·5 per cent.) salt, boil for 3 minutes, neutralise, and filter. The product is an absolutely clear jelly, which never forms any precipitate. The filtration takes 10–12 minutes through an ordinary filter-paper. Solution *B* should not be added to *A* until cool enough to avoid coagulation.

Treatment of Celloidin Sections Stained with Orcein.*—Herr H. Jordan takes the celloidin-sections (80–96 per cent.), and by means of tissue paper places them on the slide already smeared with albumen or albumen-glycerin. The paper is firmly smoothed down, and on the top of it is placed another slide. The slides, firmly held in the hand, are then heated to coagulate the albumen. When this is effected, the whole is immersed in 96 per cent. alcohol, and the upper slide and paper removed. The preparation is then transferred to the solvent. The solvents recommended are a mixture of equal parts of absolute alcohol and ether or acetic ether. The latter may be used before or after staining, as it does not damage the orcein.

Modification of the Weigert-Pal Method for Paraffin Sections.†—Dr. E. E. Laslett recommends the following procedure as efficient and trustworthy. The material, spinal cord, medulla, &c., is hardened for about a fortnight in Müller's fluid, and then cut into slices not more than 2 mm. thick. These are placed in Marchi's fluid for a week, washed, and imbedded in paraffin. The sections are fixed to the slide by the water method, and then, after removal of the paraffin, placed in the acetic acid-hæmatoxylin over-night, preferably in a warm oven, as thereby the staining process is materially hastened. After washing they may be passed into a saturated solution of sodium or lithium carbonate, by which the colour is changed to a bluish black. They are then differentiated by the Pal method, care being taken not to over-decolorise. The advantages of this method are, firstly, that it is a combination of the Marchi and Weigert methods, and secondly, that the sections are much thinner than by the celloidin method.

Method of Demonstrating the Structure of Yeast-Cells.‡— In their investigations on the yeast-cells, Prof. F. A. Janssens and M. A. Leblanc used Moeller's iodine fluid for fixing, and alcohol at 95° for hardening. The iodine solution consists of distilled water 100 ccm., iodide of potassium 1 grm., iodine to saturation. A few drops of the iodine solution are placed on a slide, and a loopful of yeast culture carefully mixed with it. Some of the mixture is then carefully spread on cover-glasses. When the fluid has evaporated, the cover-glasses are transferred to fresh Moeller's solution for 24 hours. Then, after having been washed in water, they are passed successively through one-third alcohol, alcohol at 80°, and finally at 95° for at least two days. It is necessary to remove all traces of iodine. Several methods were used for staining the preparations, among the best being the following:—fuchsin 4 grm., phenol 10 ccm., alcohol 40 ccm., water 200 ccm. The preparations are decolorised with weak H_2SO_4, and contrast-stained with Lœffler's methylen-blue. The method which gave the best results con-

* Zeitschr. f. wiss. Mikr., xv. (1898) pp. 53–5. † Lancet, 1898, ii. pp. 321–2.
‡ La Cellule, xiv. (1898) pp. 203–9. Cf. *ante*, p. 570.

sisted in mordanting the preparations for four hours in ferric alum 2·5 grm., water 100 ccm., and then staining for 18 hours in hæmatoxylin 0·5 grm., water 100 ccm. The preparations should be decolorised to the extent that the nucleus is quite black and the cytoplasm unstained.

Black hæmatoxylin was also used for staining. Preparations stained with this fluid may be advantageously contrast-stained with croccin, or by decolorising with orange or carmin-blue. In fact the cytoplasm may be completely decolorised with 0·1 grm. of carmin-blue dissolved in 500 ccm. of alcohol at 80°. The preparations may be mounted in glycerin (50 per cent.) This fluid, while very suitable for examining the objects, is very detrimental to the stains, as the yeasts are more or less rapidly decolorised. The authors, after having examined and drawn the preparations, mount them in dammar-colophon (resin), after having contrast-stained them with Congo or Bordeaux red, crocein, or carmin-blue.

The cover-glasses must not be warmed, or the yeasts will shrink to about half their former bulk. In connection with these preparations, the value of amylic alcohol is noted. After the preparations have been passed through a series of alcohols up to 95°, a drop of amylic alcohol is placed on the cover-glass. This fluid, being denser than ordinary alcohol, forms a layer immediately beneath the latter and above the specimens, and, though insoluble in water, is extremely effective in dehydrating the yeasts, and also in preventing their absorption of moisture.

(3) Cutting, including Imbedding and Microtomes.

Imbedding and Staining Lichens.*—Mr. G. H. French recommends that lichens should first be immersed in 95 per cent. alcohol for 24 hours, and then placed in thin celloidin and thick celloidin for 24 hours each. The specimens are imbedded in thick celloidin, which is hardened in 70 per cent. alcohol for 24 hours, and then cut. Staining with borax-carmin gives the fungus part of the lichen a pale pink hue, while the algal cells have a greenish-red shade. In this way the host-cells are readily distinguished from the fungus.

(4) Staining and Injecting.

Methylen-Blue for Investigating Respiration in Plants.†—Prof. J. B. Farmer points out the usefulness of methylen-blue for demonstrating the reducing power of living protoplasm. If germinating seedlings of barley or peas be placed in a test-tube filled with a 0·0005 per cent. solution of methylen-blue which has been boiled to expel the air, the liquid around them will in the course of a few hours be decolorised. If some of the decolorised fluid be withdrawn with a pipette and shaken up with air, the blue tint speedily returns. Still more striking results were obtained by putting *Chara* cells in the dark in the methylen-blue solution.

With many plants the reaction is tardy, and with all the result is attained more quickly if the plants have previously been starved of oxygen. It seems probable that the oxygen obtained by reducing the

* Journ. Applied Microscopy, i. (1898) p. 135.
† Nature, lviii. (1898) pp. 185–6.

anilin dye is not directly utilised by the protoplasm, but by some dissociation product formed during the metabolic activity of the protoplasm.

Testing Butter and Milk for Tubercle Bacilli.*—Dr. Petri found, in 102 samples of butter, tubercle bacilli present in 32·3 per cent. The tuberculoid bacillus was also frequently present, both alone and in conjunction with the true tubercle bacillus. The test applied was to inject 5 ccm. of the butter into guinea-pigs. The animals which succumbed were carefully examined, and those which survived were killed and also inspected. If rodlets giving the characteristic staining reaction were found, further inoculations were made with the suspected material. While the true tubercle bacillus invariably gave rise to infection, the tuberculoid rodlet failed to excite specific inflammatory changes, and the inoculation wound healed up perfectly.

In 64 samples of milk, 14 per cent. contained tubercle bacilli and 6·3 per cent. the tuberculoid rodlet. The milk used was centrifuged, and 3 ccm. of the cream, the buttermilk, and the sediment were injected into the peritoneal sac of four guinea-pigs.

Black Hæmatoxylin.†—Prof. F. A. Janssens recommends the following preparation of hæmatoxylin for biological work. It is prepared very much in the same way as Delafield's hæmatoxylin, the chief difference being that iron-alum is substituted for ammonia-alum. To a hot saturated solution of ammonia-iron-alum $(NH_4)_2Fe_2(SO_4)_4$, are added 4 grm. of hæmatoxylin dissolved in absolute alcohol. The soluble black dye which is thereby formed is allowed to stand for a while, and then 100 ccm. of glycerin and 100 ccm. of methyl-alcohol, CH_4O, are added.

Prodigiosin as Staining Reagent for Botanical Specimens.‡—Prodigiosin, the pigment produced by *Bacillus prodigiosus*, is recommended by Herr O. Rosenberg as a useful reagent for staining cuticula, corky membranes, and fatty substances. To these it imparts a deep red colour, and though woody tissue and cell-contents are also faintly stained, they lose the stain when washed in alcohol. The pigment is obtained by cultivating the microbe on potato at 25° for 3 or 4 days. The bacterial mass is then scraped off, placed in a glass vessel, and dissolved in 95 per cent. alcohol. The alcoholic extract when filtered is a clear brick-red fluid. For staining sections the strength recommended is 5 ccm. of the bacterial substance to 25–30 ccm. alcohol. Exposure to light damages the colour; but if preserved in black bottles protected from light, the fluid will keep for a good time. The sections from fresh or preserved tissue are immersed in the fluid for 5 to 10 minutes, and on removal it is well to pass them through alcohol. The parts stained are cuticula and corky tissue, though the oil-drops in the hyphæ of fungi take up the pigment freely. It is easy to double stain with prodigiosin, especially with malachite-green or chloranilin. In the former case the woody tissue is green; in the latter yellow.

* Arb. aus d. kaiserl. Gesundheitsamt, xiv. (1898) p. 1. See Zeitschr. f. angew. Mikr., iv. (1898) pp. 64–5.
† La Cellule, xiv. (1898) p. 207.
‡ Zeitschr. f. wiss. Mikr., xv. (1898) pp. 56–60.

Staining the Mucus-cells of Malvaceæ.*—Herr A. Nestler used Böhmer's hæmatoxylin for demonstrating mucus, the mucus-cells being stained blue. Alcoholic solution and Loeffler's solution of methylen-blue also stained the mucus-cells blue. With Meyer's reagent a similar result was obtained. The sections from material taken from alcohol were placed in 25 per cent. solution of copper sulphate, washed with distilled water, and treated with 50 per cent. caustic potash. The mucus in Malvaceæ swells up in copper-ammonium oxide and becomes pale blue. With tincture of iodine and iodopotassic iodide there is no reaction; with alcoholic solution of safranin it turns orange, and with tincture of alkanna steel-blue.

Diagnostic Stain for the Diphtheria Bacillus.†—Dr. R. T. Hewlett communicates Neisser's differential method for staining the diphtheria bacillus. (i.) One grm. of methylen-blue is dissolved in 20 ccm. of 96 per cent. alcohol and mixed with 950 ccm. of distilled water and 50 ccm. of glacial acetic acid. (ii.) Two grm. of benzoin are dissolved in 1000 ccm. of boiling distilled water, and the solution filtered. Cover-glass films from fresh serum cultures are stained in No. i. for 1–3 seconds, rinsed in water, counter-stained in No. ii. for 3–5 seconds, washed, dried, and mounted in balsam. Thus treated, the diphtheria bacillus shows as a brown-stained rodlet containing dark blue granules, usually polar, but occasionally with one at the middle of the rod.

The method is not so successful with swabbings directly from the throat, but with fresh membrane it affords a rapid means for positive diagnosis.

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

Mounted Specimens—a New Departure.—Mr. C. Baker, of 244 High Holborn, proposes during the ensuing season, should the project receive sufficient support, starting a department for lending specimens, much on the same lines as a lending library. Should the undertaking prove a success, Mr. Baker has arranged for the subscription to include postage both ways, as detailed below. The annual subscription will be *1l.* 1*s.*, payable in advance. For this sum each subscriber will have the right of borrowing some 250 specimens in 12 deliveries; that is to say, 24 slides posted monthly for the year, or the same number of slides posted each fortnight for the winter months only. In order to save subscribers as much trouble as possible, it is proposed to send the specimens in special boxes with double wrappings, the inner one of which will be stamped and addressed for return, so that the subscriber has only to re-wrap the parcel and post it. Should sufficient subscribers send in their names, steps will at once be taken to compile a catalogue especially for this department, so that subscribers may choose as far as possible the specimens they wish to see. This, however, would not be possible until the undertaking were an assured success.

Those desiring to subscribe should communicate at once with Mr. C. Baker, Optical Warehouse, 244 High Holborn, London, W.C.

* Oesterr. Bot. Zeitschr., xlviii. (1898) p. 94. Cf. this Journal, *ante*, p. 440.

† Brit. Med. Journ., 1898, ii. p. 599; and also Zeitschr. f. Hyg., xxiv. (1897) p. 443.

(6) Miscellaneous.

Some Methods of Determining the Positive or Negative Character of Mineral Plates in Converging Polarised Light with the Petrographical Microscope.* — Dr. M. E. Wadsworth gives the following instructions in the use of the petrographical Microscope as a polariscope.

"Since by varying the powers, the petrographical Microscope can be used with mineral plates of any standard thickness, the directions here given can be used with the ordinary polariscope plates, as well as those thinner ones prepared expressly for use with the Microscope.

I. *Uniaxial Minerals.*—When the mineral plate shows the common uniaxial cross in converging light, its positive or negative character can be ascertained by means of the gypsum plate or quartz wedge, as well as by the ordinary mica plate.

(1) Use of the Gypsum Plate.—Examine the mineral plate, which, in converging polarised light between crossed nicols, shows a dark cross or part of a cross with or without coloured rings or arcs. Insert the gypsum plate in the slot in the body of the Microscope, above the objective. The cross is then resolved into coloured hyperbolas. The central portion is red, terminated on the ends with yellow, and bordered on the side by blue. If the blue that borders the red lies on a line parallel to the axis of least elasticity, the mineral is positive; but if it lies on opposite sides of this line, the mineral is negative. The gypsum plate is often more satisfactory in its use than the mica plate for these determinations.

(2) Use of the Quartz Wedge.—Insert the quartz wedge thin end forward. When the wedge is gradually pushed in, the cross resolves itself into coloured arcs that cross the field of view from two opposite sides of the field, and pass out of sight on the other two sides. These arcs follow each other in succession as the wedge is pushed in. If these coloured arcs advance towards the centre of a line parallel to the axis of least elasticity, the mineral is positive; but if they march toward the centre from opposite sides of that line, the mineral is negative.

The use of the quartz wedge is less liable to error than either of the preceding, and besides it can be used in many cases where the others give no results.

(*a*) If the uniaxial plate is cut so that it shows arcs of rings, its positive or negative character can be determined by placing the arcs so that a line perpendicular to them shall make an angle of 45° with the cross-hairs. By use of the quartz wedge, coloured arcs or rings can often be brought into the field, when otherwise none are seen. Push in the quartz wedge with its axis of least elasticity tangent to the arcs. If the rings then move outwards with their convex side forward, and, in time, a black or partially black arc appears, the mineral is positive; but if the arcs move with their concave sides forwards, the mineral is negative.

As a check against any error, turn the wedge over and push it in, so that its axis of least elasticity will be perpendicular to the arcs. If then the arcs move with the concave side forward, the mineral is positive;

* Journ. of Applied Microscopy, i. (1898) pp. 20–1.

but if they move with the convex side forwards, and a black or partially black ring or rings show, the mineral is negative.

(*b*) A uniaxial plate cut parallel to the vertical axis can have its positive or negative character shown in converging polarised light as follows. Place the plate at an angle of 45° with the cross-hairs so as to show the coloured arcs or imperfect hyperbolas. Push in the quartz first with the axis of least elasticity perpendicular to the vertical or optic axis of the plate. If on pushing along the quartz wedge a dark hyperbola is seen to pass over the field, the mineral is positive. Again, push in the quartz wedge with its axis of least elasticity parallel to the vertical axis of the plate. If then a dark hyperbola is seen to traverse the field, the mineral is negative.

II. *Biaxial Minerals.*—In order to render intelligible the directions later given, there is here stated the method published in the text-books for determining the positive or negative character of a biaxial mineral plate.

If a line of extinction of a biaxial plate properly cut is placed parallel to one of the cross-hairs, it shows a cross with unequal arms; but if the line of extinction makes an angle of 45° with that cross-hair, it shows two dark hyperbolas, whose vertices or eyes mark the position of the vertical axes. Accompanying the cross and hyperbolas are coloured lemniscate figures. Oftentimes the hyperbolas are wanting, and only the coloured lemniscata can be seen; but by the insertion of the quartz wedge, the hyperbolas can frequently be brought into the field.

(*a*) The positive or negative character of this biaxial plate can then be determined by placing the plate on the stage in such a position that a line joining the hyperbola eyes, or bisecting the lemniscata through their longest direction, shall form an angle of 45° with the cross-hairs. Push in the quartz wedge with its axis of least elasticity parallel to the line joining the hyperbola eyes. If the hyperbola eyes open and move toward the centre of the lemniscate figure, the mineral is positive.

Push in the quartz wedge with its axis of least elasticity perpendicular to the line joining the hyperbola eyes. If these eyes open and move toward the centre of the lemniscate figure, the mineral is negative.

Of course, if in either case the eyes contract and move outwards, this is proof, when the axis of least elasticity of the quartz wedge is perpendicular to the line joining the hyperbola, that the mineral plate is positive; but if they move outward when the axis of elasticity is parallel to the chosen line, the mineral plate is negative.

This method is less satisfactory in practice than the one where the eyes open and move inwards.

(*b*) The above method given in our text-books can be supplemented by one that can be employed in numerous cases when both of the hyperbola eyes cannot be seen, but only one of them or only the lemniscate arcs. In either of these cases the positive or negative character of the mineral plate can be ascertained; if one can determine the position of the line joining the hyperbola eyes or optic axes, by the form of the interference figures, by the position of the larger arm of the cross, or by any other means. When this direction is observed, place the arcs so that the direction of the line joining the hyperbola vertices shall be perpendicular to, or shall bisect them; also have this line make an angle of 45° with the cross-hairs, as before. Push in the wedge with its axis of least elasticity perpendicular to the arcs, or parallel to the line joining the hyperbola eyes. If the lemniscate arcs move in towards the centre of the field with their convex side forwards, the mineral is positive.

Push in the wedge with its axis of least elasticity tangent to the arcs, or perpendicular to the line joining the vertices. If the arcs then move in with their convex side forwards, the mineral is negative. If the arcs move outwards with their concave side forwards, the mineral in the first position of the wedge is negative, and in the second position positive.

(*c*) If the distance between the hyperbola eyes is not so great but that they lie within the field of view, the mica and gypsum plates can both be employed to determine the positive and negative characters when the lemniscate figure is placed as before, with the line joining the hyperbola eyes forming an angle of 45° with the cross-hairs of the eye-piece. Insert either the mica plate with its axis of least elasticity parallel to the chosen line, or else insert the gypsum plate with its axis of least elasticity perpendicular to the chosen line. With either plate in this position, the arcs on one side of the hyperbola eyes will enlarge and those on the other side contract. If the arcs that lie on the inside of the eyes, or nearest the centre of the figure, enlarge, and those on the outside contract, the mineral is positive. On the other hand, if the arcs nearest the centre contract, and the outside arcs expand, the mineral is negative. This method can be used with plates that have too great an axial divergence for their determination when the unsymmetrical cross is placed with its arms parallel to the cross-hairs."

Microscopical Water Analysis.*—Herr C. Mez's introduction to the examination of water deals principally with drinking water and sewage. The first part treats of the vegetable and animal organisms ordinarily found in impure water, and the second and larger portion of the work deals with the methods of microscopical analysis.

One of the chief merits of the work consists in an attempt to introduce a simplified nomenclature: thus, *Diplococcus flavus liquefaciens tardus*, *Micrococcus pyogenes albus*, *Bacterium fluorescens liquefaciens minutissimum*, are designated *M. flavovirens*, *M. pyoalbus*, *B. minutissimum*.

Cleaning Slides intended for Water-stuck Sections.†—M. J. G. de Groot declares that the following procedure is absolutely perfect for cleaning slides intended to be used for sections which are to be stuck on by the water method. On a clean cloth is spread a little common chalk, and the cloth having been moistened with a drop of water, the slide is rubbed therewith. The slide is again rubbed with a clean cloth moistened with water, and is then ready for use.

* Biol. Centralbl., xviii. (1898) pp. 507–9. Hedwigia, xxxvii. (1898) pp. 96–7.
† Zeitschr. f. wiss. Mikr., xv. (1898) pp. 62–3.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

DECEMBER 1898.

TRANSACTIONS OF THE SOCIETY.

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

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

(*Read 19th October*, 1898.)

Plate XIII.

Vertebralina d'Orbigny.

Vertebralina striata d'Orb., plate XIII. fig. 1.

Vertebralina striata d'Orb., 1826, Ann. Sci. Nat., vol. vii. p. 283, No. 1; Modèle, No. 81. *V. striata* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 243, pl. iii. figs. 33, 34.

The majority of the Malay specimens have the peripheral margin angular or carinate, as in *V. insignis* Brady, but in all the test is inequilateral, and one lip of the aperture protrudes beyond the other. Thus, although most of the specimens combine certain of the characters of the two species, the typical *V. insignis* is not represented. As will be seen from the figure, which is drawn as viewed by transmitted light, the test commences with a planospiral chamber.

It occurs at several Stations, but the specimens are small and feeble.

EXPLANATION OF PLATE XIII.

Fig. 1.—*Vertebralina striata* d'Orbigny. × 90.
„ 2.—*Ophthalmidium tumidulum* Brady. × 90.
„ 3.—*Massilina secans* d'Orbigny. × 40.
„ 4. „ „ var. *macilenta* Brady. × 40.
„ 5, 6, 7. „ *alveoliniformis* sp. n. × 30.
„ 8.—*Hauerina fragilissima* Brady sp. × 45.
„ 9, 10. „ „ various forms of aperture. × 90.
„ 11. „ *compressa* d'Orbigny. × 40.
„ 12.—*Planispirina contraria* d'Orbigny sp. × 45.
„ 13. „ *exigua* Brady. × 45.
„ 14, 15.—*Fischerina pellucida* sp. n. × 90.

Ophthalmidium Kübler.

Ophthalmidium inconstans Brady.

Hauerina inconstans Brady, 1879, Quart. Journ. Micr. Sci., vol. xix. n.s. p. 54. *O. inconstans* Brady, 1884, Chall. Rept., p. 189, pl. xii. figs. 5, 7, 8. *O. inconstans* (Brady) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 216, pl. xl. figs. 12, 13. *O. inconstans* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 244, pl. iii. figs. 6, 49.

The Malay specimens are few in number, and are mostly of the Spiroloculine form from the Abrolhos Bank, figured by Brady, Parker, and Jones. Brady writes of the species, "Specimens of *Ophthalmidium inconstans* in their fullest development partake more or less of the characters of *Cornuspira*, *Spiroculina*, and *Hauerina*." *

Found only at Stations 2 and 17. The 'Gazelle' Stations are West Australia and Amboyna.

Ophthalmidium tumidulum Brady, plate XIII. fig. 2.

O. tumidulum Brady, 1884, Chall. Rept., p. 189, pl. xii. fig. 6.

A solitary specimen from Station 25. It is rather more angular than Brady's figure, and has three segments to each of the later convolutions. The surface has indications of faint oblique striæ.

Brady names but one 'Challenger' Station, "off Cubebra Island, West Indies," but says it is found in a few other localities.

Massilina Schlumberger.

In all the *Miliolidæ* which at certain stages change their plan of growth, there are two well-defined groups. In one of these the first stage is planospiral, consequently they may be regarded as dimorphic forms of *Cornuspira*. This arrangement prevails in the genera *Vertebralina*, *Ophthalmidium*, and *Planispirina*. In the other group the earlier chambers are aggregated on one or other of the Milioline plans, as in *Articulina*, *Massilina*, and *Hauerina*.

The genus *Massilina*, as constituted by Schlumberger, contains those forms which, commencing as *Miliolina*, subsequently change to *Spiroloculina*. Undoubtedly the accepted classification of this family stands greatly in need of improvement, but at present there is hardly sufficient material available to warrant the proposal of a new system.

Massilina secans d'Orbigny sp., plate XIII. fig. 3.

Quinqueloculina secans d'Orb., 1826, Ann. Sci. Nat., vol. vii. p. 303, No. 43; Modèle, No. 96. *Miliolina secans* (d'Orb.) Sherborn and Chapman, 1886, Journ. Roy. Micr. Soc., p. 742, pl. xiv. fig. 4. *Sigmoilina secans* (d'Orb.) var. *obliquistriata* Halkyard, 1889, Trans.

* Brady, 'Challenger' Report, 1884, p. 189.

Manchester Micr. Soc., p. 61, pl. i. fig. 7. *Massilina secans* (d'Orb.) Schlumberger, 1893, Mém. Soc. Zool. de France, vol. vi. p. 218, w.c. figs. 31–34 and pl. iv. figs. 82, 83. *Miliolina secans* (d'Orb.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 112, pl. xx. fig. 856.

This species is very abundant and occurs in various forms, some with the surface smooth, others covered with papillæ arranged in irregular curved lines, as shown in the figure, which is taken from one of the most aberrant forms of the species, the earlier chambers being large in proportion, and unusually angular and protruding.

It occurs at Stations in both areas, but mostly in Area 2.

Massilina secans var. *macilenta* Brady, plate XIII. fig. 4.

Miliolina macilenta Brady, 1884, Chall. Rept., p. 167, pl. vii. figs. 5, 6.

The Malay specimens confirm Brady's suspicion that this is but a costate variety of *M. secans*, and it is scarcely possible to separate the two forms.

M. macilenta is more widely diffused than the type, but occurs in less abundance.

The 'Challenger' Stations are Nares Harbour, Admiralty Islands; Humboldt Bay, Papua; and off Honolulu, Sandwich Islands.

There appears to be no other record of its occurrence.

Massilina alveoliniformis sp. n., plate XIII. figs. 5, 6, 7.

Test elliptical, chambers tubular, the earlier ones arranged irregularly around the long axis, the later ones in a Spiroloculine series, periphery rounded, aperture terminal, radiate or cribrate, obscured by sand-grains. Texture arenaceous. Length 1·40 mm.

This species in some respects resembles *Sigmoilina tenuis*, but differs from it in the composition of the test and the character of the aperture. It may be regarded as a dimorphous form of *Miliolina alveoliniformis*, the earlier chambers, as shown by fig. 6, having all the characters of that species. *Quinqueloculina fabularoides* Karrer * has a similar aperture, and the arrangement of the chambers is not unlike.

It has been observed at Stations 2, 13, and 22, but the specimens are not numerous.

Hauerina d'Orbigny.

As represented by the Malay specimens, this genus has the earlier chambers arranged after the fashion of *Miliolina alveoliniformis*. These are succeeded by a series on the Spiroloculine plan, and these again by the arrangement characteristic of the genus, in which there are three or more segments in each convolution. The aperture is invariably much compressed, but is not always cribrate.

* Sitzber. k. Akad. Wiss. Wien, vol. l. Abth. i. 1864, p. 704, pl. i. fig. 3.

Hauerina fragilissima Brady sp. n., plate XIII. figs. 8, 9, 10.

Spiroloculina fragilissima Brady, 1884, Chall. Rept., p. 149, pl. ix. figs. 12–14.

The 'Challenger' specimens of this form, as stated by Brady, might be assigned either to *Spiroloculina* or to *Hauerina*, but there is in the Malay gatherings a much compressed variety of *Hauerina compressa*, which in all but the final development of the three segments to a convolution, is the exact counterpart of *S. fragilissima*. In this latter form the aperture is sometimes cribrate, sometimes has an elongated tooth, and frequently the dentate and cribrate forms of aperture are combined in the same specimens. Various forms of aperture are figured on plate XIII. It is a very interesting and instructive passage form combining the characters of the genera *Spiroloculina*, *Massilina*, and *Hauerina*.

It is moderately abundant at several Stations in both Areas.

S. fragilissima occurs at seven 'Challenger' Stations, four of which are off the coast of Papua.

Hauerina compressa d'Orbigny, plate XIII. fig. 11.

H. compressa d'Orb., 1846, For. Foss. Vienne, p. 119, pl. v. figs. 25–27. *H. compressa* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 244, pl. iii. figs. 9, 10, 23, 24.

This rare species occurs both in the compressed form represented by Brady and in the more robust form figured by Egger. Usually it is only in the outermost convolution that there are more than two segments. The earlier chambers are indistinguishable from those of *H. fragilissima*.

In the Malay Archipelago it is found rather sparingly at a few Stations in both Areas.

Brady writes, "So far as can be gathered from the 'Challenger' material, the present distribution of *Hauerina compressa* is restricted to a very small area. It occurs in two dredgings in the narrow sea between the northernmost part of Australia and the island of New Guinea, namely off Booby Island, 6 to 8 fathoms, and off Raine Island, 155 fathoms, and a few small and doubtful specimens have been found in an adjoining locality; but beyond these limits it has not been observed."* The 'Gazelle' specimens were from Mauritius.

Hauerina ornatissima Karrer sp.

Quinqueloculina ornatissima Karrer, 1868, Sitzber. k. Akad. Wiss. Wien, vol. lviii. Abth. I. p. 151, pl. iii. fig. 2. *Hauerina ornatissima* Brady, 1884. Chall. Rept., p. 192, pl. vii. figs. 15–22.

This handsome species, so commonly found in coral sand and so seldom recorded, occurs sparingly at several Stations in both areas. The specimens, although not very large, are characteristic.

* 'Challenger' Report, 1884, p. 191.

Planispirina Seguenza.

Planispirina contraria d'Orbigny sp., plate XIII. fig. 12.

Biloculina contraria d'Orb., 1848, For. Foss. Vienne, p. 266, pl. xvi. figs. 4–6. *Planispirina contraria* Brady, 1884, Chall. Rept., p. 195, pl. xi. figs. 10, 11 and woodcut fig. 5 *a*.

From Station 27 there is a single specimen of this rather rare although widely distributed species.

It is recorded from six 'Challenger' Stations, amongst them being north of Papua and off Amboyna. A somewhat doubtful example appears on pl. iii. figs. 35, 36 of Egger's 'Gazelle' Report, but there is no reference to it in the text.

Planispirina exigua Brady, plate XIII. fig. 13.

Hauerina exigua Brady, 1879, Quart. Journ. Micr. Sci., vol. xix. n.s., p. 53. *P. exigua* Brady, 1884, Chall. Rept., p. 196, pl. xii. figs. 1–4 and woodcut fig. 5 *b*. *P. exigua* (Brady) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 216, pl. xl. fig. 4. *P. exigua* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 245, pl. iii. figs. 11, 12.

This common tropical shallow water species occurs in considerable abundance, and is widely distributed in both areas. The specimens exhibit remarkable persistency of form.

Sub-Family **Fischerininæ.**

Test free; segments numerous, arranged on a Rotaliform or inæquilaterally planospiral plan; aperture large, terminal.

This sub-family, unique amongst the Porcellanea in having the chambers arranged in a more or less Rotaliform manner, embraces the genera *Fischerina* of Terquem and *Ceratina* of Goës.

The genus *Fischerina* was instituted by Terquem in 1878 to accommodate a rare aberrant form from the Upper Pliocene of the Island of Rhodes. As usual with him, taking no notice of the shell structure, he assigned it a place between *Rotalina* and *Nonionina*, and named the species *F. Rhodiensis*.*

In 1894, Goës † described a porcellanous species from the Azores, which in form resembles *Trochammina proteus* Karrer. To this form he gave the name of *Ceratina trochamminoides*, remarking that through lack of specimens he was unable thoroughly to investigate the genus. Its affinities with *Fischerina* are, however, tolerably well marked, and it may be assigned provisionally to the same sub-family.

Fischerina Terquem.

Fischerina pellucida sp. n., plate XIII. figs. 14, 15.

Test Rotaliform, depressed, consisting of about three convolutions, each containing five or six chambers, which are all visible on the

* Mém. Soc. Géol. France, sér. 3, vol. i. 1878, p. 80, pl. xiv. fig. 25.
† K. Svenska Vet.-Akad. Handl., vol. xxv. p. 122, pl. xxv. fig. 930.

superior face. Inferior face excavated at the umbilicus, periphery rounded, slightly lobulated; sutures sunk. Aperture circular, with an everted margin. Shell smooth and translucent. Length 0·25 mm.

This interesting little form is widely distributed in the Malay Archipelago, and is by no means rare. It differs from *F. Rhodiensis* in the inflation of the chambers, in the lesser exposure of the convolutions on the inferior face of the test, and in the form of the aperture.

Sub-Family Peneroplidinæ.

Cornuspira Schultze.

Cornuspira foliacea Philippi sp.

Orbis foliaceus Philippi, 1844, Enum. Moll. Siciliæ, vol. ii. p. 147, pl. xxiv. fig. 26. *Cornuspira foliacea* (Phil.) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. p. 326, pl. xii. fig. 1. *C. foliacea* (Phil.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 247, pl. iii. figs. 20, 21. *C. foliacea* (Phil.) Fornasini, 1893, Mem. R. Accad. Sci. Ist. Bologna, ser. 5, vol. iii. p. 431, pl. i. fig. 4. *C. foliacea* (Phil.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 106, pl. xviii. fig. 834. *C. foliacea* (Phil.) Morton, 1897, Proc. Portland Soc. Nat. Hist., vol. ii. p. 114, pl. i. fig. 16.

Although tolerably abundant and widely diffused, the specimens are feeble, none of them exhibiting the rapid increase in size of the outer convolution which is characteristic of the species.

Cornuspira involvens Reuss.

Operculina involvens Reuss, 1850, Denkschr. k. Akad. Wiss. Wien, vol. i. p. 370, pl. xlvi. fig. 20. *Cornuspira involvens* Reuss, 1863, Sitzber. k. Akad. Wiss. Wien, vol. xlviii. p. 39, pl. i. fig. 2. *C. involvens* (Reuss) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. p. 327, pl. xii. fig. 2. *C. involvens* (Reuss) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 216, pl. xl. figs. 1–3. *C. involvens* (Reuss) Sherborn and Chapman, 1889, Journ. R. Micr. Soc., p. 484, pl. xi. figs. 4, 5. *C. cretacea* (Reuss) Burrows, Sherborn, and Bailey, 1890, Journ. R. Micr. Soc., p. 552, pl. viii. fig. 6. *C. involvens* (Reuss) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 246, pl. iii. figs. 18, 19. *C. involvens* (Reuss) T. Rupert Jones, 1895, Pal. Soc., p. 128, pl. iii. figs. 52–54 and woodcuts figs. 11 *a*, 11 *b*.

Is more abundant than *C. foliacea*, and occurs in two forms; in one of these the tube is very small at the commencement, and the convolutions numerous; in the other the whorls are few, and the tube, having its origin in a spherical chamber, increases but little in size. This latter is the more abundant.

Probably these represent the *Microspheric* and *Megalospheric* forms of the species. Both are figured on plate xl. of the Memoir on the Foraminifera of the Abrolhos Bank, by Brady, Parker, and Jones, referred to above.

Peneroplis Montfort.

Peneroplis pertusus Forskål sp.

Var. *a. planatus* Fichtel and Moll sp.
„ *b. pertusus* Forskål sp.
„ *c. arietinus* Batsch sp.
„ *d. cylindraceus* Lamarck sp.
„ *e. lituus* Gmelin sp.
„ *f. carinatus* d'Orbigny.

Accepting Brady's convenient arrangement of the forms composing this genus,* the above mentioned varieties are found in moderate numbers at most of the Malay Stations, but are most abundant in Area 1.

The specimens as a rule are not large, and call for little mention; it may however be observed, that although there are numerous examples of the fragile form *P. lituus*, not one of them possesses the initial chambers.

Orbitolites Lamarck.

Orbitolites marginalis Lamarck sp.

Orbulites marginalis Lamarck, 1816, Hist. Nat. Anim. sans Vert., vol. ii. p. 196, No. 1. *Orbitolites marginalis* Carpenter, 1883, Phil. Trans., vol. clxxiv. p. 559, fig. 1.

This simple form occurs in some abundance at several Stations in both areas, but the specimens are small.

Orbitolites complanata Lamarck.

Orbitolites complanata Lamarck, 1801, Syst. Anim. sans Vert., p. 376. *O. complanata* (Lam.) Egger, 1893, Abhandl. k. bayer. Akad., Cl. II., vol. xviii. p. 249, pl. iii. fig. 40. *O. complanata* (Lam.) T. Rupert Jones, 1895, Pal. Soc., p. 136, pl. iii. figs. 45–47. *O. complanata* (Lam.) Lister, 1895, Phil. Trans., vol. clxxxvi. p. 431, pl. ix. figs. 41–51.

Distribution similar to that of *O. marginalis*, and some of the specimens attain a considerable size.

Alveolina d'Orbigny.

Alveolina Boscii Defrance sp.

Oryzaria boscii Defrance, 1820, Dict. Sci. Nat., vol. xvi. p. 106 *Alveolina Boscii* (Defr.) d'Orbigny, 1826, Ann. Sci. Nat., vol. vii p. 306, No. 5; Modèle No. 50. *A. longa* (Czjzek) Egger, 1893 Abhandl. k. bayer. Akad., Cl. II., vol. xviii. p. 249, pl. iii. fig. 32.

* 'Challenger' Report, 1884, p. 204.

Occurs at a few Stations in both areas. The specimens are moderate in size.

The 'Gazelle' examples are from Mauritius.

Alveolina melo Fichtel and Moll. sp.

Nautilus melo Fichtel and Moll, 1798, Testac. Micr., p. 118, pl. xxiv. *Alveolina melo* (F. and M.) d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 306, No. 5. *A. melo* (Brady) Egger, 1893, Abhandl. k. bayer. Akad., Cl. II., vol. xviii. p. 249, pl. iii. fig. 31.

This species is very rare in the Malay Archipelago and has been found only at Stations 2 and 22.

The 'Gazelle' Stations are Mauritius and West Australia.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, Etc.

*Including Original Communications from Fellows and Others.**

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Determination of Sex.‡—Herr L. Cohn has collected the facts and theories on this subject. As is well known, there are too few facts to warrant any general theory. It seems certain that the sex of the offspring may be affected by numerous factors. Schenk's theory is condemned as a hypothesis based on very insufficient evidence. Schenk gives only three or four cases which bear out his theory. Cohn is at least more cautious.

Telegony.§—Dr. Otto vom Rath discusses the possibility of coinfœtation in mammals in its bearing on this subject. Certain breeding experiments of his own, and of Herr Fr. Engelmann's in the case of dogs, convince him that it does occur, though he admits the difficulty of eliminating the possibility of reversion in the case of the more specialised breeds. He explains the phenomenon as the result of the fact that, in the case of animals which bring forth many young at a birth, the eggs are not all ripe simultaneously, but may be shed into the oviduct at intervals of several days, and so be fertilised at different periods. He believes that the appearance of badly bred pups in a litter, which breeders regard as the result of telegony, may be accounted for in this way. He is not able to believe in the possibility of telegony on the evidence as at present stated.

* 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.

‡ 'Die willkürliche Bestimmung des Geschlechts,' Würzburg, 1898. See Biol. Centralbl., xviii. (1898) pp. 589–90.

§ Biol. Centralbl., xviii. (1898) pp. 637–42.

Respiration in Amphibia during Metamorphosis.*—Herr F. Maurer gives an interesting description of the vascularisation of the epidermis at the time of metamorphosis in *Rana*, *Bufo*, and *Hyla*. He finds that, when the skin-glands begin to develop, there appears between epidermis and corium a sub-epidermal layer remarkable for its numerous capillaries. These capillaries grow outwards, penetrating to immediately beneath the outermost row of epidermal cells, so that the epidermis becomes completely vascularised. Other experiments have convinced the author that at the time of metamorphosis neither gills nor lungs are actively respiratory. He therefore regards this temporary development of superficial blood-vessels as a proof that the skin is then the main respiratory organ. The capillaries become much less conspicuous as soon as the metamorphosis is over.

Multiple Canals in Spinal Cord of a Chick Embryo.†—Miss A. C. Smith describes the spinal cord of a chick of about ten days' incubation. The embryo was normal except as regards the cord, which showed a series of secondary neural canals, or more properly vesicles. They did not open into one another nor into the central canal. All of them were lined with the same kind of cells as those lining the central canal, of which they were probably disconnected outgrowths.

Development of Sphenodon.‡—Dr. Arthur Dendy briefly summarises the more important results of his investigations on this subject. He finds that development lasts about thirteen months, the eggs being laid in November and hatched in the December of the next year; but the earlier stages are rapidly passed through, and it would seem that development is virtually suspended during the winter months. There are several peculiarities in the formation of the amnion, notably in the presence during the early stages of a "posterior amniotic canal," quite similar to that described by Mitsukuri for Chelonians. This would seem to confirm the belief that *Sphenodon* is related to that group. The parietal eye apparently arises independently of the epiphysis, and the author is of opinion that the pineal gland is represented by a mass of convoluted tubules lying in front of the parietal eye. A similar independence of parietal organ and epiphysis has been maintained by Béraneck for *Lacerta* and *Anguis*.

Regeneration in Frog-embryos.§—Miss E. F. Brynes finds that tadpoles develop normal full-sized limbs, even if the limb-rudiment is completely destroyed at the time when it first appears. Three species were experimented on, *Rana sylvatica*, *R. palustris*, and *R. virescens*, and in all cases fresh limb-rudiments developed from the surrounding somatopleural tissue. The author considers that the experiment adds fresh evidence to the view that the entire limb is somatopleuric in origin.

b. Histology.

Ganglion-cells.‖—Dr. Rohde has extended his researches on this subject to cover the ganglion-cells of Vertebrates, and in the present

* Morph. Jahrb., xxvi. (1898) pp. 330–6 (1 fig.).
† Anat. Anzeig., xv. (1898) pp. 56–60 (6 figs.).
‡ Proc. Roy. Soc. Lond., lxiii. (1898) pp. 440–3.
§ Anat. Anzeig., xv. (1898) pp. 104–7 (3 figs.).
‖ Zeitschr. f. wiss. Zool., lxiv. (1898) pp. 697–727 (5 figs.).

paper discusses their characters from the comparative point of view. As to method, he emphasises the value of corrosive sublimate as a fixative, and especially the necessity for mounting sections in *glycerin*; such preparations show, he says, details invisible in balsam, and also allow of fresh staining, which may be necessary.

Some only of the points of structure dwelt on can be mentioned here. Ganglion-cells in general consist of three parts, a homogeneous hyaloplasm, a supporting network of spongioplasm, and a deeply staining substance having a varying relation to the spongioplasm proper. The neuroglia places the ganglion-cells in communication with one another. The nuclei of the cells contain two kinds of granules, some of nuclein, and others of paranuclein; the latter are the nucleoli. Besides the chief nucleolus, there are also smaller slightly different structures, the accessory nucleoli. These may pass out into the cytoplasm and give rise to the structures sometimes described as centrosomes; they probably form the chromatin substance already described in the cell protoplasm. The author believes that the specific function of ganglion-cells is dependent on this continued passage of accessory nucleoli from nucleus to cytoplasm. He does not believe that centrosomes occur in ganglion-cells. The structures described by Lenhossék as centrosomes in the cells of the spinal cord in the frog, are not true centrosomes. Their meaning is doubtful, but they may be remnants of degenerated ganglion-cells.

Histology of Glands.*—Herr Erik Müller has found that the remarkable secreting capillaries of the gastric glands can be demonstrated by other means as well as by Golgi's famous method. Fragments of the mucous membrane of the stomach of a dog were laid for 24 hours in Kopsch's mixture (40 parts 3·5 per cent. potassium bichromate and 10 parts of commercial formalin), and then for one or several days in the bichromate alone. They were then washed, and hardened in alcohol of increasing strengths. The sections were stained with Heidenhain's iron-hæmatoxylin. The results were admirable, and not only served for the discovery of several new points, but were valuable as an independent confirmation of results obtained by Golgi's method.

The results as to the fundus glands in the dog's stomach are to show that the paths of the secretions are first by the central lumen and cross channels, which are surrounded by a distinct ectoplasmatic membrane, and secondly by the *intracellular* secreting capillaries. In both central and parietal cells the secretion arises from granules which, before they are converted into fluid, pass through two stages, one in which they are stainable, and one in which they are not. The course of the secretion is different in the two sets of cells:—(*a*) in the first case this is poured direct into the gland-lumen; (*b*) in the parietal cells it is drained off by their intracellular canals.

In a further investigation of the mucous glands of the cat, the author, by means of the injections of pilocarpin, obtained cells free from secretion, and found that not only, as has been previously stated, do empty mucous cells and empty albuminous gland-cells closely resemble one another, but, further, neither are distinguishable from the cells of

* Zeitschr. f. wiss. Zool., lxiv. (1898) pp. 624–47 (2 pls.).

Gianuzzi's crescents. This, however, the author regards as only proving that it is the granules of secreting cells, and the nature of their respective secretions, which are to be relied on in determining specific differences.

In his concluding paragraphs, the author urges the necessity of laying more stress upon the way in which the fluid secretion arises from the solid cell contents, and discusses his results in the light of this point. In mucous cells, albuminous cells, pancreatic cells, and the central cells of the gastric glands, the secretory granules in the resting state are peripheral. In the parietal cells of gastric glands they are central, and their conversion there into fluid gives rise to the characteristic intracellular capillaries.

Distribution of Phosphorus in Tissues.*—Dr. A. B. Macallum gives some account of the results of the application of his method (see p. 686) for detecting phosphorus-containing compounds in animal and vegetable cells. In cells in general the chromatin of the nucleus gives a marked phosphorus reaction, while eosinophilous nucleoli give a similar but less well marked reaction, and the cytoplasm of most cells gives a very slight indication. To this last statement exceptions are found in liver cells; in ovarian ova of Amphibia, in which, however, the phosphorus is taken up by the yolk-spherules as these develop; in the spermatozoa of *Ascaris*; and in other cases.

Connections between Unstriped Muscle-cells.†—Herr J. Schaffer maintains that these elements are not connected either by amorphous cementing substance or by intercellular bridges like those in epithelium. The intercellular connective substance is a fibrous alveolar reticulum with sparse nuclei, directly associated with adjacent fibrillar connective tissue.

c. General.

Nocturnal Plankton of the Lake of Geneva.‡—Prof. H. Blanc relates his experience showing that the Entomostraca which form the great mass of the plankton in the Lake of Geneva are more abundant at the surface during the night than during the day. They migrate at night from the deeper to the more superficial layers. The nocturnal multiplication of such organisms as *Ceratium hirundinella* may have something to do with it.

Plankton of the Red Sea.§—Dr. A. Steuer gives a preliminary account of the pelagic fauna of this region, stating the relative abundance of the diverse constituents. His results go to show the fundamental importance of the currents in determining the distribution of the animals.

Plankton of Norwegian Lakes.‖—Herr Hartvig Huifeldt-Kaas has an interesting paper on this subject. His observations extended over thirty-three lakes, and in three cases the annual periodicity of the plankton was determined. He finds that in the general case the surface life, both in actual amount and in number of species, decreases with an

* Proc. Roy. Soc. Lond., lxiii. (1898) pp. 475–9.
† Anat. Anzeig., xv. (1898) pp. 36–41.
‡ Bull. Soc. Vaud. Sci. Nat., xxxiv. (1898) pp. 225–30 (1 chart).
§ SB. k. Akad. Wiss. Wien, cvi. (1897) pp. 407–24 (1 map).
‖ Biol. Centralbl., xviii. (1898) pp. 625–36.

increase in the depth of water, the Algæ especially being never abundant, except in shallow (2–10 metres) water. More careful observations showed, however, that this is only true in summer, and that the relative size of the drainage area of the lake is an important factor. Where a shallow lake has large and rapid feeders, its plankton will be less than that of a deeper lake which drains a proportionately smaller area. Such facts point to the special importance of the temperature of the water and of the relative frequency of its renewal. As might be expected, it was found that the number of fish in a lake bears a direct relation to the amount of its plankton. The paper is illustrated by some very instructive tables.

Evolution of Spines.*—Mr. C. E. Beecher discusses this subject with much wealth of example and illustration, his object being to reach some general conclusion as to the origin of the spinose condition. Spines are purely organic structures, and therefore subject to the law of variation; variation may be either progressive or regressive, and is therefore produced either by constructive or destructive agencies. In either case the agent may be external stimuli acting on the organism, or growth-force acting from within. There are, therefore, four factors concerned in the production of spines. But each of these factors is complex and capable of subdivision, and there may be a replacement or overlapping of forces, so that there are in all eleven causes of spinosity. It may arise:—

"(1) In response to environmental stimuli acting on exposed parts.

(2) As the extreme result of progressive differentiation of previous structures.

(3) Secondarily, as a means of protection and offence.

(4) Secondarily, from sexual selection.

(5) Secondarily, from mimetic influences.

(6) From prolonged development under conditions favourable for multiplication.

(7) By repetition.

(8) By restraint of environment causing suppression of structures.

(9) By mechanical restraint.

(10) By disuse.

(11) By intrinsic suppression of structures and functions."

A detailed discussion of these factors shows that two main generalisations may be drawn up:—"(1) That spinosity represents the limit of morphological variation, appearing in phylogeny as the limit of morphological progress and regress; and (2) that similarly, physiologically, spinosity represents the paracme of vitality." In other words, "after attaining the limit of spine differentiation, spinose organisms leave no descendants, and from such spinose types no new types are developed."

Relations between Marine Animal and Vegetable Life.†—Mr. H. M. Vernon, following up his work on the 'Effects of Environment on the Development of Echinoderm Larvæ,' has made a series of researches into the relations between marine animal and vegetable life. His work concerns itself with (1) the purification of water by vegetable life, and

* Amer. Journn. Sci., vi. (1898) pp. 1–20, 125–36, 249–68, 329–59 (1 pl., 73 figs.).
† MT. Zool. Stat. Neapel, 1898, pp. 341–425.

(2) the fouling of water by animal life. The experimenter gives a full account of his methods, and he thus summarises his results :—

Green sea-weeds, such as *Ulva*, rapidly remove the free ammonia from aquarium tank water, but they slowly increase the organic ammonia. Larvæ grown in water thus purified are, as a rule, increased in size. When grown in direct contact with the alga, they are generally decreased in size, but an increased proportion of the fertilised ova develop to larvæ.

Red sea-weeds, as *Gelidium*, generally cause an increase in the free as well as in the organic ammonia. They sometimes have a favourable, but as a rule an unfavourable effect on larval growth. Filtration through sand may remove almost all the free ammonia present and a third or more of the organic ammonia, this purification being effected by the layer of diatoms and algæ on the grains of sand. Sand kept in darkness may also effect great purification, in this instance through bacterial influence. Larvæ grown in water thus purified are increased in size some 4·2 per cent.

On keeping water in diffuse light for some weeks, nearly all the free ammonia disappears, owing to the multiplication of the small quantity of algæ and diatoms originally present. The organic ammonia is at the same time increased, but larvæ grown in the water are greatly increased in size.

Larvæ grown in water previously exposed under certain conditions to the sun are greatly increased in size. Sunlight, though it has an immediate germicidal action on the water, probably effects no bacteriological purification.

On keeping water in darkness for three or more weeks, nearly all the free, and a third or more of the organic ammonia, is removed by bacterial action. Larvæ grown in water thus purified are some 7·5 per cent. larger than the normal. As far as the ammonia is concerned, water kept in darkness may become as pure as open sea-water, but it is not physiologically so pure, for larvæ grown in the latter are 16 per cent. larger than the normal.

A very considerable purification of the aquarium water is effected by the layer of bacterial slime coating the inside of the conducting pipes. Thus half of the ammonia was sometimes removed by this means, and the larvæ grown in the water were 7·8 per cent. larger than the normal.

Larvæ grown in water filtered through asbestos and water previously heated to 50°, 76°, or 100°, are considerably increased in size.

Larvæ grown in water previously fouled by fish, crabs, molluscs, and Holothurians, are increased in size, but in water fouled by Echinoids and other Plutei, are considerably diminished. Dead Echinoids foul the water about ten times more than most living animals, whilst fish and crabs foul it ten times more than molluscs and Holothurians.

Ammonium chloride acts very injuriously on larval growth, but potassium nitrite and potassium nitrate in small quantities have no action.

Aeration has only a very slightly favourable effect on larval growth.

The nitrites present are greatly diminished on keeping the water in darkness, but are increased by vegetable growth and on development of larvæ in the water.

The arm-lengths are, as a rule, affected in the same direction as the body-lengths on change of environmental conditions, but in the reverse direction by water filtered through sand, water exposed to sunlight, and water previously heated to 100° C.

The specific gravity and purity of the aquarium water vary but little at different times of the year. The salinity is about a hundredth part greater than that of open sea-water.

Endolymphatic Apparatus of Fishes.*—Herr Szymon Sidoriak has made some observations on the development of the ear and its parts in embryos of *Rhodeus amarus*, and finds that not only do the conditions observed there confirm Nusbaum's views as to the morphology of the parts in *Cyprinus carpio*, but that the endolymphatic apparatus is more fully developed in *Rhodeus* than in the former. The special points would appear to be the development of a cross connection—the ductus endolymphaticus—between the two recessus labyrinthi, and, associated with this cross canal, the development of a large unpaired median sac, and lateral paired sacs. The last are absent in the carp, though the spaces which they occupy in the minnow are there clearly indicated.

Identification of Artificially Hatched Fish.†—Mr. H. C. Bumpus refers to the many millions of young fish which have been "planted" in various localities by the United States Fish Commission. The "planting" is followed by increase, but how can it be shown that the fish appearing in increased numbers are really the adults of the young artificially produced? To mark the fry is out of the question, but it is possible that the fry mark themselves by variational differences which may be detected. In a given area the "curve of distribution" for some native species may be determined in reference to fin-rays, scale-rows, number of vertebræ, &c. Secondly, the same may be done in another locality from which the "brood-fish" are to be taken. Thirdly, after the "planted fish" have had time to mature, new curves may be plotted for the first locality. The relation of these new curves to those first made will show whether the re-stocking has had any effect. Various objections to this ingenious proposal are considered.

Vertebral Teeth of Dasypeltis.‡—Prof. L. Kathariner has made a detailed study of the egg-breaking apparatus in *Dasypeltis scabra*. The hypapophyses which are important are especially those from 22 to 26; their tissue is true bone and *without* enamel; they lie in connective-tissue pockets with their points projecting freely. Behind the œsophagus the canal narrows abruptly, so that the broken fragments of egg-shells do not pass down. In a young specimen (38 cm. in length), which had not yet begun the adult diet, the teeth of the mouth-cavity were relatively large, and the constriction mentioned above was undeveloped. In spite of the retrogression of the teeth in the adult, the typical buccal glands remain well developed.

Larynx of Amphibians.§—Dr. Ernst Göffert, in an elaborate paper, discusses the structure and development of the larynx in Amphibians. Apart from anatomical details, the chief point is to show that the

* Anat. Anzeig., xv. (1898) pp. 93–8 (4 figs.).
† Amer. Natural., xxxii. (1898) pp. 407–11 (2 figs.).
‡ Zool. Jahrb. (Abth. Anat.), xi. (1898) pp. 501–18 (1 pl.).
§ Morph. Jahrb., xxvi. (1898) pp. 282–329 (4 pls. and 5 figs.).

primary part of the laryngeal skeleton—that is the arytenoid, cricoid, and tracheal rings—is derived from the fifth branchial arch, and that its muscles are derived from those of the same arch.

Function of Pancreas in Squalidæ.*—Prof. E. Yung finds that extract of pancreas from *Scyllium catulus* and *Lamna cornubica* contains ferments dissolving starch, emulsifying fats, and digesting fibrin. The last enzyme sometimes fails to act; the conditions of its activity remain inadequately known. A little piece of spleen mixed up with the pancreas in preparing the extract is an effective condition.

Optic Nerve in the Sciuridæ.†—Dr. Rudolf Krause describes a remarkable condition of this nerve in *Spermophilus citillus*. The nerve is compressed in cross section, and on reaching the eye swells out into a long oval body closely applied to the surface of the sclerotic. Internally, the *papilla nervi optici* is found to form a band 6–7 mm. long, over the whole of which rods and cones are absent. The papilla is richly supplied with blood-vessels. A description of the eyes of some other Sciuridæ is promised.

Tailless Batrachians of Europe.‡—Mr. G. A. Boulenger has completed his account of these Amphibians. The present part deals with Bufonidæ, Hylidæ, and Ranidæ. The text and the illustrations are worthy of each other, and it is impossible to refrain from congratulations.

Electric Organ of Malapterurus electricus.§—Dr. E. Ballowitz has recently investigated this organ. In its structure he finds much general resemblance to the conditions seen in other electric fish. He expects to publish full details later, but confines himself in the present paper to a brief description of the peculiarities of the nerve-endings. It has been long known that in *Malapterurus* there is not a complicated network of nerves, such as that found on the plates of the electric organ in other electric forms, but the exact nature of the nerve-endings has been hitherto unknown. The author was extremely successful with preparations by Golgi's method, and found that the plates of the organ are somewhat disc-shaped, the posterior surface of the disc being prolonged into a partially hollow and partially solid process called by the author the funnel, terminating in a swollen knob. On the surface of this knob lie 2–4 spirally coiled nerve-fibres with free varicose ends; these replace the nerve network seen in other forms.

Electric Organ of Mormyrus.‖—Dr. J. Ogneff has investigated by means of modern methods the electric organs of three species of *Mormyrus*. His results in general confirm those of the older observers, and emphasise the resemblance between the feebly developed electric organs of this fish and the more specialised organs of forms like *Gymnotus* and *Torpedo*.

As is well known, in all species there are four electric organs, two

* Comptes Rendus, cxxvii. (1898) pp. 77–8.

† Anat. Anzeig., xv. (1898) pp. 110–11.

‡ 'The Tailless Batrachians of Europe,' by G. A. Boulenger, pt. ii. 8vo, London, 1898, printed for the Ray Society, pp. 211–376, pls. xi.–xxiv. figs. 78–124.

§ Anat. Anzeig., xv. (1898) pp. 85–92.

‖ Zeitschr. f. wiss. Zool., lxiv. (1898) pp. 565–95 (1 pl.).

ventral and two dorsal. Each is roughly shaped like a three-sided prism with tapering conical ends, and is invested with a tendinous sheath. Connected with this sheath are numerous vertical connective-tissue partitions which divide the organ into a series of compartments, within which lie the electric plates. The number of these seems to be more or less constant for the species, the growth of the organs being due to an increase in the size of the plates and not to an increase in number. The plates are separated from the partitions by a layer of mucoid tissue in which the nerves ramify. In some species the nerves penetrate the plate in front and in some behind; there is also variation in the number of the branches into which the nerve breaks up. As to the difficult point of the relation between the myelin threads and the pale nerve-fibres, the author finds that the dark fibres consist of 30–50 myelin threads, which invest like "a finger-stall" the conical origin of the pale fibres. The latter consist of (1) a connective-tissue sheath with spindle-shaped nucleated cells, beneath which lies (2) a thin nucleated membrane, the electrolemma, then (3) a thick homogeneous sheath surrounding (4) the central axis-cylinder. In considering the connection between the fine branches of these nerve-fibres and the electric plates, it is first necessary to consider the structure of the latter. Each consists of three layers, an anterior and a posterior layer of similar structure, and a central layer. Each outer layer consists of a homogeneous mass finely dotted and containing oval nuclei. Under high magnification it is seen that the dotted appearance is due to minute fibrillar rods, perpendicular to the surface of the plate, and probably representing the remains of muscle-fibres; they are connected with the swollen ends of the pale nerve-fibres. The middle layer of the plate consists of striped muscle-fibres, though, owing to the extreme rapidity with which they undergo change, this is not always easy to demonstrate. They are surrounded by a transparent substance.

Finally, as to the relation of the pale nerve-fibres and the plates. Where the connective-tissue sheath persists (as in *M. oxyrhynchus*) to their branched ends, it is continued into the mucoid layer between the plates. The thin electrolemma beneath it spreads out over the surface of the plate, the thick sheath of the fibre is continuous with the transparent layer of the plate. The fate of the axial cylinder is unknown, its fibrils have been followed only to the end of the little rods.

Toxin and Anti-toxin of Snake-venom.*—Dr. Charles J. Martin has been continuing his observations on this subject, with especial reference to the observed discrepancy between the quantities of anti-venene required to neutralise a given dose of venom, when they are (1) previously mixed outside the body; and (2) simultaneously injected under the skin. His conclusions are that (1) about the same quantity of anti-venene necessary to neutralise the venom *in vitro* is capable of doing so when the former is injected into the blood-stream, and the latter sub-cutaneously; (2) at least ten to twenty times this quantity is required when they are both placed simultaneously under the skin, but in different parts of the body. The author is of opinion that these results markedly support his view that the nature of the antagonism between the toxin and anti-toxin is a chemical one. The practical result is that the anti-venene should be injected intravenously.

* Proc. Roy. Soc. Lond., lxiv. (1898) pp. 88–94.

Tunicata.

Different Forms of Anchinia.*—Prof. A. Korotneff describes an asexual form of *Anchinia*, which differs in its mode of budding from the other two asexual forms previously described. Including the sexual generation there is thus a polymorphism of four stages.

INVERTEBRATA.

Mollusca.

γ. Gastropoda.

"Nebenkern" in Spermatogenesis of Pulmonata.†—Mr. J. A. Murray has studied the history of this body in *Helix pomatia* and in *Arion*. The most important result of his research is the conclusion that in the attraction-sphere (*Nebenkern*) of Pulmonata there are no structures which can in any way be compared to chromosomes. "The salient characters by which these are recognised—constant number, equal distribution to the daughter-cells, and longitudinal division—are absent." This conclusion is strongly against the supposed high importance of the constituent elements of the attraction-sphere as such.

New South African Marine Gastropod.‡—Mr. G. B. Sowerby describes a remarkable mollusc, which has characters in common with the Volutidæ, Buccinidæ, and Fusidæ. The soft parts, which have been described by Mr. M. F. Woodward, have some resemblance to those of the Volutidæ, and are quite unlike those of Fusidæ and Buccinidæ. The most striking feature in the shell is its apex; the nucleus being large, and of a bulb-like form; otherwise it would be taken for a species of *Neptunea* Bolton = *Chrysodomus* Swainson. Mr. Sowerby proposes *Neptuneopsis Gilchristi* g. et sp. n., as the name of this new Gastropod.

Caudal Triangular Groove of Arion.§—M. Emile André describes this in *A. empiricorum* Fér. and *A. fuscus* Müll. It is a depression bounded anteriorly by the mantle, and laterally by the margins of the sole. It is lined by epithelial cells among which there are calcareous and mucous unicellular glands. The secretion is greatest at the time of reproduction in spring. It may be odoriferous, and Saint-Simon has noted that two slugs eat one another's mucus before pairing. It has no toxic quality.

δ. Lamellibranchiata.

Australasian Shipworms.‖—Mr. C. Hedley describes *Calobates fluviatilis* sp. n., from a river in Fiji, and compares it with other forms. The soft parts rather than the hard parts should be taken as a guide in classification. A salient character is the cup-like process of the mantle which embraces both siphons and palettes; the siphons differ in the extent to which they are divided. The genus *Calobates* Gould is remodelled, and is characterised by a cup-like anterior fold of the mantle and short siphons divergent for half their length. It thus embraces

* MT. Zool. Stat. Neapel, xiii. (1898) pp. 426–32 (1 pl.).
† Zool. Jahrb. (Abth. Anat.). xi. (1898) pp. 427–40 (2 pls.).
‡ 'Report of the Marine Biologist (Cape of Good Hope) for the Year 1897,' issued 1898, pp. 132–4.
§ Rev. Suisse Zool., v. (1898) pp. 179–82 (1 fig.).
‖ Proc. Linn. Soc. N.S.W., xxiii. (1898) pp. 91–6 (9 figs.).

Wright's *Nausitoria*, possibly Gould's *Lyrodus*, and species referred to other genera. The new species described is distinguished by the rounded and produced auricle of the valve, and by the hatchet-shaped palettes.

Arthropoda.

Phylogeny of Pantopoda.*—J. E. W. Ihle discusses the various opinions held as to the relationships and phylogeny of the Pantopoda. He holds that it is impossible to ally them with Arachnoids or with Crustaceans, but he thinks that the Myriopods may be regarded as the ancestral stock. The Pantopoda should be ranked as an independent class of Tracheata, very divergent, but more nearly related to Myriopoda than to any others. The occurrence of a pair of abdominal appendages is especially emphasised.

More 'Challenger' Pycnogonids.†—Dr. P. P. C. Hoek describes four new species of Pycnogonids,—*Pallene dimorpha*, *Anoplodactylus neglecta*, *Colossendeis japonica*, and *Pycnogonum magellanicum*. They were found by Prof. G. O. Sars in his 'Challenger' collection of Cumacea, after the completion of the report on Pycnogonids. The author also describes *Chætonymphon hirtum* Kröyer from the southern part of the North Sea.

α. Insecta.

Individual Variation in Wings of Lepidoptera.‡—Mr. W. L. W. Field has tried to answer two questions in this connection :—(1) Is a part, developed in any given species in an extraordinary manner as compared with the development of the corresponding part in other allied species, more variable than parts which exhibit less specific peculiarity ? and (2) Which sex is the more variable? He worked with the moth *Thyreus abbotii* Swainson, one of the common Sphingidæ of Eastern North America, and his measurements related to the irregular and very long outer margin of the wing. He finds that this, the most aberrant dimension of the fore-wing, is likewise the most variable. This accords with Darwin's law. The females show, in general, a greater degree of variability than the males; but in the markedly aberrant feature under discussion, their variability is *less* than that of the males. It is possible that the sinuosity of the margin has a protective significance, and is of less importance in the males whose conditions of life are easier.

Natural Selection in Lepidoptera.§—Mr. M. L. Sykes illustrates this by a study of mimicry, and gives an admirable exposition illustrated by eight photographed plates.

Post-embryonic Development in Ants.‖—Herr W. Karawaiew now publishes full details of his investigations on this subject in *Lasius flavus*. As to method, the author chiefly emphasises the necessity for dropping the larvæ for a few seconds into water heated to about 80° C. before fixation. The fixing agents, of which several were tried, were then used cold. The most important general result is to show that, in marked

* Biol. Centralbl., xviii. (1898) pp. 603–9.
† Tijdschr. Nederl. Dierk. Ver., v. (1898) p. 290 (2 pls.).
‡ Proc. Amer. Acad. Sci., xxxiii. (1898) pp. 389–96 (5 figs.).
§ Trans. Manchester Micr. Soc. for 1897 (issued 1898), pp. 54–64 (8 pls.).
‖ Zeitschr. f. wiss. Zool., lxiv. (1898) pp. 385–478 (4 pls. and 15 figs.).

contrast to the conditions seen in flies, phagocytes play a very unimportant part in the metamorphosis. In this respect *Lasius* resembles the Lepidoptera, and the author agrees with Korotneff and Rengel in believing the peculiarity to be associated with the length of time occupied by the metamorphosis. When this is rapid, as in flies, phagocytic activity may be assumed; when slow, the degenerative changes are self-induced, and phagocytes are unimportant. The two conditions are compared to the pathological states known as acute and chronic inflammation. The most important part played by phagocytes in *Lasius* is in connection with the cells of the fatty body, which are actually broken down by means of phagocytic cells. This the author considers to be due to the necessity for providing room in the abdomen for the rapidly growing organs, especially the gonads. The contrast between the phagocytic and non-phagocytic types of development are well illustrated in a comparison of the development of the imaginal muscles in flies and in *Lasius*. While in the former the larval muscles are completely consumed by phagocytes; in the latter, although the muscle is interpenetrated by imaginal myoblasts, these do not exercise any apparent influence on the larval muscle fibres and cells. The latter undergo a gradual process of disintegration, due, according to the author, to exhaustion of vitality produced by too active functioning. When disentegrated, the muscle fibres and cells form a liquefied mass, which is gradually taken up by the imaginal myoblasts.

The paper includes detailed comparisons with the results obtained by other observers for different insects.

Development of Mantis.*—Mr. T. D. A. Cockerell has made a few observations on the development of a species of *Stagmomantis*, and is unable to confirm what Pagenstecher described in regard to *Mantis*, e.g. as to the state of the legs, or as to a real ecdysis between the pupa-like form and the active young. The young insects did not hang by their threads to the ootheca "for some days," but ran about the morning after hatching.

The Genus Trimerus.†—Dr. Alfred Nalepa gives an account of this genus founded by him for certain members of the family Eriophyidæ, found either as parasites within galls or in diseased growths of woody trees. Fourteen species are known, three being now described for the first time.

Wings of Insects.‡—Messrs. J. H. Comstock and J. G. Needham continue their account of venation and tracheation, discussing in this instalment the Hymenoptera and Embiidæ. It can be accepted as a firmly established fact that the courses of the wing-veins of primitive insects were determined by the courses of pre-existing tracheæ. But there is little correlation in Trichoptera, Diptera, or Hymenoptera.

Specialisation of Lepidopterous Wing.§—Mr. A. Radcliffe Grote finds that specialisation is manifested in two principal directions:—(1) the suppression of the media, common to both pairs of wings; and (2) the suppression of the branches of the radius, confined to the fore-

* Amer. Nat, xxxii. (1898) pp. 513-4 (2 figs.).
† Zool. Jahrb. (Abth. Syst.), xi. (1898) pp. 405-11 (1 pl.).
‡ Amer. Natural., xxxii. (1898) pp. 413-24 (11 figs.).
§ Proc. Amer. Phil. Soc., xxxvii. (1898) pp. 17-44 (3 pls.).

wings in most Lepidoptera, and occurring sporadically. His survey of the Pierinæ leads him to the conclusion that the Anthocharini represent the most generalised forms in the holarctic fauna, and that they are probably the survivors, not on the direct line, of a former five-branched condition of the family.

New Family of Diptera.*—Dr. Benno Wandolleck has formed the family STETHOPATHIDÆ to include what he regards as three genera of flies, especially characterised by the absence of both wings and halteres, and in one case by the ectoparasitic habit. Of the genera the first, still unnamed, has been erected for some specimens discovered by Prof. Cook on African snails probably of the genus *Achatina.* After the author had begun the study of these specimens, Prof. Dahl † obtained some similar flies from Ralum; these he regarded as links between Diptera and Aphaniptera, and described as male and female of *Puliciphora lucifera g. et sp. n.* Wandolleck has since obtained Dahl's specimens, and states that they are not male and female, but both females belonging to different genera; he denies the suggestion of affinity with the fleas, rejects Dahl's description, diagnosis, and name, and places the forms in the genera *Stethopathus* and *Chonocephalus.* These two genera together with his own constitute the new family Stethopathidæ, of which females only are known. In them the thorax is greatly reduced, wings and halteres absent, and compound eyes feebly developed. Full descriptions of the specimens are given. The paper is exceedingly controversial in tone.

Gnats and Malaria.‡—Prof. B. Grassi makes a preliminary note of much interest as to the probable rôle of *Anopheles claviger*, *Culex penicillaris*, &c., in the dissemination of the germs of malaria. If the thesis be correct, it suggests a practical way of lessening the scourge.

δ. Arachnida.

Lymphoid Glands of Scorpion.§—Prof. A. Kowalevsky has made a study of two "lymphoid glands" (in *Scorpio europæus*) which are attached by their anterior ends to the diaphragm dividing the body into a thoracic and an abdominal cavity immediately behind the coxal glands. They are analogous to the median "lymphatic gland" which covers the nerve-cord, but they show a greater power of absorbing introduced liquids, while the latter has a greater avidity for solids.

New Parasitic Mite.‖—M. Marin Molliard describes, under the name of *Phytopus aquilina*, a parasite found by him on the under surface of the fronds in *Pteris aquilina.* It is botanically interesting because it modifies the shape of the fronds of the fern, and also prevents the development of sporanges. The female of the species is figured, but no specific description is given.

African Opilionidæ.¶—Dr. J. C. C. Loman gives a complete chronological list of the Opilionidæ already described in Africa, and adds to

* Zool. Jahrb. (Abth. Syst.), xi. (1898) pp. 412–41 (2 pls.).
† Zool. Anzeig., No. 543 (1897) pp. 409–12.
‡ Atti R. Accad. Lincei (Rend.), vii. (1898) pp. 163–72.
§ Mem. Ac. Imp. St. Pétersbg., v. (1897) p. 18 (2 pls.).
‖ Rev. Gén. de Bot. (Morot), x. (1898) pp. 93–6 (1 fig.).
¶ Zool. Jahrb. (Abth. Syst.), xi. (1898) pp. 515–31 (1 pl.)

the list nine new species from South Africa and Madagascar. Six of these came from Prof. Weber's collection, and three from that of Dr. H. Lenz. All are fully described, and their systematic position discussed.

ε. Crustacea.

Minute Structure of Gills.*—Dr. J. Kimus has studied the gills in species of *Asellus*, *Cirolana*, *Idotea*, *Anilocra*, and *Cymothoa*. Each lamella is an outgrowth of the body-wall, with two epithelial walls and an external cuticle. The epithelial walls bound a vascular cavity, and are united by bridges or pillars in which some connective-tissue may be included. This intermediate tissue, mesodermic in origin, has not been previously described. It seems to be of some physiological importance in determining the course of the blood.

Parthenogenetic Cypridæ.†—Dr. Richard Woltereck has investigated especially the formation and development of the egg in certain species of *Cypris*, and prefaces his paper by noting how little is really known of the Ostracods as compared with Phyllopods and Copepods. Among the special points of interest exhibited by the first named are the great variation in habit in nearly related forms, and the frequency of parthenogenesis, whether permanent, temporary (seasonal), or local. There is similar variation in the form and colour of the egg, and in the methods of egg-laying.

The origin, growth, and maturation of the eggs were followed in detail, and the regular occurrence of a synaptic state in the growing eggs was demonstrated. As in other cases, the synapsis is indicated by the fusion of the chromatin threads into a ball, while the nucleolus retreats to the opposite end of the nucleus. When the synaptic state is over, it is seen that the similar germ-cells have become differentiated into ova and nutritive cells. The latter, demonstrable in the ovary, have broken down by the time the ova reach the oviduct. They are remarkable for their excess of chromosomes (hyperchromatosis), and for the tendency these have to group themselves in dyads and tetrads. These ultimately approach nearer and nearer together, until the nucleus is filled with a dark amorphous mass of chromatin. In the egg-cells on the other hand the chromosomes diminish and disappear, the chromatin being represented by minute microsomes, the conspicuous nucleolus appears in several different forms, a clear vesicle is developed in the nucleus, and the so-called yolk-nuclei appear in varying form in the cytoplasm. When the growth of the egg is completed, it is laid, and maturation begins. With the beginning of this process the chromosomes reappear. The single polar body usually divides after its formation. The process of segmentation is described in detail, and the result is to show much general resemblance to the conditions seen in Copepoda.

In an interesting discussion of the theoretical value of his results, the author rejects the suggestion that synapsis has anything to do with reduction, and regards it as a suppressed mitotic division, notably because it is preceded by a segmentation of the chromatin threads into chromosomes, a process which does not again occur in the egg-cells till

* Anat. Anzeig., xv. (1898) pp. 45–51 (6 figs.).
† Zeitschr. f. wiss. Zool., lxiv. (1898) pp. 596–623 (2 pls.).

immediately before the formation of the polar body. The nucleolar substance the author regards as a product of the active metabolism of the nuclear chromatin. The formation of tetrads in the nutritive cells is to be regarded as a degenerative process, but the nuclei of these cells as a whole play an important part in the nutrition of the egg. The yolk-nuclei of the egg are most nearly related to nucleolar substance.

Annulata.

Viviparity in an Annelid.*—MM. F. Mesnil and M. Caullery have already described the polymorphism of *Dodecaceria concharum* Œrsted, two forms of which (*B* and *C*) undergo a metamorphosis of which there is no trace in a third form (*A*). They have now found out that this form *A* is viviparous and parthenogenetic. There is no hint of males belonging to this *A* form. The larvæ appear to be liberated by the rudimentary segmental organs. It seems to be a case of what Chun has called "dissogony."

Structure of an Australian Land-Leech.†—Miss Ada M. Lambert gives a careful account of a species which Blanchard has named *Philæmon pungens.* It bears more resemblance to *Hæmadipsa* than to any other genus of Gnathobdellidæ. It possesses five pairs of eyes, a point in common with *Mesobdella*, but differing from *Xerobdella.* It differs, however, from all three genera in having only two tooth-plates.

Histology of Rhynchobdellidæ.‡—Herr Emil Bayer, in the course of his researches on the anatomy and development of these leeches, has made some observations on the hypodermis, sense-organs, and skin-glands. He finds that the cells of the hypodermis show a distinct division into two regions, an inner filled with granular protoplasm, and an outer which shows vertical fibrillation. The fibrillation is apparently the result of a modification of the protoplasmic network, and is associated with the development of a cuticle. It is comparable to a similar structure in the epidermal cells of *Gordius.* As to the sense-organs, the cup-shaped organs in the Rhynchobdellidæ are scattered irregularly over the whole surface of the body. There are also hitherto undescribed sense-organs of very remarkable structure in the Rhynchobdellidæ, notably in *Glossosiphonia sexoculata.* In this species the sense-organs may be seen under slight magnification as little cones scattered over the dorsal surface. Each consists of two cells; the outer, the sense-cell proper, is a modified hypodermis cell with a large nucleus, and ending in exceedingly fine cilia which penetrate the cuticle. The lower cell is a muscle-cell, capable by its contraction of acting on the sense-cell so as to telescope this within itself. It is divided into an upper transversely striated region and a lower clear area containing the nucleus. These remarkable sense-organs are described in detail, the description being illustrated by admirable figures. They are apparently tactile organs, and their position and number are associated with the habits of the species. The paper ends with some account of the hypodermal and sub-hypodermal glands, which are chiefly distinguished from one another by the degeneration of the nucleus in the former.

* Comptes Rendus, cxxvii. (1898) pp. 486–9.
† Proc. R. Soc. Victoria, x. (1898) pp. 211–35 (5 pls. and 5 figs.).
‡ Zeitschr. f. wiss. Zool., lxiv. (1898) pp. 648–96 (3 pls. and 10 figs.).

New Species of Pristina.*—Dr. A. Garbini describes *Pristina affinis* sp. n., nearly allied to Beddard's *P. proboscidea*. He found the Oligochæte in studying *Utricularia neglecta* which sometimes captures it. The proboscis (prostomium) is very long, almost cylindrical, and very delicate and mobile.

Abyssal Sipunculids.†—M. Louis Roule makes a preliminary note on the Sipunculids collected by the 'Travailleur' and 'Talisman' from depths of 958 to 4255 m. in the Atlantic, off Spain, Morocco, and Senegal. Two genera were represented in the collection,—*Phallosoma* Levinsen, nearly related to *Sipunculus*, and *Phascolosoma*. In regard to the latter in particular, the author expresses his strong doubt as to the value of specific distinctions previously suggested. It appears to him to be a very plastic type with numerous local varieties connected by transition-forms.

South African Gephyreans.‡—Dr. C. Ph. Sluiter gives an account of the Gephyreans obtained by Prof. Weber in Africa; the collection contained six species only. The greater part of the paper is taken up by a description of a Malay form previously described by the author § as *Sipunculus indicus* Peters, but now formed into a new species as *S. discrepans*. The two species differ in several points, notably in the minute structure of the skin, which is described and figured in both.

Rotatoria.

Rotatoria of the Basin of the Lake of Geneva.||—Dr. E. F. Weber publishes the first part of what promises to be a very valuable contribution to the rotatorial fauna of Switzerland. This first part contains a descriptive list, with synonyms and bibliography, of 17 Rhizota and 18 Bdelloida so far found by the author in this district, and every species is illustrated with excellent original and coloured drawings. One species, *Callidina brycei*, is described as new.

New Rotifer, Monostyla appendiculata.¶—Mr. A. Skorikow of Charkow, figures in outline and describes as new this rotifer which he found in an inland salt-water lake in Russia. Unfortunately, this new species was already figured and described by Dr. E. von Daday in 1893, under the name *Monostyla lamellata*, from salt-water lakes in Hungary.

Nematohelminthes.

Introduction to Study of Nematode Parasites.**—Mr. N. A. Cobb has made a laudable attempt to popularise the study of nematode parasites which he has already greatly advanced. After a description of methods of observation, he gives a general account of the structure and functions, most liberally illustrated. Eight new genera are proposed;

* Zool. Anzeig., xxi. (1898) pp. 562–4 (1 fig.).
† Comptes Rendus, cxxvii. (1898) pp. 197–9.
‡ Zool. Jahrb. (Abth. Syst.), xi. (1898) pp. 442–50 (2 figs.).
§ Naturk. Tijdschr. Nederl. Indië, v. p. 475.
|| Rev. Suisse de Zool., v. (1898) pp. 263–354.
¶ Zool. Anzeig., 1898, p. 556 (1 fig.).
** Extract from MS. Report on the Parasites of Stock, Dep. of Agric. N.S.W., Miscellaneous Publication, No. 215, Sydney, 1898, 62 pp. and 129 figs.

but in spite of the author's apology, we regard it as unfortunate that these should be mixed up with a very useful introduction.

New Species of Gordiacea.*—Dr. Thos. H. Montgomery describes two new species of *Chordodes*, one *Ch. furnessi* from Borneo, and the other *Ch. albibarbatus* from Africa. The first was found in two species of *Mantis*, and is especially characterised by the presence of tubercles in pairs. The other species is distinguished by the tufts of white hairs on its cuticle; both sexes are known, and the male and female differ from one another in several respects.

Filaria and Spiroptera.†—Dr. M. Stossich gives a monographic account of the numerous species belonging to these and related genera. He deals with 212 species of *Filaria*, 89 species of *Spiroptera*, and several species of *Oxyspirura*, *Filaroides*, *Spiroxys*, and *Gongylonema*. A list of 489 hosts with their various *Filaria*-parasites is given.

In a previous paper ‡ he continues his miscellaneous Helminthological Notes.

Platyhelminthes.

Structure of Tænia confusa Ward.§—Mr. M. F. Guyer has made a detailed study of this new species of human tape-worm. There is unfortunately some doubt with regard to the head, but the other organs of the body are described in detail, and are contrasted with those of *T. saginata* and *T. solium*.

Stichocotyle Nephropis.‖—Herr T. Odhner has succeeded in finding the sexual form of this Trematode, whose larval form was described in 1884 by Mr. J. T. Cunningham from the gut of *Nephrops norvegicus*, and afterwards (1895) by Nickerson from the American lobster. The adult was found in the biliary ducts of the liver of *Raja clavata*, but doubtless occurs in other species. It is distinct from *Macraspis elegans* Olsson, to which Monticelli (1892) referred the larva; but a more precise statement as to its affinities is reserved.

Anatomy and Histology of Nemertines.¶—Dr. Ludwig Böhmig has recently refound the little fresh-water Nemertine formerly described by him as *Tetrastemma græcense*, and has also obtained more specimens of the terrestrial form described by von Graff as *Geonemertes chalicophora*, and has subjected both forms to a thorough histological examination. He has in the first place emended *Tetrastemma græcense* (Böhmig) to *Stichostemma græcense* (Böhmig), and has modified the diagnosis of von Graff's species, notably by showing that the sexes are separate and the male unknown. The remainder of the paper is devoted to the anatomy and histology of the two species; a few of the more general points only can be noted here. The observations show that, as stated by Bürger, a body-cavity is absent in the adult; it is however possible that it exists in the young forms and is filled up by the intercellular substance secreted by the connective-tissue cells. Both of

* Zool. Jahrb. (Abth. Syst.), xi. (1898) pp. 379-84, 493-96 (3 pls.).
† Boll. Soc. Adriat. Sci. Nat., xviii. (1898) pp. 13-162.
‡ Tom. cit., pp. 1-10 (2 pls.).
§ Zool. Jahrb. (Abth. Syst.), xi. (1898) pp. 469-92 (1 pl.).
‖ Zool. Anzeig., xxi. (1898) pp. 509-13.
¶ Zeitschr. f. wiss. Zool., lxiv. (1898) pp. 479-564 (5 pls. and 1 fig.).

the forms investigated have a complex excretory system. In *Stichostemma græcense* there was found to be only one pair of nephridia in small specimens, while the larger had sometimes eight at one side of the body and nine at the other. The nephridial tubules formed a fine network through the body, the fine branches ending internally in well defined "flame-cells." A similarly complicated nephridial system was found in *Geonemertes*, where ten excretory pores were counted on either side of the body. During the course of his detailed observations on the gland-cells of the cerebral organ of *Stichostemma*, the author came to the conclusion that the disappearance of the nucleolus from an actively secreting cell shows that it is a reserve from which new chromatin may be manufactured.

Incertæ Sedis.

Larval Development of Cheilostomata.* —M. Louis Calvet has studied this in numerous species, e.g. of *Bugula*, *Scrupocellaria*, *Flustra*, and *Lepralia*. A blastula with a reduced blastocœle is followed by an epibolic gastrula, in which four initial endoderm cells enter the segmentation cavity. The endoderm retains its primitive character through the whole of the larval development; the mesoderm is not differentiated until shortly before hatching. In the larvæ of the viviparous species there is a neuro-muscular system quite comparable to that of *Cyphonautes compressus* and the larvæ of Ctenostomata (Flustrellidæ, Alcyonididæ), but there is no digestive tube. A "mesodermic thickening" occurs similar to that which Prouho has described in Ctenostomata.

Origin of Polypide in Marine Ectoprocta.†—M. Louis Calvet has studied the much-discussed origin of the polypide in the oozoids, young blastozoids, and adult blastozoids, of numerous species.

Only in the oozoids does the polypide arise as an invagination of the zoœcial walls. In other cases the polypide begins as a solid mass, which secondarily becomes diploblastic and hollow. Only in the oozoid's polypide are there elements representing the three germinal layers. In the blastozoids, the polypide has a mesenchymatous origin, from elements which in the young blastozoids are derived from the ectodermic epithelium, and in the adult blastozoids from the funicular tissue. In these cases, therefore, the differentiation of the three germinal layers is not recognisable.

Echinoderma.

Amputation of Disc-covering in Ophiurids.‡—Dr. C. Ph. Sluiter begins an interesting note by referring to Prof. Jeffrey Bell's description of a remarkable ophiurid from Brazil (1888) in which the covering of the disc was lost, and the dorsal surfaces of the most proximal arm-joints were strangely affected. Sluiter believes that this form was probably identical with or nearly allied to *Amphiura grisea* Lym. But he is more concerned with the occurrence of a similar loss of the disc-covering in *Ophiocnida echinata* Ljn. (Lym.), in which he suspects that a normal amputation occurs periodically, probably in connection with reproduction. It is also suggested that the covering of the disc and the genital organs are regenerated after the reproductive season.

* Comptes Rendus, cxxvii. (1898) pp. 79–81. † Tom. cit., pp. 194–7.
‡ Tijdschr. Nederland. Dierk. Ver., v. (1898) pp. 303–10 (2 figs.).

Cœlentera.

Arctic Hydromedusæ.*—Gösta Grönberg gives a list of 41 species which have been found in the Arctic region, and describes two new forms, *Sarsia brachygaster* sp. n., and *Solmundus glacialis* sp. n., besides others already more or less satisfactorily diagnosed.

New Actinarian.†—Mr. E. L. Mark describes a very remarkable new form found during the 'Albatross' expedition, which he regards as a sea-anemone possibly allied to *Cerianthus*, and calls *Branchiocerianthus urceolus*. The disc is oval and much higher at one end than at the other, the marginal tentacles 85–97 in number, and arranged in the form of a horseshoe. The oral tube rises above the level of the disc, and is surrounded by numerous (about 130) oral tentacles. Between this tube and the marginal tentacles are a varying number (21–37) of paired branched organs, called by the author "gills." The column resembles that of *Cerianthus*, and its lower bulb-shaped termination is invested by a complex sheath. The description is preliminary only.

Alcyonaria from Spitzbergen.‡—Herr Walther May describes the Alcyonaria found by Kükenthal and Walther off the east coast of Spitzbergen. They all fall into Kükenthal's genus *Paraspongodes*, which includes most of the new genera founded by Danielssen. The genus is defined by the following characters:—Nephthyidæ without supporting fasciculi, the polypes single or united in clusters. The specimens include six species, of which two are new. Full details as to distribution are given, an interesting point being that the species are cold-water animals, and the depth at which they live is determined apparently by temperature only. Thus *Paraspongodes fruticosa* occurs on the west coast at a depth of 600 fathoms, but on the east in 52 fathoms, this being apparently due to warm and cold currents respectively.

Structure of Xenia.§—Mr. J. H. Ashworth has a note on certain points in the anatomy of a species of the Alcyonarian *Xenia*. In this species the six short mesenteric filaments of most Alcyonarians are absent, but the stomodæum contains secreting "goblet-cells," which probably perform the digestive function usually discharged by the cells of the filaments. Certain of the endoderm-cells are remarkable in that they are each furnished with a long pseudopodium, which may be from four to eight times the length of the cell.

Porifera.

Calcareous Sponges.‖—Mr. G. P. Bidder discusses certaint points connected with the skeleton and classification of these sponges. He believes that in the formation of spicules too little stress has been laid upon tension as an important factor, and differs from Minchin in believing that the explanation of the exact geometrical figure of any spicule is to be sought in crystallography rather than in physiology. "The angles of a triradiate calcareous spicule are dictated by the properties

* Zool. Jahrb. (Abth. Syst.), xi. (1898) pp. 451–68 (1 pl.).
† Bull. Mus. Comp. Zool., xxxii. (1898) pp. 147–54 (3 pls.).
‡ Zool. Jahrb. (Abth. Syst.), xi. (1898) pp. 385–404 (1 pl.).
§ Proc. Roy. Soc. Lond., lxiii. (1898) pp. 443–6 (3 figs.).
‖ Op. cit., lxiv. (1898) pp. 61–76 (10 figs.).

of calcite, and, within a considerable range, would appear neither to influence nor be influenced by selective mortality in the species among which it occurs." The position is elaborated in considerable detail.

In the second part of the paper the author criticises the classification of sponges according as they are homocœl or heterocœl, and, without prejudging the question as to whether there is or is not a natural class Calcarea, he proposes to establish two sub-classes—(1) Calcaronea, and (2) Calinea. These sub-classes are mainly based on the two points already noticed by Minchin, that in the first division the nucleus of the collar-cells and of the flagellate cells of the larva is distal, and the flagellum arises from it directly, while in the second the flagellum does not arise directly from the nucleus, which is basal; and that in the first case the larva is an amphiblastula, in the second a parenchymula. The two sub-classes are also characterised by their spicules, the first to appear in the one case being oxea, and in the second triradiates. Detailed diagnoses are given of the sub-classes and their orders, and in some cases also of the families.

Calcareous Sponges from the White Sea.*—Herr L. L. Breitfuss describes a collection from the White Sea and from the Murman or Barent Sea. Altogether there are 41 Arctic species on record,—15 Asconidæ, 20 Syconidæ, and 6 Leuconiidæ, and there seems to be great uniformity in the circumpolar distribution.

Protozoa.

Deep-water Deposits from the Red Sea.†—Dr. E. Gräffe describes the composition of the ooze from depths of 1000 m. or more in the Red Sea. It may be described as midway between Globigerina- and Pteropod-ooze. The list includes a large number of Foraminifera, 2 Radiolarians, 13 Pteropods, and 2 Heteropods.

Classification of Ciliata.‡—Dr. V. Sterki maintains that the Peritricha are quite distinct from all the other Ciliata, which he terms Pantotricha. He subdivides the Pantotricha into Gymnostomata and Trichostomata (em.), and recognises three orders of Trichostomata, viz. Aspirotricha, Oligotricha (em.), and Zonotricha.

Licnophora.§—Sig. A. Garbini gives a short description of *Licnophora europæa* sp. n. from fresh water at Verona. A similar form (*L. setifera*) was described from fresh water in New Zealand by Maskell (1886), but Bütschli doubted its validity, which Garbini now confirms. His discovery is a remarkable Protozoon, very contractile, and Protean in form. The posterior region is irregularly rectangular, and bears two groups of minute setæ; the anterior region forms a right angle to the posterior part, and is covered with short cilia. The terminal oral aperture is surrounded by numerous long cilia.

Luminosity of Ceratium tripos.‖—Herr J. Reinke states that the luminosity of this marine organism may be incited by a variety of

* Mém. Acad. Imp. St. Pétersbg., vi. (1898) p. 41 (4 pls.).

† SB. K. Akad. Wiss. Wien, cvi. (1897) pp. 431–8.

‡ Amer. Natural., xxxii. (1898) pp. 425–8.

§ Zool. Anzeig., xxi. (1898) pp. 513–4 (2 figs.).

‖ Wiss. Meeresunters. v. d. Comm. z. Unters. d. deutschen Meere in Kiel, N.F., iii. p. 39. See Bot. Ztg., lvi. (1898) 2te Abth., p. 282.

mechanical agencies, as also by warmth, though there is an optimum temperature, above and below which the phenomenon is not exhibited. Various foreign substances—alcohol, iodine, sulphuric acid, in moderate concentration—produce the luminosity. Electric irritation gave no definite results.

A New Gregarine.*—MM. Maurice Caullery and Félix Mesnil describe, under the name of *Gonospora longissima*, a new cœlomic Gregarine, found in the epitokous form of *Dodecaceria concharum* Œrst., and exhibiting several interesting peculiarities. It resembles the other members of the genus in being short when young; but the adults are long filaments, 1–2 cm. in length. The life-history of the parasite progresses along parallel lines with that of the host. At the sexual maturity of the latter, the Gregarine forms its spores, and the cysts are liberated by the nephridia with the genital products. The spores hatch in the alimentary canal of the new host, and the young penetrate into the intestinal cells. The remarkable point, however, is that in these cells the young Gregarines undergo endogenous multiplication, and it is these secondarily produced forms or sporozoites which reach the cœlom of the host. This process of self-infection of the host has not been previously described in Gregarinida, and is of interest because it has already been shown to exist in the Coccidea.

Hæmatozoon of Goitre.†—Dr. E. Grasset points out the parallelism between goitre and paludism; each has a peculiar geographical distribution; each is associated with the enlargement of an organ of internal secretion (thyroid and spleen); each may reach an extreme in a cachexia; and each has an associated Hæmatozoon. Laveran has described the hæmatozoa of paludism; Grasset has found similar forms in the blood of recently infected goitre patients. The bodies are spherical and non-nucleated, with brick-red pigment; another form is a "free flagellum"; in others there are numerous agglomerated segments. More details must of course be forthcoming.

Exosporidium marinum.‡—M. René Sand describes this new parasite found on the legs of an Acarid common among seaweed. Its membrane, ectoplasm, granules, sluggish movements, and hints of spore-formation, suggest a Gregarine; and the observer places it provisionally beside *Amœbidium parasiticum* described by Cienkowski.

* Ann. Microgr., x. (1898) pp. 152-5.
† Comptes Rendus, cxxvii. (1898) pp. 75-7 (10 figs.).
‡ Bull. Soc. Belge Micr., xxiv. (1898) pp. 116-9.

BOTANY.

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

a. Anatomy.

(1) Cell-Structure and Protoplasm.

Form of the Cell-nucleus.*—In a paper on the Physiology of the Cell-nucleus, Dr. F. G. Kohl sets down the normal form of the nucleus in young protoplasmic cells as spherical or elliptical. But subsequently its form may undergo very great change; as in the elongated vermiform nuclei of the parenchymatous cells in the vascular bundles of *Allium Porrum*, the cells of the hairs of *Tradescantia*, &c., where the length of the nucleus may be fifty times its breadth. In the endosperm-cells of *Zea Mays* the nuclei are peculiar branched filiform bodies which fill up the spaces between the starch-grains. In the epidermal cells of *Hyacinthus orientalis* the nuclei are pointed at both ends, as also are those of the epidermal cells of the leaf of *Ornithogalum umbellatum*, and those of the hairs on the leaf-stalk of *Pelargonium zonale*. In cells with living protoplasm endowed with motility the author was, in some cases, able to see a slow change of form, when the outline was observed at intervals of 20, 30, or 40 minutes. Amœboid motions, similar to those of the nucleus of animal cells, were also observed in some instances, connected probably with the absorption of nutriment by the nucleus. This had apparently not been observed before in vegetable cells enclosed in a cell-wall.

Streaming of Protoplasm.†—From observations made on the hairs on the flower of the common gourd, Herr M. Heidenhain contests the ordinary statement that solid particles (granules) are passively carried along in protoplasm-currents. The "streaming" of the granules is a phenomenon quite distinct from the local movement of masses of protoplasm, though the two kinds of motion may concur. The movement of the granules may, however, take place equally when the mass of protoplasm is at rest.

Chromatolysis of the Nucleus.‡—From a study chiefly of the muciferous idioblasts of *Opuntia*, Dr. B. Longo comes to conclusions in several points opposed to those of Cavara. He maintains that the phenomenon of chromatolysis does not occur in normal nuclei; that the nucleoles are composed of a single substance, and not of a central substance (plastin of Zacharias, pyrenin of Schwartz, representing, according to Cavara, the nucleole properly so called), and of a peripheral substance representing the chromatin; that the "nucleole properly so called" of Cavara is nothing but a vacuole; that the nucleoles are perfectly homogeneous, vacuolated, but not alveolated. He concludes that at present we know nothing of the true function of the nucleoles.

* SB. 69. Versam. Deutsch. Naturf. u. Aerzte, Braunschweig, 1897. See Bot. Centralbl., lxxii. (1897) p. 168.

† SB. Phys.-med. Gesell. Würzburg, 1897 (1898) pp. 116–39.

‡ Atti r. Accad. Lincei, vii. (1898) pp. 282–90. Cf. this Journal, *ante*, p. 549.

Plasmolysis and the Protoplasmic Membrane.*—Prof. R. Chodat and M. A. M. Boubier have made experiments on plasmolysis in a number of plants belonging to various classes of Cryptogams (Algæ, Muscineæ, fern-prothallia), as well as on flowering plants. The following is a summary of the conclusions arrived at.

In isolated cells the plasmolysed protoplasm does not become completely detached from the cell-wall; it remains for a time connected with it by more or less numerous threads of ectoplasm. These threads have no connection with the filaments of protoplasm which pass through the cell-wall. Their formation is explained by the viscid consistence of the ectoplasm, and by the fact that the limiting layer of the protoplasm passes insensibly into the cell-wall, and may give rise, by apposition, to new layers. The adhesion of the ectoplasm to the cell-wall partly explains its passivity in the protoplasmic movement. The ectoplasmic layer (parietal utricle) cannot be regarded, as some authors have done, as a sharply differentiated structure, a distinct organ. In many gelatinous Algæ it passes insensibly into the cell-wall; while it is also continuous with the granular protoplasm, to which it adheres more strongly than to the cell-wall.

Structure of the Cell-wall.†—Prof. E. Strasburger gives the result of fresh researches, especially on the following points:—The formation of the division-walls in the pollen-mother-cells of *Lilium* and *Alstroemeria*; the formation of a membrane round isolated protoplasm-balls in *Vaucheria*; the formation of the beams of cellulose in *Caulerpa*; the formation of sacs in the epiderm of the seeds of *Cuphea*; the formation of the massulæ-chambers and glochids in *Azolla*; the development of the extine of pollen-grains of *Knautia* and *Althæa*; the stratification of the pith-cells in the stem of *Clematis*. The following are the results already attained.

The materials of the cell-wall are products of the protoplasm. They are either excreted on the surface of the protoplasts (division-walls in pollen-mother-cells of *Lilium*, &c., protoplasm-balls of *Vaucheria*), or they remain in the interior of the protoplasts, and there undergo a variety of changes (beams of *Caulerpa*). In many cases (massulæ of *Azolla*) a definite mass of protoplasm is completely transformed into cellulose, the material for the formation of cellulose being apparently a product of the splitting up of cytoplasm. The cell-walls increase in superficies by passive traction and simultaneous apposition of new lamellæ, or by active intussusception. Their increase in thickness in tissues is generally effected by the apposition of new lamellæ, which do not further increase in thickness by active intussusception, but undergo changes by passive infiltration and incrustation. In certain cases, especially in isolated cells, a secondary increase in thickness of the lamellæ takes place by active intussusception, often accompanied by striking changes in form (extine of the pollen-grains of *Althæa* and *Knautia*). Both apposition and intussusception therefore take part, separately or combined, in the increase in thickness of the cell-wall.

Instead of the terms kinoplasm and trophoplasm for constituents of the cell, Strasburger proposes *filarplasm* and *alveolarplasm*. The secon-

* Journ. de Bot. (Morot), xii. (1898) pp. 118–31 (1 pl.).

† Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxi. (1898) pp. 511–98 (2 pls.).

dary increase in thickness of the extine of the pollen-grains of *Althæa* and *Knautia* is attributed to a secondary imbibition of living protoplasm rather than to the original presence of protoplasm. In these pollen-grains the extine is double, the two layers being separated by a rod-layer (*Stäbchenschicht*); the rods are free, but the spaces between them may be filled by soluble pigments. Similar "rod-layers" unite also the more strongly refractive layers of the membranes of the pith-cells in *Clematis*, and possibly occur in all stratified membranes. The author finds that the thick-walled strongly lignified pith-cells of *Clematis* are still capable of division.

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

Active Albumin in Reserve-material.*—Out of 48 species of trees examined, M. U. Suzuki finds, in 25, active albumin in the cortex, and more abundantly in the cortex than in the buds. He concludes that active albumin acts as a reserve-material, being stored up in the winter and used up in the spring in the formation of the buds.

Spheroids and Crystalloids in Phytolacca.†—Herr O. Kruch describes these structures especially in the apex of the leaf of *P. icosandra*, which runs out to a sharp leathery yellowish point, and in other species. They are large round usually colourless strongly refringent structures, and occupy a large space in the protoplasts. They are usually homogeneous, but sometimes contain one or more vacuole-like cavities. Similar structures were observed in the apex of the leaves of *P. abyssinica*, where there is either one in each cell in the neighbourhood of the nucleus, or a number of small ones, often united into clusters.

Tannin-like Drops in the Cell-sap of the Leaves of Bromeliaceæ.‡—In the parenchyme-sheath of the vascular bundles of the leaves of *Billbergia amœna*, Dr. G. S. Wallin finds peculiar very refringent yellow to yellow-green or yellow-brown drops in the cell-sap of all the cells. In each cell is usually one relatively large (16–18 μ) or several smaller drops. The micro-chemical reactions are given, which determine these drops to be neither of a resinous nor of an oily, but of a tannin-like character. They are nearly or quite insoluble in the cell-sap, in which respect they differ from similar bodies in the Scrophulariaceæ, which are partially soluble. The presence of this substance is usually limited to the bundle-sheaths; it was found in all species of Bromeliaceæ examined, and appears to be peculiar to that order. It is probably an excretion product.

Distribution of Glutamin in Plants.§ — According to Herr E. Schulze, asparagin is frequently replaced by glutamin as the soluble nitrogenous food-material of plants. It was found in 22 species belonging to 10 different families, among others *Lepidium sativum*, *Raphanus sativus*, *Camelina sativa*, *Spergula arvensis*, *Spinacia glabra*, and *Picea*

* Bull. Imp. Univ. Tokio, iii. (1897) p. 253. See Bot. Centralbl., lxxv. (1898) p. 199.

† Ann. R. Ist. Bot. Roma, vii., 12 pp. and 1 pl. See Bot. Centralbl., lxxv. (1898) p. 127.

‡ Bot. Centralbl., lxxv. (1898) pp. 323–6.

§ Landwirth. Versuchs-Stat., 1898, p. 442. See Bot. Centralbl., lxxv. (1898) p. 200.

excelsa. It occurs specially frequently in the Cruciferæ; the largest proportion being 2·5 per cent. of the dried substance. In all cases where glutamin has at present been found, the seeds contain abundance of oil, though the seedlings from some oily seeds (poppy, *Tropæolum*, pine) contain asparagin and not glutamin.

Structure of Starch-grains.*—From the minute study of starch-grains obtained from a variety of different plants, Herr J. H. Salter comes to the following general conclusions. In all stages of its growth the starch-grain is sharply differentiated from the plastid in which it is formed; its substance is excreted, and is not produced by gradual transformation of successive layers of protoplasm. Staining experiments show that the stratified appearance of starch-grains is the result essentially of variations in density, i. e. in the capacity for absorption of the different layers. All growing starch-grains appear to have a denser margin which is not stratified. The lamellæ attain their final differentiation only when they are covered by those formed later. A progressive, but not uniform, decrease in density may be detected, advancing from the margin to the nucleus of the grain. Observation of grains in process of solution renders it probable that changes may in some cases take place in the surface of the grain from the action of a ferment. The relation of the plastid to the starch-grain in process of solution appears in some cases to confirm Meyer's view that the ferment is excreted by the chromatophore. As regards the inner structure of the starch-grain, all the phenomena lead to the conclusion that each lamella, or at least, each watery lamella, consists of a series of elements deposited radially.

Arsenic in Plants.†—Herr J. Stoklasa reports the results of a careful series of observations on the presence of arsenic in the vegetable kingdom, and on its poisonous effects on plants. He states that arsenious and arsenic acids are both highly poisonous to plants, even in excessively minute quantities, and that arsenic acid is not able to replace phosphoric, as has been stated. Arsenic is, however, a very widely diffused element, especially in association with sulphuric acid; in superphosphates it may even be present to the extent of 0·3 per cent.; but its presence in the form of $As(OH)_3$ or $AsO(OH)_3$ is not injurious to vegetation unless it exceeds 0·4 per cent.

Ferment in Barley.‡—MM. E. Bourquelot and H. Herissey find, in germinating barley-seeds, in addition to amylase and trehalase, a soluble ferment which has a special action on pectin.

Raphids in Monocotyledons.§—Mr. J. Parkin describes the presence, in certain genera of Liliaceæ and Amaryllideæ, of raphid-cells intermediate between those of ordinary structure in which a bundle lies in the centre of the cell surrounded by a mucilage-sheath, and those of *Iris*, in which each crystal-sac contains a large acicular crystal, and has a nucleus and protoplasm, but no mucilage. The raphids in question were observed in *Funkia ovata*, *Convallaria majalis*, *Phormium tenax*, *Tritoma*

* Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxii. (1898) pp. 117–66 (2 pls.).
† Zeitschr. f. d. landwirtsch. Vers. in Oesterreich, 1898, p. 154. See Bot. Centralbl., lxxv. (1898) p. 304.
‡ Comptes Rendus, cxxvii. (1898) pp. 191–4. Cf. this Journal, *ante*, p. 218.
§ Ann. of Bot., xii. (1898) pp. 147–51 (1 pl.).

Uvaria, and *Polianthes tuberosa*. The individual crystals are fewer and larger than in an ordinary bundle, and are destitute of a mucilage-sheath.

Coagulation of Latex.*—Mr. R. H. Biffen describes the mode of coagulating the latex in several species of rubber-producing plants, and the evidence afforded of the existence of a proteid constituent, whether acid or alkaline, as well as of globulins, albumoses, and peptone.

Reserve-Material in Deciduous Trees.†—Mr. E. M. Wilcox gives a preliminary account of his researches into the changes which occur during the dormant period in the reserves of trees. He has studied the changes from October to March in about twenty-five species of trees, and finds there is a general movement of the starch from the peripheral to the deep-seated portions of the stem in winter, and a reversal of the process in spring.

(3) Structure of Tissues.

Comparative Anatomy of the Cycadeæ.‡—Mr. W. C. Worsdell gives the following as the general results of his study of the comparative anatomy of certain genera of Cycadeæ.

"In *Cycas* the conduplicate vernation and arrangement of the bundles in the fleshy hypogæal cotyledons, the secondary extrafascicular rings, the concentric cortical strands, and, in one species, the peculiar concentric structure of the leaf-traces in the stem, and in the hypocotyl some curious concentric strands running obliquely out from the cylinder, and in a small seedling, the secondary vascular cylinders lying outside the normal stele; in the seedling of *Stangeria paradoxa* the small primary concentric bundles in the stalk common to the two cotyledons, which, both higher up and lower down, become collateral, and in the adult stem the occurrence of a secondary concentric strand in the periphery of the cortex; and, in *Ceratozamia mexicana*, the vertical succession through the pith of a large stem of effete peduncular cylinders, the peduncles which occasionally terminate the stem being in turn pushed to one side and their basal region enclosed by a lateral shoot which continues the main vegetative axis."

From these characters the author draws the conclusion that the Cycadeæ are nearly allied to certain fossil fern-like plants, notably the Medullosæ. The species examined were *Cycas revoluta*, *C. media*, *Macrozamia spiralis*, *Ceratozamia mexicana*, and *Stangeria paradoxa*.

Anatomy of the Hemp §—Sigg. G. Briosi and F. Tognini describe in great detail the structure of the vegetative organs of *Cannabis sativa*. Among the more important points brought out are the following. In the stem there was found, in the interior of the xylem portion of the vascular bundles, a string of phloem-tissue, not containing any sieve-tubes, which they call "internal pseudo-liber" and regard as a retrogressive or undifferentiated phloem. In the root the results obtained by the authors differ somewhat from those of Van Tieghem and Douliot. In the

* Ann. of Bot., xii. (1898) pp. 165–71.
† Amer. Journ. Sci., vi. (1898) pp. 69–74.
‡ Journ. Linn. Soc. (Bot.), xxxiii. (1898) pp. 437–57 (1 pl.).
§ Atti Ist. Bot. Univ. Pavia, iv., 175 pp. and 26 pls. See Bot. Centralbl., 1898, Beih., p. 27.

meristem of the root the periblem arises from two initial layers. There is no pericycle in the upper part of the hypocotyl or in the stem. The xylem-bundles of the root are perfectly continuous with those in the stem; the passage from the centripetal to the centrifugal arrangement takes place without torsion. The fibres of the hemp are always more or less fusiform, and have often spathulate, curved or wart-like ends, but are never branched.

Wood of Pomeæ.*—Dr. A. Burgerstein has continued his investigations of the structure of the wood in several genera of this family. He states that, in the development of the histological elements of the secondary xylem, there is only a gradual differentiation, and that transitions occur in all directions. The medullary rays consist, with some exceptions, of only one or two rows of cells, or partially of three. Several genera exhibit diagnostic characters in the structure of the wood.

Absciss-layer in the Leaves of Monocotyledons.†—In the leaves of *Narcissus*, *Galanthus*, and *Leucojum*, Mr. J. Parkin has observed the formation of a layer of cells with corky walls which cause the detachment of the leaf from its tunicate base. Some time before the leaves turn yellow, certain of the parenchymatous cells situated a little above the tunicate base of the foliage-leaf become meristematic, and divide to form a zone of narrow cells with conspicuous nuclei and abundant protoplasm.

Resin-galls of the Abietineæ.‡—Herr P. Nottberg discusses in detail the formation of masses of resin between the wood and bark in pine-stems. Their formation is always the result of the energy of the cambium in repairing an injury. Immediately after their formation the cells of this pathological parenchyme begin to form resin internally; but whether the resinogenous layer arises from the cell-wall or from the protoplasm is uncertain. The resin-passages of the duramen are always closed by thyllæ, thus preventing any external communication through injury to the alburnum. In the silver-fir (*Edeltanne*), which does not normally produce secretion-receptacles, resin-passages are formed as the result of injury.

(4) Structure of Organs.

Influence of Carbon dioxide on the Form and Structure of Plants.§—M. E. C. Téodoresco compares the effect on the form and structure of plants (*Lupinus albus*, *Phaseolus multiflorus*, *Pisum sativum*, *Faba vulgaris*) of an atmosphere containing a larger amount of carbon dioxide than ordinary atmosphere, with one deprived as far as possible of that gas. He finds that in the former case the plants have their hypocotyl or their first internodes shorter, but the following internodes longer, the total length of the stem being usually greater. As a rule, the internodes have in the former case a larger diameter, the number of vascular bundles being also often greater; in each bundle the xylem, the phloem, and the generating zone (cambium), are also more fully

* SB. k. Akad. Wiss. Wien, cvii. (1898) pp. 8–22. Cf. this Journal, 1897, p. 546.
† Ann. of Bot., xii. (1898) pp. 151–3 (2 figs.).
‡ Zeitschr. f. Pflanzenkrankheiten, vii. (1897) pp. 181 *et seq.* (1 pl. and figs.). See Bot. Centralbl., lxxv. (1898) p. 209.
§ Comptes Rendus, cxxvii. (1898) pp. 335–8.

developed; the leaves are thicker; the cells of the palisade-tissue more elongated, and the air-chambers larger.

Male Organs of Gymnosperms.*—M. Thibaut calls attention to the difference in structure between the male organs of the Coniferæ and Cycadeæ on the one hand and those of the Gnetaceæ on the other hand.

In the Cycadeæ the stamen consists of a scale which bears the pollen-sacs on its under side. The scale or vegetative portion of the stamen is large and well developed. It consists of one or two much-branched vascular bundles, an epiderm with a strongly developed cuticle, and a dense layer of fibres and sclerites, deposits of tannin and calcium oxalate, and secretion-canals. The pollen-sacs have a septum formed either of a single layer of epidermal cells or of a layer of hypodermal fibres. The epiderm, which represents the elastic zone of the septum, is distinguished from the epiderm of the rest of the stamen only by a stronger development of its cuticular layers and by the lignification of its lower region. Its cell-walls are strongly thickened on their lateral sides.

The same type occurs, with more or less variation, in all Conifers, the variations depending mainly on the degree of reduction of the scale and on the diminution in size of the pollen-sacs. In the Araucarieæ, Taxodieæ, and Cupressineæ, the pollen-sacs are obviously on the lower [upper in *Bot. Centr.*] side of the scale, in other Coniferæ they exhibit a tendency to become depressed. As the vegetative portion of the stamen becomes reduced in size, it exhibits also a simplification in structure, while that of the pollen-sac becomes more and more complicated.

The Gnetaceæ, in contrast to the Cycadeæ and Coniferæ, possess perfect male flowers. The pollen-sacs are not placed on one side of a scale, but on the apex of so-called supports (staminophores). They open by a fissure at their apex. The epidermal cells have no thickening zone, but, on the other hand, curved septa; those of all the other Gymnosperms being flat.

Sporophyll of Cycadeæ.†—Mr. W. C. Worsdell has studied the vascular structure of the sporophyll in a number of species belonging to different genera of Cycadeæ. He finds, in the male sporophyll, a single vascular bundle leaving the cylinder of the axis of the cone, which, on entering the stalk of the sporophyll, divides into three. The bundles supplying the sporanges are much smaller in size than the similar ones on the female side. They also diverge less from the mesarch structure of those of the foliage leaf than do the bundles of the female sporophyll. In the female sporophyll two bundles leave the cylinder of the axis of the cone, usually dividing up in the cortex into a larger number, so that, as a rule, four bundles occur in the stalk of the sporophyll, of which the two lateral ones are much larger than the rest. The divergence from the ordinary mesarch structure of the foliage leaf is here much more marked. In the sterile portion of both kinds of sporophyll, i.e. in the part above the insertion of the sporanges, the mesarch structure of the bundle prevails. As compared with the bundles of the stalk, the centripetal is, as a rule, much more developed than the centri-

* 'Rech. s. l'appareil mâle d. Gymnospermes,' 225 pp. and 16 pls., Lille, 1896. See Bot. Centralbl., lxxv. (1898) p. 129.

† Ann. of Bot., xii. (1898) pp. 203–41 (2 pls.).

fugal xylem; while the phloem, which shares the development of the centrifugal xylem in the stalk, becomes reduced and insignificant.

From these facts Mr. Worsdell draws the conclusion that, in the Cycadeæ, the sporophyll is probably a more primitive organ than the foliage leaf.

Composition of Pollen.*—In the ash of the pollen of the pine, Herr E. Ramann finds the greatly preponderating substances to be salts of potassium and of phosphoric acid. After combustion he found in the ash 50·746 per cent. of potassa, and 39·086 per cent. of phosphoric acid, the remaining substances being present in much smaller quantities, viz. soda 1·958, lime 2·612, magnesia 2·518, manganese oxide 1·119, iron oxide 1·958 per cent., and a trace of silica. The dried substance contained, in 1000 parts, 24·15 of potassa, 18·59 of phosphoric acid, 4·81 of sulphuric acid, and 43·66 of nitrogen.

Protection of Fruit against Parasitic Fungi.†—Herr A. Zschokke describes the mode in which cultivated fruits, especially species of *Pyrus*, *Malus*, *Sorbus*, *Cydonia*, and *Mespilus*, as also *Cotoneaster*, are protected against the attacks of parasitic fungi, the chief of these being *Monilia fructigena*, *Botrytis cinerea*, *Penicillium glaucum*, *P. olivaceum*, *Mucor pyriformis*, and *M. stolonifer*. He states that none of these fungi can penetrate the uninjured cuticle. The stomates become very sparsely distributed by the growth of the fruit, and are ultimately transformed into lenticels. There is often a copious local or general formation of cork, as in the russet apple. Since it is very rarely that the epiderm is not locally injured, the chief protection against fungi is the chemical nature of the fruit itself, especially the abundance of tannin and malic acid in the peripheral layers of cells.

Fibrovascular Bundles of Leaves.‡—In completing his review of the connection between the number and symmetry of the vascular bundles in the petiole and the degree of organisation of the plant, M. A. Chatin points out that we have in these characters a further evidence of the low organisation of Monocotyledons as compared with Dicotyledons. There may be a single vascular bundle in the petiole, or 3, 5, 7, 9–11, or a larger number, but never a single compound bundle resulting from the fusion of several. This is clearly connected with the almost universal absence of a pinnate venation. The single vascular bundle of the stem is often almost entirely destitute of vessels. The parallel venation of most Monocotyledons implies an indefinite number of petiolar bundles, while the palmate or pinnate venation, so rare among Monocotyledons, implies a limited number of bundles in the petiole.

Hypertrophied Bud-Scales in Pinus.§—Mr. F. E. Lloyd has observed that, in lateral shoots produced by the pruning of staminate shoots in *Pinus ponderosa*, the small triangular scales which subtend the leaves

* Zeitschr. f. Forst. u. Jagdwesen, xxx. (1898) p. 105. See Bot. Ztg., lvi. (1898) 2te Abth., p. 233.

† Landwirth. Jahrb. d. Schweiz, xi. (1897) pp. 153–96 (2 pls.). See Bot. Centralbl., lxxv. (1898) p. 217.

‡ Comptes Rendus, cxxvii. (1898) pp. 301–7. Bull. Soc. Bot. de France, xlv. (1898) pp. 241–8, 310–7. Cf. this Journal, *ante*, p. 320.

§ Ann. N.Y. Acad. Sci., xi. (1898) pp. 45–51 (1 pl.).

had, by hypertrophy, become leaves in structure and function. They may be compared to similar normal structure in other conifers, and must be regarded as primitive atavistic structures such as occurred in *Leptostrobus*.

Aerial Roots of Tæniophyllum.*— According to Prof. J. Wiesner, the aerial roots of *Tæniophyllum Zollingeri*, a leafless epiphytic Javanese orchid, have a remarkably slow growth, compared to that of the bamboo as 1 to over 2000. They grow in a nearly vertical direction, flat against the stem of the tree, and do not display any geotropic curvature. They are negatively heliotropic and hyponastic, which enables them also to grow on horizontal surfaces. Their growth appears to be entirely suspended in the dark. The plant has a remarkably lichen-like habit, the roots apparently performing all the functions of nutrition.

Adaptation of Land-Plants to Existence in Water.†—Dr. R. Keller gives further illustrations of this phenomenon in the cases of *Myosotis Rehsteineri*, *Lythrum salicaria*, and *Ficaria verna*, describing the changes which take place in the external form and in the internal structure of the various organs.

β. Physiology.

(1) Reproduction and Embryology.

Fertilisation in Pinus.‡—Mr. V. H. Blackman gives an account of the cytological details and of the processes surrounding it, in *Pinus sylvestris*, from the formation of the ventral canal-cell to the period of cell-formation at the base of the egg.

As the oosphere nucleus, after separation of the nucleus of the ventral canal-cell, moves rapidly towards the centre of the egg, it increases greatly in size, from the formation of a peculiar metaplasmic substance which fills up the nucleus and ultimately obscures the chromatin. Almost the whole of the contents of the lower part of the pollen-tube passes over into the oosphere by the rupture of the closing membrâne of the pit at the apex of the tube. At this stage all the four nuclei may be seen lying in the cytoplasm of the egg. The stalk-cell nucleus, the pollen-tube nucleus, and one generative nucleus, remain at the apex of the egg, and ultimately become disorganised. The other generative nucleus advances rapidly towards the female nucleus, and gradually penetrates its substance until it is almost completely enclosed within it. After fusion has taken place, the chromosomes can be distinguished as two separate groups. No definite resting fertilised nucleus is formed. The spindle, which lies obliquely in the centre of the egg, is at first multipolar in form, and, while it is in this condition, the chromosomes begin to split longitudinally, but can still be distinguished in two groups. Only after the formation of four segmentation-nuclei do these begin to wander down to the base of the egg. The number of chromosomes in the egg-nucleus is twelve; and the same number were also found in the nuclei of the cells of the prothallial tissue and of the pollen-mother-cells. The chromosomes of the first segmentation-spindle

* SB. k. Akad. Wiss. Wien, cvi. (1897) 1te Abth., pp. 77–98 (1 pl.).

† Biol. Centralbl., xviii. (1898) pp. 545–52 (10 figs.). Cf. this Journal, *ante*, 441.

‡ Proc. Roy. Soc., lxiii. (1898) pp. 400–1.

were found to be twenty-four; and this is probably also the number in the sporophytic tissue. No centrospheres or centrosomes were seen in connection either with fertilisation or with any of the related processes.

Embryology of Gnetum.*—Dr. J. P. Lotsy contributes the following notes on the embryology of *Gnetum Gnemon*.

The female flowers in the purely female inflorescences have three envelopes; those in the pseudo-androgynous inflorescences two, with at first the rudiment of a third. Several embryo-sacs (megaspores) are formed; multiplication of the nucleus takes place in them all; but usually only one megaspore attains its full size. If unimpregnated, the embryo-sac becomes completely filled with endosperm. In the mature embryo-sac is a parietal protoplasm-sac with numerous free nuclei. Before impregnation the embryo-sac becomes constricted into a smaller lower and a larger upper portion. In the lower portion a tissue is formed before the pollen-tube reaches the embryo-sac, which the author regards as a prothallium. No cell-division takes place in the upper portion of the embryo-sac. At the time when the pollen-tube reaches the wall of the embryo-sac, it contains a pollen-nucleus which is already disorganised, and two generative nuclei. One or more pollen-tubes enter the upper portion of the embryo-sac which contains the free nuclei, both the generative nuclei entering the sac. Each of the male generative nuclei coalesces with one of the free nuclei of the embryo-sac, so that two products of copulation result from each pollen-tube; each of these "zygotes" then surrounds itself with protoplasm, and ultimately with a cell-wall. Some of the free nuclei form a rudimentary endosperm around the zygotes. The pollen-tubes may still be attached to the zygotes after these begin to grow. They first grow into long tubes (pro-embryos), the nucleus travelling to the apex. The pro-embryos either insert themselves between the prothallium and the wall of the embryo-sac, or enter the prothallium. This latter now presses aside the nucellar tissue and grows to a large size, with a small hollow at the apex corresponding to the upper part of the embryo-sac. In this upper portion the upper apices of the pro-embryos project, while the lower apices penetrate further into the prothallium. At this stage the seed falls from the tree.

Embryology of Drosera.†—According to Prof. C. A. Peters, the mode of development of the embryo of *Drosera* somewhat approaches the monocotyledonous type. A sporogenous layer of four cells is produced in the nucellus, but no tapete. Three of these cells soon become disintegrated, the fourth being the mother-cell of the embryo. The microsporange produces a tapete which originates and disappears in a similar way. From the first division of the pollen-mother-cell are produced two cells lying in close proximity, which soon divide, thus producing the tetrads. The first spindle disappears before the second two are formed. The suspensor consists of only two cells.

Embryo of Indian Corn.‡—Mr. W. W. Rowlee and Mr. M. W. Doherty thus describe the peculiarities of the structure of the embryo of

* Bot. Centralbl., lxxv. (1898) pp. 257–61.
† Proc. Amer. Ass. Ad. Sci., 1897 (1898) p. 275.
‡ Bull. Torrey Bot. Club, xxv. (1898) pp. 311–5 (1 pl.).

Zea Mays. The bundles of the primary root are of the true radial type. The innermost elements of the xylem are anomalous, and it is doubtful whether they are true ducts. The leaf-trace bundles of the scutellum do not in any way affect the arrangement of the main bundles. The first internode closely resembles the root in structure. The fibrovascular bundles change from the radial type to the collateral type in the second node. These bundles, on entering the second node, pass outward and terminate blindly toward the periphery, the last elements to disappear being the xylem. The bundles of the sheath differ from those of normal leaves in that they originate in the node from which they are given off, that they blend into pairs, and finally, in the sheath, appear as two bundles at opposite points on the axis, and that the curves of this bundle in the node are very sharp.

Ornithophilous Flowers.*—According to Dr. J. Johow, the number of flowers pollinated by the agency of birds is much smaller than is often stated, being, in fact, nearly confined to those described as such by F. Müller. Humming-birds in particular, since they feed entirely on insects, and not on nectar, play but little part in the carriage of pollen. He proceeds then to describe an unquestionable ornithophilous species, *Paya chilensis*, an arborescent species of Bromeliaceæ growing on the Chilian sea-coast. The "nectar" is exceedingly abundant, but is not attractive to insects, containing only a very small amount of sugar in solution. It is, however, eagerly drunk by humming-birds, but more especially by the "Chilian starling," *Curæus aterrimus*. In this way they get their heads plentifully besprinkled with pollen, which they then carry to other flowers.

Cross-pollination and Self-pollination.—According to Mr. R. J. Webb,† the closed flowers of *Gentiana Andrewsii* are cross-pollinated by humble-bees, which forcibly open them in order to obtain the honey.

Herr H. Ross ‡ describes the mode of pollination in *Cobæa macrostemma* from Guatemala, which differs in some respects from that in *C. scandens*. While normally entomophilous (through the agency of Sphingidæ), this species shows well-developed contrivances for ensuring self-pollination.

Herr E. Ule § describes the structure of the flower, and the appliances for pollination, in species of *Aristolochia*, natives of or cultivated in Brazil. In *A. macroura* we find one of the most perfect and striking examples of proterogyny known. Cross-pollination appears absolutely necessary for fertility, and self-pollination impossible. The flowers of *A. elegans* are almost invariably visited by a quantity of small flies of a particular species, which carry the pollen to the stigma. *A. brasiliensis* and *cymbifera* are not known to ripen their fruit.

Dr. P. Knuth ‖ finds *Leucojum æstivum* more fully adapted for cross-pollination by insect agency than *L. vernum*; though self-pollination is by no means excluded. In *Iris germanica* the length of the nectar-tube ($5-5\frac{1}{2}$ mm.), almost exactly corresponds to that of the proboscis of the

* SB. k. Preuss. Akad. Wiss. Berlin, 1898, pp. 332–41.
† Amer. Naturalist, xxxii. (1898) p. 265.
‡ Flora, lxxxv. (1898) pp. 125–34 (1 fig.).
§ Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 74–91 (1 pl.).
‖ Bot. Centralbl., lxxv. (1898) pp. 161–3; lxxvi. (1898) pp. 33–5 (2 figs.).

honey-bee. In *Lilium candidum* self-pollination is almost impossible; while in *L. testaceum* and *chalcedonicum* it may readily occur, though probably the ordinary mode of pollination is by visiting insects.

Mr. J. H. Lovell * describes the structure of the flower and enumerates the visiting insects observed in *Gaultheria procumbens* (proterandrous, Apidæ); *Chelone glabra* (not self-pollinated, species of *Bombus*); *Impatiens biflora* (Apidæ); *Cornus canadensis, stolonifera*, and *alternifolia* (self-pollination generally prevented, a great variety of visitors); *Aralia racemosa* (strongly proterandrous, a great variety of visitors, as many as 80 species).

Hybridism.†—Dr. M. Abbado reviews the state of our knowledge at present, and the literature on the subject of the production of hybrids in the vegetable kingdom, especially with reference to the morphological characters of the hybrids as compared to those of the two parents. He regards hybridism as an effectual origin of new species. A very copious bibliography is appended.

Knuth's Handbook to the Biology of Flowers.‡—This most important work completes the survey of this branch of vegetable physiology from the publication of Müller's 'Befruchtung der Blumen' down to the present date (April 1898); every important observation made during the past quarter of a century being recorded. The first volume comprises a review of the literature of the subject to the present time, and treats of the various modes of pollination and of distribution of the sexual organs, cleistogamy, parthenogenesis, the different classes of insects and of other animals that contribute to the carriage of pollen, the part played by the conspicuousness of flowers, their scent, &c. In the first part of the second volume are contained the records of observations on particular species of plants in Europe and the Arctic region, from Ranunculaceæ to Compositæ; the adaptations of the flowers themselves and of the visiting insects being in each case described. The second part of the second volume will contain similar details from the Lobeliaceæ to the Coniferæ; and a third volume will be devoted to observations on extra-European plants.

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

Influence of Mineral Salts on the Form and Structure of Plants.§—From a series of experiments on a great variety of plants, M. C. Dassonville states, as a general law, that the mineral solutions most favourable to the growth of plants are those which incite the greatest amount of differentiation. There are special differentiations which are localised in particular tissues. For example, the pericyclic fibres become more abundant, the fibrovascular bundles increase in importance,

* Bull. Torrey Bot. Club, xxv. (1898) pp. 382–90.
† Nuov. Giorn. Bot. Ital., v. (1898) pp. 76–105, 265–303.
‡ Knuth, P., 'Handbuch d. Blütenbiologie,' Bd. i. Einleitung u. Litteratur, 400 pp., 81 figs., and 1 portrait. Bd. ii. Th. i. Ranunculaceæ—Compositæ, 697 pp., 210 figs., and 1 portrait. Leipzig, 1898.
§ Rev. Gén. de Bot. (Bonnier), x. (1898) pp. 14–25, 59–68, 102–24, 161–70, 193–9, 238–60, 289–304, 335–44 (10 pls. and 4 figs.). Comptes Rendus, cxxvi. (1898) pp. 856–8. Cf. this Journal, 1896, p. 643.

and the generative layer retains longer its power of division. A general sclerosis which hinders the development of the plant, must be distinguished from a local sclerosis which increases the differentiation of the tissues and is an indication of a higher organisation.

Potassium and sodium salts have opposite effects on the tissues; the former retarding the differentiation of the supporting elements, whilst the latter increase the rigidity of the plant. Potassium silicate gives a dark green colour to the leaves. Potassium phosphate is altogether indispensable to the plant.

A very large number of results are given with respect to the influence of different mineral salts, in different degrees of concentration, on a variety of cultivated plants, both in aqueous solutions and in the open ground. The first effects of a salt on the development of a plant are often in opposition to the final result, the exuberance of growth being due, at least in part, to an accumulation of water.

Conducting-path of Organic Substances.*—From a variety of experiments made on living plants, Herr F. Czapek draws the following general conclusions.

The conducting-bundles run down from the lamina of the leaf separately through the petiole without anastomosing; the conducting-path of the carbohydrates cannot therefore lie through the fundamental parenchyme; the current can take place only through the leptome-bundles of the leaf-stalk, and in a nearly straight direction without any transverse branches; the conducting elements are exclusively the sieve-tubes and the cambiform cells, especially the latter. In addition to starch, sugars are of common occurrence in the sieve-tubes. The leptome-parenchyme is the storehouse of the leptome; starch is stored up in its cells in great quantities, also often a large amount of reserve-proteids. Dead portions of the leptome have no power of conveying the products of assimilation. The process is intimately connected with the functions of living protoplasm, which takes up the nutritive substances and gives them out again from cell to cell. The protoplasmic connections of the sieve-tubes play, therefore, a very important part in the conduction of food-materials. The individualising of the separate members of a stock is a reaction induced by the cessation of the interchange of food-material between the stock and the cell that is thus separated.

Function of Leaves.†—From the fact (which he has confirmed by direct observation) that the amount of nitrogenous substance, and especially that of asparagin, decreases during the night, M. U. Suzuki concludes that one important function of leaves is the splitting up of proteinaceous substances into amido-bodies; these amido-bodies being then conveyed to the fruits, roots, underground stems, &c., where they are required for the formation of proteids.

Passage of Food-material into and from the Leaves.‡—Herr E. Ramann confirms the statement of Wehmer that (contrary to the usual

* SB. k. Akad. Wiss. Wien, cvi. (1897) 1[te] Abth., pp. 117–70.

† Bull. Imp. Univ. Tokio, iii. (1897) p. 241. See Bot. Centralbl., lxxv. (1898) p. 18.

‡ Zeitschr. f. Forst. u. Jagdwesen, xxx. (1898) pp. 157–66. See Bot. Ztg., lvi. (1898) 2[te] Abth., p. 231.

belief) no diminution of the amount of mineral substances in the leaves takes place during the autumn. The amount of nitrogen, potassium, and phosphorus was found (in the beech) to be practically unchanged up to the end of September. This, however, does not negative the theory of a passage of mineral substances back from the leaves to the petiole and the stem; but this is counterbalanced by the transpiration-current.

Functions of Stomates.*—Using the hygroscopic apparatus already described for measuring the opening and closing of stomates, Prof. F. Darwin says that, notwithstanding previous statements to the contrary, partial closure of the stomates of marsh and aquatic plants does take place when the leaf is gathered. In many cases closure of the stomate is preceded by temporary opening, which may occur almost simultaneously with the gathering of the leaf. In dark stormy weather the stomates may be nearly closed by day, even in summer. After darkness has been prolonged for several days, the stomates gradually open. The great majority of plants (not nyctitropic) show some closure of the stomates by night.

Assimilation of Nitrates in the Dark.†—From experiments made by M. U. Suzuki, chiefly on barley, he has come to the conclusion that flowering plants can assimilate nitrates in the dark, and form proteids from them. The nutrient solution used contained 0·2 per cent. sodium nitrate, 0·1 per cent. potassium monophosphate, 0·1 per cent. potassium biphosphate, 0·1 per cent. magnesium sulphate, 0·07 per cent. calcium sulphate.

Growth of Roots.‡—From observations made on a large variety of trees, Herr O. G. Petersen establishes a general law of seasonal periodicity in the growth of roots,—active in April and May, and again in September, but suspended in July. This periodicity was least clearly manifested in the maple and the ash. In the oak the autumnal fresh formation of roots takes place in October. The growth of the mycorhiza continues until November. The annual formation of rings in the main roots usually begins in May, and ends in September or October.

Influence of the surrounding Medium on the Growth of Roots.§—Herr J. Wacker states that, as in the case of land-plants (*Vicia Faba*, *Lupinus albus*, *Helianthus annuus*, *Cucurbita Pepo*) the growth of the primary root almost ceases when they are cultivated in water; so also with water plants (*Lemna minor*, *L. trisulca*, *Azolla filiculoides*, *Hydrocharis morsus-ranæ*) the growth of the primary root almost entirely ceases when they are planted in a saturated soil. This is not the result of a difference in the proportion of oxygen in the two media. In mud the roots of land plants perish either from the absence of free oxygen, or from the presence of various products of decomposition. They have, apparently, not the same power of absorbing oxygen that those of bog-plants possess.

* Proc. Roy. Soc., lxiii. (1898) pp. 413–7. Nature, lviii. (1898) pp. 212–3. Cf. this Journal, *ante*, p. 134.
† Bot. Centralbl., lxxv. (1898) pp. 289–92.
‡ Overs. Kgl. Danske vidensk. selsk. Forhandl., 1898, No. 1 (many figs.). See Bot. Centralbl., lxxv. (1898) p. 272.
§ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxii. (1898) pp. 71–116.

Grafting of the Wild on the Cultivated Carrot.*—M. L. Daniel has experimented on the grafting of the wild carrot on a well-established and very distinct cultivated variety, and allowing it to produce seed. The seedlings from the seeds thus produced manifested a distinct approach in characters to those of the host, the phenomena being somewhat similar to those of hybridisation.

Exudation of Drops from Leaves.†—Pursuing his researches on this subject, Dr. A. Nestler finds, in several genera of Malvaceæ, an abundant excretion of water, though he was unable to determine whether it was effected through trichomes, through the stomates, or through the peculiarly constructed mucilage-cells. Cut shoots of *Tropæolum majus* exude water in a moist atmosphere not only at the ends of the vascular bundles at the margins of the leaves, but also from the stem; in the latter case through the stomates. Other examples are afforded by *Tradescantia viridis*, *Juncus articulatus*, and *Dichorisandra discolor*.

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

Formation of Albuminoids.‡—Dr. B. Jacobi gives a *resumé* of the results obtained by recent observers on the location and conditions of formation of proteids in green plants, which he summarises as follows.

The synthesis of proteids takes place in the leaves. Under otherwise normal conditions of growth, this process may commence in the dark, a reaction taking place between the carbohydrates and nitric acid, ammonia, and amides. The extent to which this process can proceed in the dark depends on the amount of disposable carbohydrates. If these are present in large quantities, proteids are formed; but if the supply is small, the process is arrested, in the dark, at the production of amides. Light contributes indirectly to the formation of proteids, since it increases the supply of carbohydrates. The true source of energy is, therefore, in the carbohydrates.

Action of Diastase on Venom.§—M. C. Wehrmann confirms Lacerda's observations relative to the digestive power of serpent venom. He states that venom does not saccharise starch, nor invert saccharose. It does peptonise fibrin. It contains a toxin and a feeble diastase. Observations on the action of diastases on venom show that some of these bodies possess very active properties, while others are but feebly active, and the rest inactive.

Ptyalin was found to act with remarkable energy on venom, and pepsin scarcely at all. Hence, when venom is introduced by the mouth, its harmlessness is probably due to the action of the buccal secretion.

The very active diastases were ptyalin, papain, pancreatin; the feebly active ones, pepsin, rennet, amylase, and the inactive emulsin sucrase and oxydase.

* Comptes Rendus, cxxvii. (1898) pp. 133-5. Cf. this Journal, 1895, p. 72.
† SB. k. Akad. Wiss. Wien, cvi. (1897) 1te Abth., pp. 387-406 (1 pl.). Cf. this Journal, 1897, p. 557.
‡ Biol. Centralbl., xviii. (1898) pp. 593-603.
§ Ann. Inst. Pasteur, xii. (1898) pp. 510-6.

γ. General.

Application of Anatomy to Classification.*—M. F. Crépin contends, especially as a result of his long study of the genus *Rosa*, that systematists of the new school have neglected the phenomena of morphology, as an aid to those of histology, in determining the affinities of species. The systematist who bases his conclusions on anatomy ought to be associated with a morphologist, and all anatomical research should be preceded by a profound study of species from a morphological point of view.

Organic Gradation in the Organs of Nutrition and Reproduction.†—M. A. Chatin reviews the results at which he has arrived as to the relative degree of organisation of the various groups of plants derived from a study of the number and arrangement of the vascular bundles in the petiole. He regards also hermaphroditism, and consequently autofecundation, as a higher type of structure than the separation of the sexual organs and consequent cross-fertilisation. A multiplication of parts (corolline, staminal, or carpellary), such as occurs in the Ranunculaceæ and Magnoliaceæ, and which is unknown in the highest type, the Corolliforæ, is evidence of retrogression towards the spiral foliar type. He further denies the insectivorous habit of *Drosera* and other "carnivorous" plants.

Artificial Production of Alpine characters in Plants.‡—From a series of experiments made at Fontainebleau (on *Trifolium repens*, *Teucrium Scorodonia*, *Senecio Jacobæa*, *Vicia sativa*, *Avena sativa*, *Hordeum vulgare*), M. G. Bonnier comes to the conclusion that it is possible to produce artificially the special characters of Alpine plants grown in the open air by subjecting them to alternations of temperature comparable to those to which they are subject at high altitudes. Comparing plants of the same species, springing from the same stock, the first set kept continually at low temperatures (4°–9° C.), the second set subject to the normal variations of temperature in the environs of Paris, and the third set to very low night-temperatures, and to insolation during the daytime, the latter were found to exhibit a decrease in stature compared to the two former, the internodes becoming proportionally short, the leaves smaller, thicker, and of firmer consistency, with a more rapid production of flowers.

Fructification of Macrostachys.§—M. B. Renault has examined the structure of this organism, from the *terrain houiller* of Commentry; and states that it presents an example of one of the most ancient forms of vegetation possessing secondary xylem which originates from a permanent secondary layer. The reproduction takes place by means of megaspores and microspores, as in many living Vascular Cryptogams.

Ligule of Lepidostrobus.‖—Mr. A. J. Maslen describes the presence, in the fossil *Lepidostrobus*, the strobile of *Lepidodendron*, of a ligule, occupying a precisely similar place to that of *Selaginella*, the sporange intervening between it and the axis.

* Bull. Soc. Roy. Bot. Belgique, xxxvii. (1898) pt. i. pp 7–15.
† Bull. Soc. Bot. de France, xlv. (1898) pp. 98–108. Cf. *supra*, p. 613.
‡ Comptes Rendus, cxxvii. (1898) pp. 307–12 (3 figs.). § Tom. cit., pp. 284–6.
‖ Ann. of Bot., xii. (1898) pp. 256–9 (1 fig.).

B. CRYPTOGAMIA.

Germination of Spores.*—From a series of experiments on the germination of the spores of Bryophyta and Pteridophyta (*Marchantia*, ferns, *Equisetum*), Mr. F. De F. Heald concludes that, under ordinary conditions of temperature and inorganic nourishment, moss and liverwort spores are unable to germinate in the dark. Organic nourishment, in the form of either peptone or grape-sugar, will incite the germination of most spores in complete darkness. Moss protonemes are able to attain a considerable size in the dark by a saprophytic nourishment, although the vigour of growth is considerably below the normal. Under ordinary conditions of temperature and inorganic nourishment, fern spores are unable to germinate in the dark; but a higher temperature will furnish conditions for germination in complete darkness. The spores of *Equisetum* germinate apparently as well in darkness as in light, and at ordinary temperatures.

Cryptogamia Vascularia.

Leaf and Sporocarp of Marsilia.†—Mr. D. S. Johnson has studied the development of the leaf and sporocarp in *Marsilia quadrifolia*, and states that in its mode of origin the leaf agrees closely with that of other leptosporangiate Pteridophyta, as also in its further growth by the segmentation of a two-sided apical cell; but the details of the segmentation differ. The sporocarp originates from a transversely placed apical cell arising in a marginal cell on the inner side of the young leaf. The microsporanges and megasporanges are derived from sister-cells, and it is not correct to say that the former come from segments of the apical cell of the latter. The author regards the sporocarp of *Marsilia* as homologous with the petiole only of the sterile branch of a leaf.

Leaf and Sporocarp of Pilularia.‡—From studies made on *P. globulifera*, Mr. D. S. Johnson concludes that the leaves of *Pilularia* arise, in acropetal succession, on the right and left sides alternately of the upper surface of the stem. Each leaf originates in a large cell, from which a typical two-sided apical cell is cut off by curved anticlinals. The sporocarp arises on the inner and anterior side of the leaf, just above the axillary bud, which is always present. A fertile branch of the stem has a sporocarp on nearly every leaf, but there is never more than one on the same leaf. A careful study of the leaf does not indicate the presence of even a rudimentary lamina. The sporocarp originates from the two-sided apical cell in one of the marginal cells of the fourth grade in (probably) the first segment of the anterior side of the leaf. The megasporanges and microsporanges are not derived from different marginal cells, as in *Marsilia*. The sporocarp of *Pilularia* appears to be the equivalent of a sporocarp of *Marsilia* in which the number of sori has been reduced to two pairs.

Oophyte of Botrychium.§—Mr. E. C. Jeffrey publishes further details respecting the interesting discovery of the gametophyte of

* Bot. Gazette, xxvi. (1898) pp. 25–46 (1 pl.).
† Ann. of Bot., xii. (1898) pp. 119–45 (3 pls.).
‡ Bot. Gazette, xxvi. (1898) pp. 1–25 (3 pls.).
§ 'The Gametophyte of Botrychium virginianum,' Toronto, 1898, 32 pp. and 4 pls. Cf. this Journal, 1897, p. 415.

Botrychium virginianum, among the more important of which are the following:—The gametophyte is entirely subterranean, without chlorophyll, and is probably symbiotic. The whole surface is furnished with rhizoids which are mostly multicellular. The reproductive organs are found exclusively on the upper surface. It possesses a well-marked apical meristem. The endophytic fungus appears to be intermediate between the genera *Pythium* and *Completoria*. The neck of the archegone consists of seven or eight tiers of cells; the neck-canal-cell has two nuclei. The root, stem, and cotyledon grow by the segmentation of a single apical cell. A single instance of polyembryony was detected; also an indication of apogamy.

Mucilage-Canals of the Marattiaceæ.*—M. L. Lutz states that in the leaves of the Marattiaceæ (*Marattia fraxinea*, *Angiopteris evecta*) there are two kinds of mucilage-canals; the one true intercellular spaces formed schizogenously; the others originating in the first place from rows of cells rich in tannin and poor in mucilage, which become transformed, by the gelification of their transverse septa, into mucilage-cells, without any small bordering cells, as is the case with those of the first kind; these latter have, therefore, a lysigenous origin.

Muscineæ.

Indusiella, a new Genus of Musci.†—From Central Asia, Herr V. F. Brotherus describes a new genus of Mosses, which he thus characterises: Genus curiosissimum Tortulacearum, juxta *Aloinam* ponendum, sed foliis elamellosis, seta perbrevi, theca ovali, peristomio erecto et calyptra magna campanulata, longe diversum.

Modifications of the Thallus of Marchantia and Lunularia.‡—M. J. Beauverie has made a series of experiments on the alterations in the structure and mode of growth of these Hepaticæ produced by abnormal conditions of illumination, exposing them to a feeble, but constant and uniform light. In place of the ordinary flat creeping thallus there appeared a number of narrow vertical green plates, the original flat thallus exhibiting signs of disorganisation. The author regards the flat plagiotropic growth of the thallus of these plants under ordinary conditions as the result of an equilibrium resulting from the action of a negative geotropism and a negative heliotropism; when the action of light is removed, the negative geotropism alone comes into play. The structure of the modified thallus undergoes a great change; the air-chambers and the pseudo-stomates almost entirely disappear, and the distribution of the chlorophyll becomes completely changed, the difference between the two surfaces being greatly reduced. It would appear, therefore, that the dorsiventrality of the ordinary thallus of the Hepaticæ may almost entirely disappear under altered conditions, but it always remains latent; the lower surface can never be made to produce stomates, nor the upper surface rhizoids and amphigasters.

* Journ. de Bot. (Morot), xii. (1898) pp. 133–5 (1 pl.). Cf. this Journal, 1895, p. 659.
† Bot. Centralbl., lxxv. (1898) pp. 321–2.
‡ Ann. Soc. Linn. Lyon, xliv. (1898) pp. 57–69 (9 figs.).

Structure and Development of Dendroceros.*—Prof. D. H. Campbell gives the following as the main results of his study of this epiphytic genus of Hepaticæ.

In its apical growth and in the form of the thallus, *Dendroceros* differs widely from other genera of Hepaticæ. The type of apical cell is that found in *Pellia epiphylla*, and in the homosporous Ferns, especially *Osmunda*, where the prothallium resembles the thallus of *Dendroceros* also in the definite midrib and the occasional development of leaf-like lobes. The archegone corresponds in its structure to that of the other Anthoceroteæ, and is intermediate in character between *Notothylas* and *Anthoceros*. The antherid is solitary, and arises, as in the others of the order, endogenously. The first wall of the embryo is longitudinal, as in *Anthoceros*, but the first transverse wall determines the limits of the foot, as in *Notothylas*. The origin of the archespore is from the amphithece, as in the other genera, but it is less massive than in either of these. The division of the archesporial cells into sporogenous and sterile is less regular than in either of the other genera, and the primary archesporial cells may be transformed directly into sporogenous cells without any further divisions. The capsule is destitute of stomates.

Algæ.

Cystocarp of Delesseriaceæ.†—Mr. R. W. Phillips has studied the development of the cystocarp in several species of *Delesseria* and *Nitophyllum*, and lays stress on the following points as presenting some divergence from conclusions arrived at by other observers. The carpogonial branch is invariably four-celled, as is universally the case in the Rhodomelaceæ. Although usually arising singly on an inner cell of the cortex, the carpogonial branches occasionally appear in pairs. The author was unable to confirm the formation of a second chamber described as separated from the spore-containing cavity by the middle layer as a kind of diaphragm. The fusion of the auxiliary cell with neighbouring cells at the "placenta," so general in the Florideæ, is strikingly absent in *Delesseria*; nor does it occur in *Grinnellia*. An anterior auxiliary cell, cut off from the pericentral cell, occurs in most Rhodomelaceæ, and in all Ceramiaceæ. When the cells adjacent to the central cell in a fertilised protocarp become charged with nutriment prior to the formation of the gonimoblast-filaments, they become multinucleate, as many as eight or ten nuclei at times occurring in one cell.

As regards their systematic position, the Delesseriaceæ are undoubtedly nearly allied to the Rhodomelaceæ.

Myrionemaceæ.‡—M. C. Sauvageau has studied the structure and mode of reproduction of this small family of epiphytic and endophytic sea-weeds belonging to the Phæosporeæ.

In *Myrionema vulgare* he distinguishes the following four structures:—(1) A creeping thallus, with marginal growth from transverse division and dichotomous branching of its cells; (2) the rhizoids, multicellular filaments growing downwards from the thallus; (3) the hairs, springing

* Journ. Linn. Soc. (Bot.), xxxiii. (1898) pp. 467–78 (2 pls.).
† Ann. of Bot., xii. (1898) pp. 173–202 (2 pls.). Cf. this Journal, 1896, p. 546.
‡ Ann. Sci. Nat. (Bot.), v. (1897) pp. 161–288 (29 figs.).

endogenously from young cells near the margin, with a basal zone of growth; (4) the erect assimilating filaments, usually unbranched, springing at a distance from the margin, and with apical growth. The chromatophores are small and disc-shaped, several in a cell. The secreting cells (described for the first time) are formed from meristematic marginal cells, and secrete a brown tannin-like substance, which subsequently passes into the first-formed hairs. The sporanges are both unilocular and multilocular, the latter with a few greater or a larger number of smaller chambers (megasporanges and meiosporanges). The mode of germination of the zoospores varies according to their origin.

The following new species are described:—*Myrionema Corunnæ* on *Laminaria pallida*; *M. polycladum* on *Fucus serratus*; *M. papillosum* on *Laminaria saccharina*. A new genus *Hecatonema* is established, from *Phycoselis maculans*, occurring in three distinct forms; also *Chilionema* g. n., distinguished by the erect filaments being united into irregular groups. It comprises *C. Nathaliæ* sp. n., and *C. reptans* (*Ectocarpus reptans* Crouan, *Myrionema reptans* Foslie). The genus *Ascocyclus* is distinguished by its erect sac-like secreting cells, which are situated directly on the creeping filaments, and are designated by the new term *ascocysts*. A new species is described, *A. sphærophorus*, growing on *Rhodymenia palmata*, and distinguished by its nearly spherical ascocysts; also *A. hispanicus* sp. n. on *Saccorhiza bulbosa*.

Hapters of Laminaria saccharina.*—Herr M. Pedersen gives the following description of the development of the hapters of this seaweed, growing on *Furcellaria fastigiata*. The sporelings attach themselves firmly to a stone, and form, in the first year, a generation of short hapters; after a period of repose, a second generation is formed above the first, and so on. The hapters are flattened at the end and branch, and are of a firm and stiff consistency. The cell-walls of the central layers are strongly thickened; those of the peripheral layers less so. Irritation of the hapter is excited by constant contact, and especially by friction.

Ægagropilæ.†—Herr F. R. Kjellman has studied the structure of the compact balls composed of densely interwoven filaments of green algæ which go under this name. On disentangling the weft of filaments, it is found that the basal portion differs from the remainder of the filament in all perfect individuals, consisting of one or two cells with thicker cell-wall, and obviously playing the part of a bud from which the rest of the filament has sprung. This was observed especially in a new species, *A. canescens*. The degree of branching of the shoot varies greatly. The author regards the mass of filaments in the true *Ægagropilæ* as forming a cœnobe. He treats *Ægagropila* as a section of the genus *Cladophora*, differing only from the typical *Eucladophoræ* in the property of forming "cœnobes"; while *Acrosiphonia*, with which they have sometimes been associated, is more nearly related to *Siphonocladus* than to *Cladophora*.

* Bot. Tidsskr., xxi. (1898) pp. 319–25 (5 figs.). See Bot. Centralbl., lxxv. (1898) p. 192.

† Nova Acta R. Soc. Sci. Upsaliensis (German), xvii. (1898), 26 pp., 3 pls., and 3 figs.

Fungi.

Composition of the Cell-wall of Fungi.*—Herr C. van Wisselingh has made a careful examination of the chemical nature of the cell-wall in more than 100 species of Fungi, belonging to all the more important families. His general conclusion is, that while cellulose occurs but rarely, chitin is a substance of very wide distribution, and is identical with the chitin found in animals. Cellulose was found in Fungi belonging to the Myxomycetes (*Didymium squamulosum*), Peronosporeæ (*Plasmopara densa*, *Cystopus Portulacæ*), and Saprolegniaceæ (*Saprolegnia dioica*). Chitin occurs in the Myxomycetes (*Plasmodiophora Brassicæ*), Chytridiaceæ (*Synchytrium Taraxaci*). Entomophthoreæ (*Empusa Muscæ*), Mucorineæ (*Mucor Mucedo*, *Chlamydomucor racemosus*, *Pilobolus crystallinus*), Rhizopeæ (*Rhizopus nigricans*), and in almost all the higher Fungi. In a few cases (bacteria, *Saccharomyces Cerevisiæ*, *Fuligo septica*, *Cetraria islandica*), neither substance occurred; in no case could the presence of the two substances simultaneously in the cell-wall be determined. Chitin is not so abundant in the reproductive as in the vegetative organs, and in thin-walled spores may be replaced by mycosin. The chitin is often limited to a definite part of the cell-wall, as occurs in many spores. It is commonly accompanied by other little-known substances, as lichenin, and two others hitherto undescribed, which the author names usnein (*Usnea barbata*) and geasterin (*Geaster fornicatus*).

The author believes that the chemical nature of the cell-wall may be turned to account in the systematic classification of Fungi.

Mineral Food-Material of Fungi.†—Herr E. Günther finds a good nutrient solution for fungi to contain necessarily a salt of potassium and one of magnesium, and a sulphate and phosphate. A high concentration of the solution retards the growth of the fungi. Potassium cannot be replaced by sodium, lithium, rubidium, cæsium, or copper, except that rubidium may replace potassium with *Botrytis cinerea*. Magnesium cannot be replaced by calcium, strontium, barium, beryllium, zinc, or cadmium; salts of these elements are injurious in various degrees, in the order named. Salts of copper, when very dilute, promote the growth of fungi, but when more concentrated are poisonous.

Formation of Diastase by Fungi.‡—From experiments made on *Penicillium glaucum* and *Aspergillus niger*, Herr J. Katz comes to the conclusion that these fungi have the power of forming diastase, the presence of starch not being absolutely necessary for this process. The presence of grape- or cane-sugar checks the formation of diastase, but the sugar is inverted. In the case of cane-sugar, 1·5 per cent. prevents the formation, while as much as 10 per cent. of milk-sugar is required. *Bacillus megaterium* presents very similar phenomena. The continual removal of the diastase as formed promotes the production of fresh quantities.

Fungi producing Citric Acid.§—Herr C. Wehmer finds that *Penicillium luteum* is capable of producing citric acid, to the extent of 2–3 per

* Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxi. (1898) pp. 619–87 (2 pls.).

† 'Beitr. z. mineralischen Nahrung d. Pilze,' 59 pp., Erlangen, 1897. See Bot. Centralbl., lxxv. (1898) p. 194.

‡ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxi. (1898) pp. 599–618.

§ Chem. Zeit., xxi. (1897) pp. 1022–3. See Journ. Chem. Soc., 1898, Abstr., ii. p. 446.

cent., from saccharine solutions. *Mucor pyriformis* produces a larger proportion of citric acid when grown on boiled rice, developing at the same time an ethereal odour. With both fungi, however, the production of citric acid is uncertain.

Calcium oxalate in Fungi.*—Mr. C. B. Plowright records the occurrence of crystals of calcium oxalate in the lamellæ of *Clitocybe cyathiformis*; also in *Geaster mammosus*, where they have a regular octahedral form.

Development of Sporodinia grandis.†—Herr G. Klebs finds this species a specially favourable one for observing the influence of external conditions on the reproduction of Fungi, since it produces readily both zygotes and sporanges, and is easy to cultivate in nutrient solutions of very different composition. It is not, as has been stated, a parasite, but a saprophyte. Herr Klebs finds the production of sexual or non-sexual organs of reproduction not to be due, as van Tieghem has stated, to the presence or absence of oxygen, but to the degree of moisture of the air. If the air is comparatively dry, i.e. if the conditions are favourable for active transpiration, the aerial hyphæ produce sporanges. If, on the other hand, the air is moist and the transpiration checked, zygotes are produced. Temperature and light play only a secondary part, as they affect moisture and transpiration. The formation of parthenospores can be induced in a variety of ways, as by a diminution of the air pressure.

Structure of the Peronosporaceæ.‡—A study by Prof. A. N. Berlese of the vegetative organs of the Peronosporaceæ (*Peronospora*, *Phytophthora*, *Plasmopara*, *Cystopus*, &c.) leads him to the following general conclusions. The mycele is furnished with true haustoria for absorbing the nutriment from the host-plant; their form differs in the different genera. The presence of callose in the cell-walls is confirmed. Distinct conidiophores do not occur in all the genera; in *Pythium* the filaments which bear the conids or the zoosporanges differ in no respect from the ordinary filaments of the mycele; they present the strongest differentiation in *Basidiophora*, *Plasmopara*, and *Peronospora*; in *Phytophthora* they are occasionally branched. The conids are solitary, except in *Cystopus* and in some species of *Pythium*; they are often papillose. They are multinucleate, the number of nuclei usually varying between 4 and 8; they have been derived directly from the conidiophore. Besides the conids, which produce zoospores on germinating, *Pythium* possesses a second kind of zoosporange, often borne on special branches of the mycele.

Division of the Nucleus and Formation of the Conids in Oidium.§—Prof. A. N. Berlese has studied these phenomena especially in *O. monilioides*, parasitic on grasses, the imperfect form of *Erysiphe graminis*. The division of the nucleus is karyokinetic, and presents all the usual stages. The conids are not formed successively one at a time, as stated by de Bary. The cylindrical cells, rich in granular protoplasm, near the apex

* Bull. Soc. Mycol. de France, 1898, p. 13 (2 pls.). See Bot. Centralbl., 1898, Beih., p. 42.

† Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxii. (1898) pp. 1–70 (2 figs.).

‡ Riv. di Patol. Veg., vi. (1897) pp. 78–101, 237–68. Cf. this Journal, *ante*, p. 455.

§ Tom. cit., pp. 66–75 (2 pls.).

of the mycelial filaments, put out on the side removed from the substratum each a minute vesicular papilla, into which passes a small quantity of finely granular protoplasm. The nucleus of the cylindrical cell begins to divide, and one of the two daughter-nuclei enters the papilla, which becomes separated from the mother-cell. The papilla now elongates; the nucleus in each again divides, a transverse septum is formed in each of the two, producing a filament of four cells, the growth being basal and not apical. By repetition of these processes are formed the rows of cells which ultimately become chains of conids.

Parasites of Economic Plants in India.*—Dr. D. D. Cunningham records the following:—*Ustilaginoidea Oryzæ* on rice; *Phytophthora infestans*, *Fusisporium Solani*, a *Pythium*, and a *Sclerotinia* on the potato; a sclerote on the leaves of *Ficus stipitata*; also one on the tea; *Peronospora arborescens* on *Papaver somniferum*; as well as several others that are not specifically identified. The leaves of the tea have been found infested by an endophytic alga, *Cephaleuros virescens*.

Parasites of the Sugar-Cane.†—Herren H. J. Wakker and F. A. F. C. Went enumerate the following parasites of the sugar-cane in Java, producing diseases of which the Dutch names are given:—(1) On the stem; *Ustilago Sacchari*, *Colletotrichum falcatum*, *Thiebaviopsis ethaceticus*, *Marasmius Sacchari*, *Bacillus vascularum*; (2) on the leaf-sheaths; *Cercospora vaginæ*; (3) on the leaves; *Cercospora Köpkei*, *Uredo Kühnii*, *Leptosphæria Sacchari*, *Eriosphæria Sacchari*, *Pestalozzia fuscescens*; (4) on the root; *Cladosporium javanicum*, *Allantospora radicicola*. A number of saprophytic species are also described.

Development of Anthracnoses.‡—Bertha Stoneman contributes some information to the life-history of the group of parasitic fungi known by the somewhat vague name of anthracnoses. Though naturally parasitic, they are easily cultivated as saprophytes. The development of the conidial forms, belonging mostly to the genera *Glœosporium*, *Colletotrichum*, and *Volutella*, was followed both on the host-plant and in cultures, and several new species are described. The formation of so-called secondary spores or buds is not a constant character of these genera, but may be absent during the entire cycle of development. In four species the connection was established with perfect or perithecial forms. These are made by the author to constitute a new genus *Gnomoniopsis*, nearly allied to *Gnomoniella*, but differing in the conids being curved instead of ovate.

Exobasidium Vitis.§—M. A. Potebnia regards this fungus as nearly related to *Dematium pullulans* rather than as a Basidiomycete. He notes the phenomenon, under cultivation, that, at a certain stage of development, masses of protoplasm escape, usually from the apex of a filament, which form either irregularly shaped or more regular spherical or kidney-shaped bodies.

* Sci. Mem. Medical Officers of the Army in India, 1897, 36 pp. and 6 pls. See Bot. Centralbl., lxxv. (1898) p. 147.

† 'De Ziekten v. h. Sinkerriet op Java,' Deel i., 25 pls., Leiden, 1898. See Bot. Centralbl., lxxv. (1898) p. 150. ‡ Bot. Gazette, xxvi. (1898) pp. 69–120 (12 pls.).

§ Arb. Naturf.-Gesell. Charkow, xxxi. (1897) pp. 28–35 (1 pl.). See Bot. Centralbl., lxxv. (1898) p. 122.

Æcidium graveolens.*—Herr P. Magnus has studied the development of the fungus which produces the "witch-broom" of the barberry, and describes the deformation caused by it in the tissues of the host-plant. He now identifies it as the æcidioform of *Puccinia Arrhenatheri*, and designates it *Æcidium graveolens* Shuttlew., instead of the usually accepted name *A. magellanicum*, which belongs to a fungus growing on *Berberis ilicifolia* from the Straits of Magellan.

Roesteliæ producing Mycocecidia.†—M. L. Géneau de Lamarlière discusses the various æcidioforms of *Gymnosporangium* in reference to their life-history, and the host-plants of both forms, which he classifies as under :—

Æcidia.	Teleutospores.
Roestelia cancellata on the pear.	*Gymnosporangium fuscum* (= *G. Sabinæ*) on *Juniperus Sabina*, *J. Oxycedrus*, *J. virginiana*, *J. phœnicia*, and *Pinus Halapensis*.
Roestelia . . . on *Cydonia vulgaris*, *Cratægus oxyacantha*, and *Mespilus germanica*.	*Gymnosporangium confusum* on *Juniperus Sabina*.
Roestelia lacerata on *Cratægus oxyacantha*.	*Gymnosporangium clavariæforme* on *Juniperus communis*.
Roestelia cornuta and *R. penicillata* on *Pyrus Malus*, *Sorbus Aria*, *S. Aucuparia*, and *S. Chamæmespilus*.	*Gymnosporangium tremelloides* (= *G. conicum* and *G. juniperinum*) on *Juniperus communis* and *J. nana*.

The changes produced by the cecidia in the tissues of the host-plant are described in detail; hypertrophy is displayed especially in the cortex and homologous tissues, as the lacunar tissue of the leaf. The cecidia produced by different species of the same genus, and having the same mode of life, have the same structure, with only differences in detail, on host-plants belonging to the same family, these being always arborescent Rosaceæ.

Restoration of Spore-formation in Alcohol Yeasts.‡—M. W. Beijerinck—who had previously noticed that in *Saccharomyces octosporus* the asporogenous cells reproduce asporogenous cells only, while the spores give origin to both sporogenous and asporogenous cells—now extends this observation to colonies. Thus, yeast-colonies which are derived from spores reproduce spores in their turn, and the more spores there are in a colony the more there will be in those cultivated from it; while cells originating from spore-free colonies produce asporogenous colonies.

* Ann. of Bot., xii. (1898) pp. 155–63 (1 pl.). Cf. this Journal, 1897, p. 321.
† Rev. Gén. de Bot. (Bonnier), x. (1898) pp. 225–37, 276–88 (2 pls. and 5 figs.
‡ Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 657–63, 721–30 (1 pl.).

The differences between the two kinds of colonies are recognisable by the following distinctions. Spore-bearing cells are distinguished from the spore-free cells by means of the iodine reaction which stains the spores blue or the glycogen violet-brown; asporogenous cells, being free from glycogen, do not stain. Spore-bearing colonies usually liquefy wort-gelatin sooner than spore-free colonies. Spore-bearing colonies are white and remain white; while the spore-free colonies are only white at first, and become brown afterwards.

The author appears to think that the differences between the two kinds of colony are due to heredity; and acting on this idea, he has been able to regenerate the functions of sporulation and proteolysis by carefully selecting suitable and proper cells from an old culture which had almost entirely lost these functions.

Biology of Stereum hirsutum.*—Prof. H. Marshall Ward has made some observations on the mode in which this fungus attacks woody tissue. He finds that, in the case of the horse-chestnut, the hyphæ attack the walls of the tracheids and other xylem-elements from within, gradually delignify them layer by layer, and then consume the swollen cellulose matrix. The mycele grows more luxuriantly in the alburnum than in the duramen.

Polyporoid form of Mushroom.†—M. N. Patouillard describes a specimen of *Agaricus campestris* bearing, on the underside of the pileus, a polyporoid hymenium, closely resembling that of a *Polyporus* or *Boletus*. The basids and spores were normal in size and structure. The author believes that many so-called species of the Polyporeæ are really polyporid forms of Agaricineæ.

Rabenhorst's Cryptogamic Flora of Germany (Fungi Imperfecti).‡—Under this section of the exhaustive work on the Cryptogams of Germany, Austria and Switzerland, are comprised all the conidial fructification-forms which precede or accompany the mature ascoform of the Ascomycetes (Pyrenomycetes and Discomycetes); and their elaboration has been entrusted to Herr A. Allescher. They are arranged under three orders:—(1) Sphæropsideæ, spores abstricted in black or light-coloured, mostly spherical, lenticular or conical receptacles (peritheces or pycnids), or more or less conspicuous sporophores; (2) Melanconieæ, spores or conids formed in sori which are only at first covered by the epiderm, but then emerge on sporophores or basids, and are therefore not enclosed in true receptacles or peritheces; (3) Hyphomycetes, spores or conids usually developed superficially or nearly so, on the substratum, on free hyphæ, not in receptacles, very rarely in the interior of insects. The Sphæropsideæ are again divided into four families,—the Sphærioideæ, Nectrioideæ, Leptostromaceæ, and Excipulaceæ. The Sphærioideæ are classified under eight sections, and the first of these, the Hyalosporæ, comprises 26 genera. Of the first genus, *Phyllosticta*, 490 species are described, and a commencement is made of *Phoma*, with 296 species. They are arranged, in both genera, in accordance with the habit and

* Trans. Roy. Soc., clxxxix. (1898) pp. 123–34 (5 pls.).

† Bull. Soc. Mycol. France, xv. (1898) pp. 46–7 (1 pl.). See Bot. Centralbl., lxxv. (1898) p. 240.

‡ 1ter Band, vi. Abth. Lief. 59–62, 256 pp. and 5 figs., Leipzig, 1898.

the systematic position of the host-plant, and several new species are described. The illustrations represent the characters of the genera.

Myxomycetes.

Ceratification in Myxomycetes and Myxobacteria.* — Herr H. Zukal describes a resting condition in certain Myxomycetes dependent on the conversion of the cell-walls of the plasmodes and receptacles into a horny substance. It was observed in *Trichia fallax*, *T. varia*, and *Lycogala epidendron*. In the first-named species the sporanges were in one spot converted into a reddish-brown mass of a horny consistence, the spaces between the spores, sporanges, and capillitium-filaments, being filled by a hard homogeneous transparent substance, in the place of air or a fluid protoplasmic mass. The process he believes to be a perfectly normal one, similar to the formation of sclerotes in Fungi, and enabling the plant to remain for a time in a state of rest. A similar phenomenon was observed in the other Myxomycetes named, also in two Myxobacteria, *Chondromyces crocatus* and *Myxococcus macrosporus*.

Protophyta.

a. Schizophyceæ.

Reproduction of Diatoms.†—Count Abbé F. Castracane reviews his previous conclusions on the subject, and points out that the diminution in size of diatoms by scissiparition takes place only in those genera where the two valves of the frustules are joined in such a way that one encloses the other; in the Melosireæ this diminution is compensated by the natural increase in size of the individual. He further notes that in *Melosira varians* the frustules, usually described as cylindrical, are occasionally spherical.

Decrease and Increase in the Size of Diatoms.‡—Dr. P. Miquel has carried on for nearly three years a series of experiments on the decrease in size of *Nitzschia linearis*. He finds that, in 71 cultures, during this period, the greatest length is reduced from 70·2 to 39·0 μ, the average length from 63·6 to 33·6 μ. He calculates that the number of multiplications required for this reduction would be at least 1640, and that the number of individuals produced in these multiplications, represented by the expression 2^{1640}, would exceed in mass that of our globe as much as a cubic metre exceeds a grain of sand, and could only be expressed by a series of more than 500 figures. When the minimum size has thus been attained, a sterile microfrustule is produced, from which the author was unable to obtain auxospores. With *Nitzschia sigmoidea*, on the other hand, during a culture which extended over several months, the amount of reduction was only from 170 to 130 μ, and microfrustules were then obtained which germinated, and re-established the original size. Similar results were obtained with *Nitzschia palea*, *N. elliptica*, *Cyclotella comta*, *Biddulphia aurita*, *B. rhombus*, and *Navicula elliptica*. Abnormal auxospores and megafrustules were sometimes produced, interrupting the regular course of diminution in size.

* Biol. Centralbl., xviii. (1898) pp. 573–8.
† Ann. de Micrographie, x. (1898) pp. 67–80.
‡ Tom. cit., pp. 49–59, 182–91 (2 figs.).

Abnormal Diatoms.—Dr. P. Miquel * records the occurrence, in a series of cultures of *Nitzschia linearis*, of a number of abnormal forms which he believes to be due to unfavourable conditions of heat, light, or nutriment, or to the presence of injurious chemical substances in the medium.

Mr. S. Lockwood † affirms, as the result of observations made through a long series of years, that if kept in darkness, the spores or germs of diatoms may retain their vitality for a period of sixteen years. When germinating after that length of time, they may give rise to remarkable anomalous forms.

White Forms of Euglena.‡—E. Couvreur has studied the gradual disappearance of chlorophyll-grains in *Euglena* and the resulting white forms. These can live for some time at the expense of the reserves of paramylon, but they are incapable of multiplying. There is no doubt, he concludes, that they are Algæ, not Protozoa.

β. Schizomycetes.

Action of the Röntgen Rays on Bacteria.§—Contrary to the experience of Wolfender and Forbes-Ross, Herr H. Rieder finds that the Röntgen rays have a greater inhibitive or even destructive effect on bacteria than those of ordinary light. This was found to be the case with *B. coli*, *Staphylococcus pyogenes aureus*, *Streptococcus pyogenes*, the bacilli of cholera, diphtheria, typhus, and fowl-cholera. Bacteria suspended in agar, blood-serum, or gelatin plates, perished in an hour under the action of the Röntgen rays; even bouillon cultures of the cholera bacillus were killed by long exposure.

Nucleo-proteids of Bacteria.‖—The question of immunity and of toxins and anti-toxins is closely associated with that of the chemical composition of the micro-organisms themselves. The previous researches of Sig. G. Galeotti indicated that the proteid substance they contain is nucleo-proteid. The bacterium specially investigated during the present research was Ernst's *Bacillus ranicidus*, large cultures of which are obtainable. The neclec-proteid separated from this by the usual methods yielded xanthine bases. It contained a low percentage of nitrogen (12), while the phosphorus amounted to 1·01 to 1·8 per cent. It produced intra-vascular coagulation in rabbits, but small doses conferred immunity. The colour reactions with anilin dyes are also dealt with.

Denitrifying Micro-organisms.¶—Herr O. Künnemann finds that horse-dung contains two kinds of denitrifying organisms, of which one, *B. denitrificans* i, is effective only in symbiosis with *B. coli*. The other is a variety of *B. denitrificans* ii. The same micro-organisms were sometimes, but not always, found in cattle-dung. The loss of nitrates may

* Ann. de Micrographie, x. (1898) pp. 177–81 (2 figs.). † Tom. cit.,, pp. 1–9.

‡ Ann. Soc. Linn. Lyon, xliv. (1898) pp. 99–100.

§ Münchener Med. Wochenschr., 1898, No. 4. See Bot. Centralbl., 1898, Beih., p. 4. Cf. this Journal, *ante*, p. 460.

‖ Zeit. Physiol. Chem., xxv. (1898) pp. 48–63. See Journ. Chem. Soc., lxxiii. and lxxiv. (1898) Abstr., pt. ii. p. 444.

¶ Landw. Versuchs-Stat., l. (1898) pp. 65–113. See Journ. Chem. Soc., lxxiii. and lxxiv. (1898) Abstr, pt. ii. pp. 444–5.

be considerable, but is less in soil poor in organic matter. Exclusion of air and abundance of aeration retard the action of *B. denit.* i, but have no effect on *B. denit.* ii. Sulphuric acid (0·17 per cent.) prevents the development of denitrifying organisms. The varieties of denitrifying organisms found in different kinds of soils were different from those found in dung. They were *B. pyocyaneus*, *B. fluorescens liquefaciens*, and *B. denitrificans* iii. Denitrification is not disturbed by 0·1 per cent. of caustic lime, but is slower in presence of 0·25 per cent.; with 0·5 per cent. of lime *B. pyocyaneus* alone caused denitrification. Marl had no effect.

New Chromogenic Saprophyte.*—M. V. V. Rodzewitch describes a chromogenic organism which he isolated from *Tilletia levis* of the family Ustilagineæ. The organism is a short thin mobile rodlet, which, when cultivated on the ordinary media, grows well between 20° and 37°. The colonies are of a bright yellow hue, and in from one to two months the medium is stained yellow. The best media were potato and grape-sugar-agar. Gelatin is liquefied.

The organism stains well with anilin dyes, and is not decolorised by Gram's method. It does not apparently form spores, and is non-pathogenic to animals.

New Pathogenic Tetracoccus.†—Sig. L. Vincenzi isolated from an enlarged submaxillary lymphatic gland in a child three months old a tetracoccus, designated *Tetragenus citreus*, which was cultivable on the ordinary media. It is a potential anaerobe, is not decolorised by Gram's method, and grows quickly at 25°–35° C. In bouillon cultures a lemon-coloured deposit is thrown down. In gelatin plates the deep colonies are round and yellowish, and look like drops of wax. The appearances in agar cultures are much the same. Milk is not coagulated by *T. citreus*, though the yellow precipitate forms there too. It is not pathogenic to rabbits, mice, or guinea-pigs.

Mobile Sarcina.‡—Herr Th. Sames describes a mobile *Sarcina* which was isolated from the drain water of a pigstye. The average diameter of the coccus was found to be about 3 μ. The *Sarcinæ* stain well with the usual anilin pigments and also by Gram's method. Flagella-staining showed the presence of numerous long flagella (25–50), which are well depicted in the accompanying illustration. The organism grew well on all the usual media, and appeared to be equally well adapted for aerobic and anaerobic conditions.

Bacterial Disease of the Hyacinth.§—Dr. E. F. Smith confirms the statement of Wakker that a common disease of the hyacinth is due to the attacks of a bacterial organism. It belongs to the genus *Pseudomonas*, and has one polar flagellum.

Relation between Human and Avian Tuberculosis.‖—M. Nocard is of opinion that it is possible to impart to the bacillus of human tuberculosis the biological characters and the virulence of the bacillus of

* Wratsch, 1897, No. 5. See Ann. de Micrographie, x. (1898) p. 228.
† La Riforma Med., 1897, p. 758. See Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 193–4. ‡ Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 664–9 (1 pl.).
§ Proc. Amer. Ass. Adv. Sci., 1897 (1898) p. 274.
‖ Ann. Inst. Pasteur, xii. (1898) pp. 561–73.

avian tuberculosis, and that the two bacilli, so different in appearance, are merely varieties of the same species. By inserting in the peritoneal sac of fowls collodion bags filled with cultures of human tuberculosis, and removing these after an incubation of four months, the author succeeded in imparting to the human tubercle bacilli characters which are recognised as being distinctive of avian tuberculosis.

The chief differences between the two varieties are that the cultures of human tuberculosis are dry, scaly, and difficult to dissociate, while those of avian tubercle are soft, greasy, wrinkled, and easily spread out. Avian tubercle bacilli still grow at 43°, a temperature at which human tubercle bacilli cannot be cultivated. It is almost impossible to inoculate fowls with mammalian tubercle; on the other hand, certain mammals are refractory to avian tuberculosis, e. g. the dog. The guinea-pig resists subcutaneous inoculation, but succumbs to intraperitoneal, though the lesions it then presents are different from those excited by human tubercle.

Permanence of the Infection of the Tubercle-bacteria.*—From experiments on a variety of species of Leguminosæ, Herren F. Nobbe and L. Hiltner find that in all cases the bacteria which infest the root-tubercles retain not only their vitality, but their activity, for twelve months; and this power of infection is not confined to tubercles belonging to the same species, or even genus, of host-plant, as that from which the microbe was originally obtained.

Influence of Filtration on Diphtheria Antitoxin.† — According to Dr. L. Cobbett, diphtheria serum loses in antitoxic power by transmission through filters. This loss varies from practically nil to over 30 per cent., and depends directly on the "stopping" power of the filter. Hence diphtheria antitoxin, when prepared in bulk, should be passed through an easy flowing filter, and the operation should be suspended as soon as there are indications of the apparatus getting blocked, and no attempt should be made to force the liquid through at a high pressure. Of course the antitoxic efficiency must be calculated after filtration.

Aberrant Growth-forms in Streptococcus and Pneumococcus.‡—Dr. A. Stolz draws attention to atypical appearances and aberrant forms which occur in *Streptococcus* and *Pneumococcus*. In some preparations, large flask-shaped and bacillary forms are not uncommon; and if the chains or collections be carefully observed, these will show not only great differences in the size and shape of the individuals, but also frequent departures from the normal division-direction. Thus, instead of *Streptococcus* forming long chains composed of individuals of the same size and shape, reproduction masses having resemblance to *Staphylococcus*, rosette collections, bifurcating lines, &c., will be found to be not unfrequent.

Method of Action of Preventive Serum against Swine Erysipelas.§ — M. F. Mesnil, who has investigated the method of action of preventive serum of swine erysipelas, states that when rabbits are vaccinated by the Pasteurian method, it is possible to obtain an anti-

* Landwirdsch. Vers.-Stat., 1898, p. 467. See Bot. Centralbl., 1898, Beih., p. 64.
† Centralbl. Bakt. u. Par., 1[te] Abt., xxiv. (1898) pp. 386–91, 415–19.
‡ Tom. cit., pp. 337–48 (6 figs.).
§ Ann. Inst. Pasteur, xii. (1898) pp. 481–500.

infectious serum which, when used on mice, pigeons, and rabbits, is found to have preventive properties, and, further, to be curative up to 24 hours after the introduction of the virus, provided that the infection have not already become generalised.

In vitro the serum is not bactericidal; it is endowed with marked agglutinating properties, even when strongly diluted. The agglutinated microbes do not lose their virulence, and the bacilli, in the immunising serum, form chains composed of a large number of joints.

The body-juices of mice, passively immunised, do not exert any action on the microbes, their destruction being due to the action of phagocytes which incorporate them in a living virulent condition. The serum, then, is a stimulant to the cells charged with the defence of the organism.

The virus was introduced either into the abdominal cavity or injected beneath the skin of the belly.

Contagious Pneumonia of Guinea-pigs.*—M. M. G. Tartakowsky describes a malady affecting laboratory guinea-pigs, the most prominent feature being an acute pneumonitis. The causative organism closely resembles the bacillus of glanders in size; the rodlets have rounded ends, and are 2–3 times as long as broad. They are usually in pairs. They are easily stained, but not by Gram's method. Neither spores nor spontaneous movements were observed. On glycerin-gelose or on gelose the growth is greenish-blue, while on gelatin and potato it is brownish-yellow. Milk is not coagulated. It is strictly aerobic, and is sensitive to the reaction of the medium, growing fairly well in neutral media, best when the reaction is slightly alkaline, and not at all when acid.

The distribution of the microbe in the body of the guinea-pigs is limited to the respiratory organs; even when the animal is infected experimentally by subcutaneous inoculation, the organism is found only at the site of injection.

Intraperitoneal inoculation killed guinea-pigs in 30–36 hours; rabbits take the disease when inoculated, but are not affected naturally or spontaneously. The name proposed for this hitherto undescribed disease is Pneumonia contagiosa bacillaris caviarum.

Achalme's Bacterium and Acute Rheumatism.†—Prof. I. Sawtcenko confirms the observation of Achalme,‡ that in the blood of persons sick with acute rheumatism there exists a specific anaerobic bacterium. Four times out of six the bacterium was obtained in a state of purity, once mixed with *Streptococcus*, and once the results were negative. The most favourable cultivation medium was lactose-bouillon mixed with milk, the reaction being slightly acid. 1 ccm. of blood was mixed with 10 ccm. of the medium.

The bacterium, the morphological and cultural characters of which are not described, secretes substances endowed with negative chemiotaxis and necrotic properties.

Injection of filtrates of virulent cultures appeared to increase the immunity of animals. The presence of salicylate of soda diminished

* Arch. Sci. Biol. St. Pétersbourg, vi. p. 255. See Ann. de Micrographie, x. 1898) pp. 228–32.

† Ann. de Micrographie, x. (1898) pp. 220–2.

‡ Cf. this Journal, *ante*, p. 119.

the development of the bacteria; this inhibition being no doubt due to the presence of salicylic acid set free during the fermentation process.

Dysentery and Abscess of the Liver.*—Dr. A. P. Petridis, who has made bacteriological and inoculation experiments for the purpose of ascertaining the relation between dysentery and abscess of the liver, finds that the endemic dysentery of Egypt is of microbic origin. The microbe having the greatest share in the production of the disease is a *Streptococcus;* amœbæ do not seem to possess any pathogenic action. The cat, which suffers from spontaneous dysentery, was found to be a suitable animal for experimental purposes. When inoculated with dysenteric material, or with pure cultures of *Streptococcus*, the disease was easily produced, and in four cases out of sixty there was abscess of the liver. In these abscesses and in others of spontaneous origin, *Streptococcus* is the organism usually found, but sometimes *Staphylococcus* may be present. Amœbæ do not appear to have any connection with the production of liver abscesses.

Action of the Sorbose Bacterium on Wood-sugar.†—M. G. Bertrand has found that when the sorbose bacterium is cultivated in yeast decoction containing xylose or wood-sugar, it exhibits its oxidising action by transforming the sugar, with the exception of a few hundredths, into a corresponding monobasic acid, xylonic acid. What action this microbe has on other glucoses is reserved for a future communication.

Flagella of Termobacterium aceti.‡—Herr A. Zeidler, who had previously described § an acetic acid bacterium endowed with movement, now gives an excellent photogram of this organism, which shows extremely well the flagella as stained by Bunge's method.

Bacteriology of Verruca.‖—M. C. Nicolle communicates the results of an examination made on a case of Peruvian wart, a disease characterised by the outbreak of tumours on the skin and mucosas, and also by internal deposits.

Sections of the lungs showed nodules composed of epithelioid cells surrounded by a zone of small round cells; but no giant cells or caseation were observed. In the liver were similar aggregates, but these contained giant cells. In the spleen and lymphatic glands were more or less extensive areas of caseation.

In the affected parts were found bacilli morphologically resembling those of tuberculosis. They were isolated and frequent, and stained well by the Ehrlich method. If anything they were somewhat stouter than the bacillus of tubercle.

Dr. Letulle, who has examined specimens of the cutaneous lesions of Verruca peruviana, has also found a microbe identical with the tubercle bacillus as to shape and colour reaction.

Capsule of Pneumococcus.¶—Dr. N. Pane gives reasons for supposing that the capsule of *Pneumococcus* is merely the outer part of the

* Ann. de Micrographie, x. (1898) pp. 192–213.
† Comptes Rendus, cxxvii. (1898) pp. 124–7.
‡ Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) p. 669 (1 pl.).
§ See this Journal, 1897, p. 161.
‖ Ann. Inst. Pasteur, xii. (1898) pp. 591–5.
¶ Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 289–94 (2 figs.).

bacterium which has become swollen from imbibition and degeneration. Two illustrations of preparations of blood infected with *Pneumococcus* are shown. In the first preparation of blood taken from the heart immediately after death, the cocci are seen without capsules. The second preparation is from the same blood, but had been preserved for ten days in sealed glass tubes. In this the cocci are seen to be surrounded with a broad characteristic capsule, and their central darkly stained portion to be distinctly diminished in size.

Sporogenous Pseudo-diphtheria Bacillus.*—Dr. A. de Simoni describes a spore-forming pseudo-diphtheria bacillus obtained from nasal discharge. It is cultivable on all the ordinary media. It is rather smaller than the true diphtheria bacillus, but presents similar shape, appearances, and the characteristic granules. It is easily stained, and best with methyl-violet. On agar the growth is indistinguishable from the Klebs-Loeffler. On gelatin it does not grow at all at 20°–22°. In milk and on potato it produces spores when kept in the thermostat at 30°–34° for 48 to 60 hours. The bacilli stand 80 degrees of moist heat, and 85 degrees of dry heat for 10 minutes. Solutions of sublimate (0·02–0·1 per cent.) are very effective, the spores being killed in a few minutes.

Micro-organisms of Rigg's Disease.†—Mr. D. Whittles briefly notices, without description, the invariable presence of a micro-organism in the case of progressive infective ulceration of the peridontium, or true Rigg's disease. He believes it to be "of the anaerobic variety."

* Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 294–7 (1 pl.).
† Anat. Anzeig., xv. (1898) pp. 108–10.

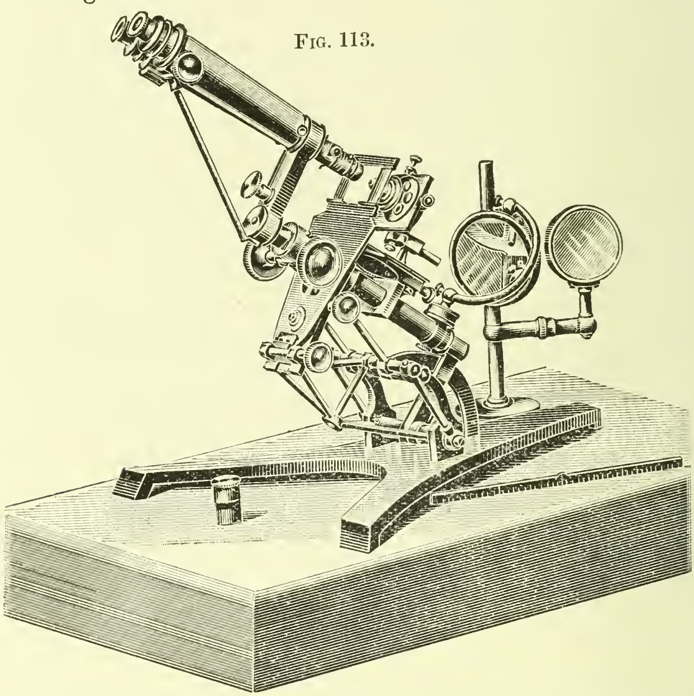
MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Large Binocular Microscope designed and made by an Amateur. —At the meeting of the Society on November 16th, the President brought under the notice of the Society a large binocular Microscope (fig. 113) which was not only designed, but actually made by an amateur, and accompanied an exhibition of a photograph of the instrument with the following remarks.

Fig. 113.



"The three largest Microscopes that have been constructed since the introduction of achromatism, with which I am acquainted, are first, Tulley's, 1826.† The second was made by G. Lowden, jun., of Dundee, in 1851.‡ This was 4 ft. long, had a body-tube 4 in. diameter, and weighed $1\frac{1}{2}$ cwt. The third was made by C. D. Ahrens, and was exhibited before this Society in 1888. It had a body-tube of $4\frac{1}{8}$ in. diameter, and it stood $2\frac{1}{4}$ ft. high.§

"Of these three the second can hardly be called a practical construction, and the third was intended solely for polariscope work; on the other hand, the one represented in the photograph, although large, is a practical and serviceable working instrument. A one-foot rule is placed

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous. † Carpenter, 7th edition, fig. 112, p. 147.
‡ Journ. R.M.S., 1882, p. 851, fig. 156. § Op. cit., 1889, p. 273, fig. 39.

on the table beside it, forming a rough scale by which its size may be estimated. The action of the various parts of this Microscope is so unlike that of any other instrument that they will hardly be understood from an inspection of the photograph; a detailed account is therefore necessary. To the flat tripod foot, which is about 18 × 12 in., are fixed two lateral flat upright posts, braced together at their upper end by a fixed horizontal rod; to the centre of this rod one end of a quadrant is attached, its other end being fixed to the base.

"The quadrant and its lower point of fixture are clearly seen in the photograph; but the fixed horizontal rod, which supports the upper end of the quadrant, is hidden by another horizontal bar; its terminal screw, which passes through the right-hand vertical upright post, can however be seen. Through the bases of the upright posts is fixed a stout cylindrical horizontal bar, its centre being the centre of the quadrant. A strong arm, forming a radius of the quadrant, turns on the middle of this bar; its upper end, which embraces the quadrant, is produced a short distance beyond the quadrant, and forms a rigid attachment for the lower end of the tail-piece. To the extremities of this lower horizontal bar is pivoted the lower end of a lattice bracing, the upper end of this bracing being attached to the lower fixed stage-plate, which in this Microscope is behind the tail-piece. The plan of this lattice-work is clearly seen in the photograph; a more minute description is therefore unnecessary. Attention however may be drawn to the third horizontal rod, to which are attached the stays and struts of the lattice bracing, and which moves with the lattice bracing when the Microscope is inclined. The Microscope can be clamped in any inclined position by a screw, which, passing through the upper end of the radius, pinches the quadrant. Thus far we have an entirely original method of supporting a large Microscope, which ensures rigidity, apart from undue weight. Passing on to the Microscope itself, we see that it is constructed on the Ross model, with an unusually long (for that model) fine adjustment lever. The coarse adjustment is of the ordinary type, racking a prism bar out of the tail-piece. The body, which is binocular and 12 in. long, is supported at the back by a strut.

"In this part we meet with little or no divergence from known forms; but in the stage we find considerable novelty. The mechanism is as follows:—there are three plates, the upper one, which is identical with the actual stage of the Microscope, is attached by a pivot, seen a short distance from its lower end, to a middle plate, which carries a tangent screw. These two plates slide in a vertical dovetailed groove in the third or lowest plate, the vertical movement being actuated by rack and pinion in the usual way. The transverse movement is a transverse movement in arc; this is performed by the tangent screw at the lower end of the middle plate causing the upper plate to revolve on the pivot seen a little above it. Special notice should be given to this stage with regard to its rigidity, which depends of course upon the rigidity of its lowest plate; but this, as we have seen, is supported by no less than five struts of the lattice bracing and by the tail-piece. The result obtained by this design is an open, thin, and unhampered stage, and I know not where you will find its equal in this respect.

"From the stage we pass on to the substage, in which we shall find some more novel and interesting details. The substage itself has the usual rectangular movements for centering, and it is also fitted with a slow motion focussing screw, the milled head of which is seen at the lowest point of its support, immediately in front of the tail-piece. This support of the substage swings in arc (the reflection of a portion of the arc can be seen in the mirror), the centre of rotation being the object on the stage. The substage, carrying the condenser, can also be further turned obliquely to the optic axis by means of the pivot in its front support. By means of these two motions extreme obliquity of illumination can be obtained.

"With regard to the invention of the swinging substage, there is one figured in Adams on the Microscope, 1798 (Pl. 9, fig. 5), in connection with Jones's Lucernal Microscope, as improved by the Rev. John Prince, of Massachusetts, and Mr. John Hill, of Norfolk.* The idea underlying this construction was not for purposes of oblique illumination, as we now understand it, i. e. for sending an oblique beam below the stage on a transparent object, because this kind of illumination would be simply useless with a lucernal Microscope which projected the image on a ground-glass screen. But the swing was applied in order that the substage might be turned round to the upper side of the stage, so that it might become a super-stage illuminator for opaque objects. Substage oblique illumination was neither intended nor used at this date. The next time we meet with a swinging substage is in Grubb's Sector Microscope † (described before the Royal Irish Academy on May 10th, 1852, and patented 1854). In this Microscope the substage, with a right-angled prism attached beneath it, was fixed to a slot, which traversed in a radial groove.‡ Coming to more recent times (1871), Tolles, § in America, revived the swinging substage, to facilitate the resolution of lined tests with oblique light. He was followed by Bulloch ‖ (1873) and Zentmayer ¶ (1876) in America, as well as by all the principal makers in this country, Powell excepted. This absurd craze culminated in the Ross-Wenham radial Microscope of 1882.** I am, however, happy to say that the 3/4 axial cone has slain the Lernæan Hydra, and both swinging substages and radial Microscopes have sunk to rise no more. Returning, however, to the model before us, we have a very perfect and early form of swinging substage; for I first saw this Microscope in 1870, and at that time it must have been about ten or fifteen years old. Several of the objectives used with this Microscope were computed and made by its designer."

* Journ. R.M.S., vol. vii. ser. 2, 1887, p. 297, fig. 45.

† Op. cit., vol. iii. 1880, p. 1056, fig. 126, and Proc. R. Irish Acad., v. (1853) p. 296.

‡ The following is abstracted from a footnote which occurs in a paper on 'The Measurement of Aperture,' written by the learned and Reverend J. R. Robinson, D.D., Dean of Armagh, with reference to a new Microscope Mr. Grubb had made for him (Quarterly Journal of Microscopical Science, iii. p. 166, 1855).

"This Microscope (*Grubb's Sector*) deserves to be known. . . . Mr. Grubb's illuminator is a prism whose aberrations are corrected for a lamp placed at a given distance in the plane of the stage. It travels on a graduated arc of 120°, and through this range its focus continues on the object. . . If raised above the stage it gives at once a capital illumination for opaque objects; it acts well with Lieberkuhn and Nicol's prism, and trifling additions make it equally effective with Mr. Bergin's parallel illuminator, which shows some objects with peculiar distinctness." Mr. Bergin's illuminator was a combination of a rhombic prism with Mr. Shadbolt's parabolic reflector.

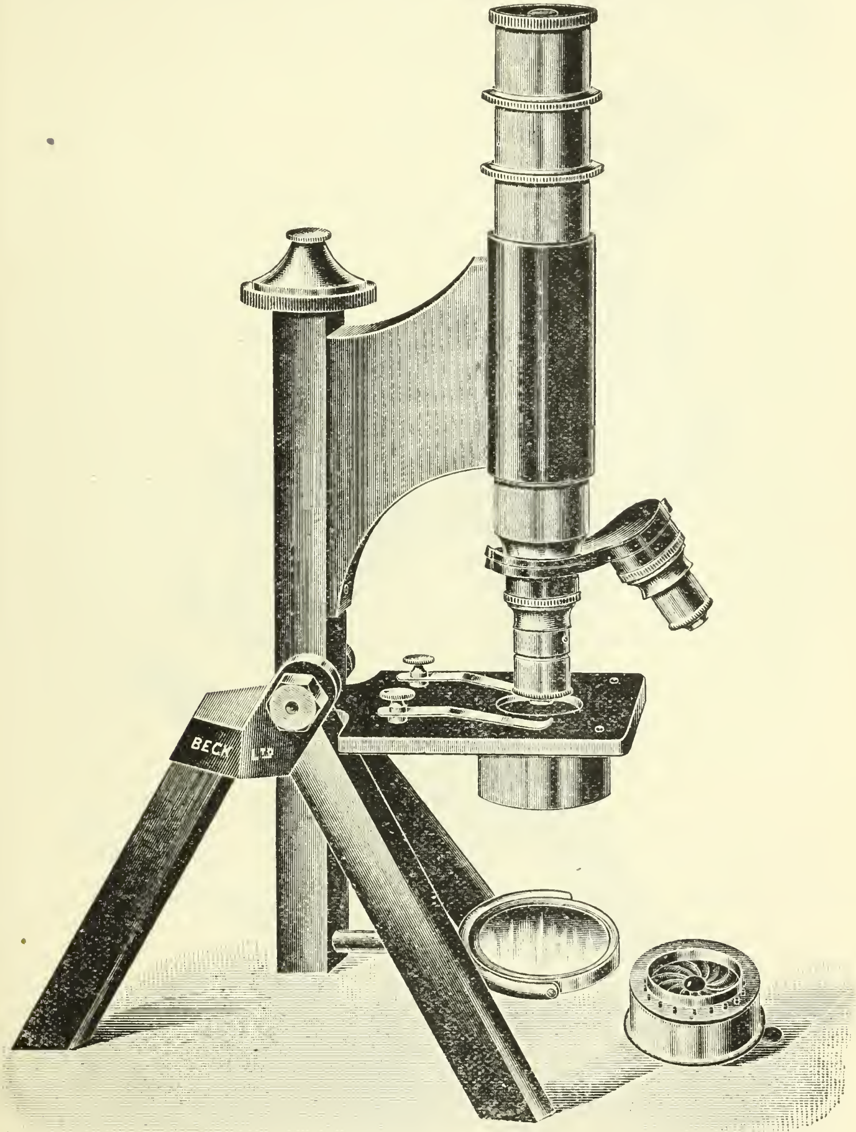
§ Journ. R.M.S., vol. iii, 1880, p. 1061, figs. 128, 129.

‖ Tom. cit., 1880, p. 1068, fig. 133. ¶ Op. cit., vol. ii. 1879, p. 320, and 2 figs.

** Op. cit., vol. ii. ser. 2, 1882, p. 256, 4 figs. and pl. p. 145.

"**British Students'" Microscopes.**—This name is given by Messrs. R. and J. Beck to their new forms of Students' Microscopes, two of which

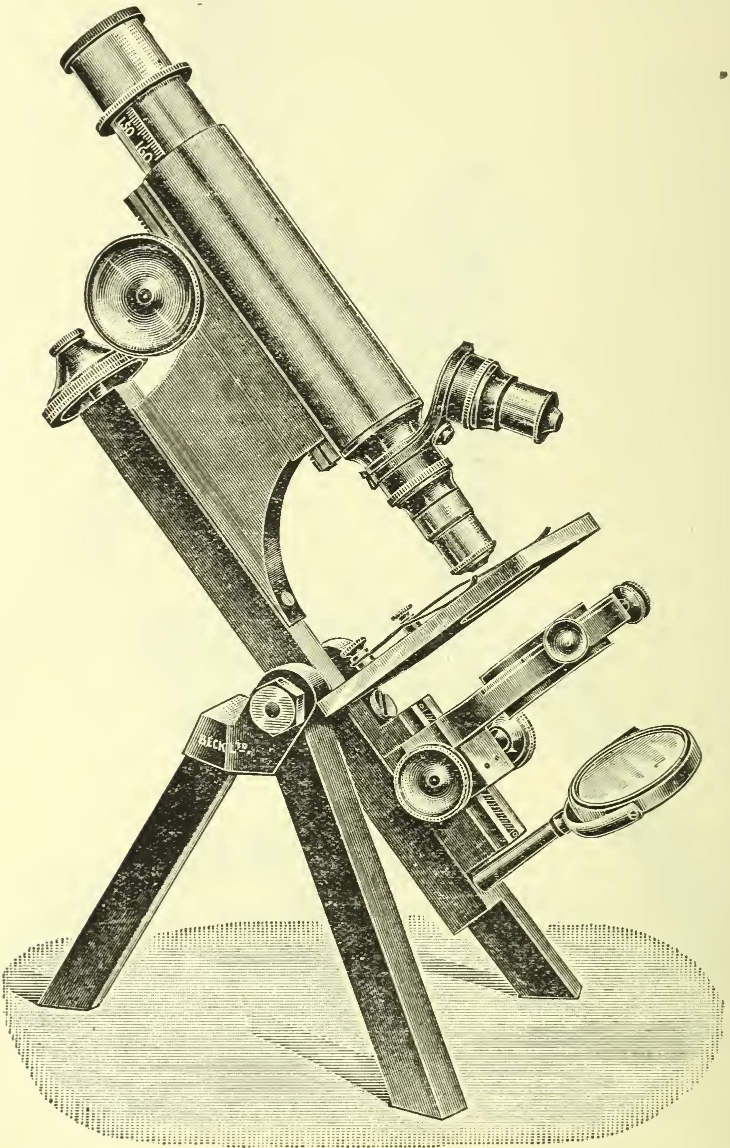
Fig. 114.



are here figured. By making large numbers of these instruments, and by the extensive use of machinery in their production, Messrs. Beck consider that they have brought out an excellent class of low-priced Microscope.

Fig. 114, which shows the cheapest of the set, has a sliding coarse-adjustment. Its stand is a solid heavy tripod, with a spread of 6 in.

Fig. 115.



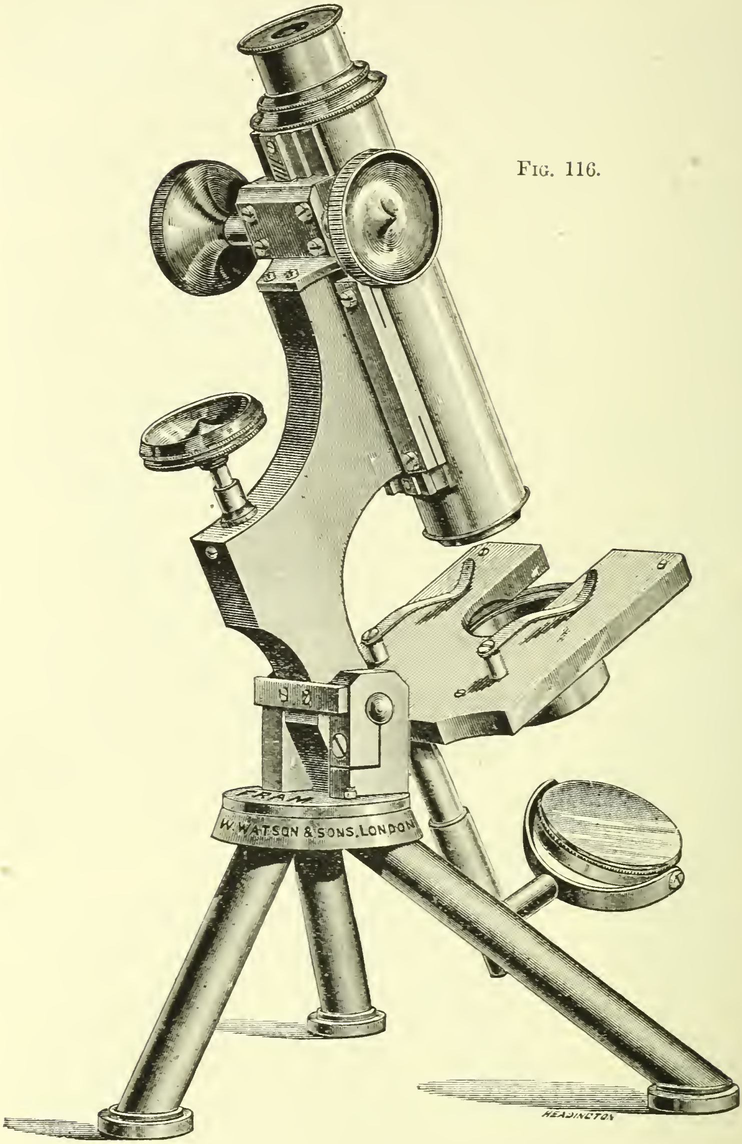
between each foot. It has a joint for inclination, and the fine-adjustment is regulated by a micrometer-screw and large milled head. The large square stage has a distance of $2\frac{1}{2}$ in. from centre of stage to limb, and allows a very large culture-plate to be examined. The under-stage is provided with a fitting of the full size, and is furnished with an improved form of iris-diaphragm enlarged or contracted by means of a handle shown in the figure. Each instrument is provided with a plane and concave mirror. An Abbe form of condenser at once converts the instrument into a very efficient Microscope for bacteriology and other high-power study.

Fig. 115 shows a more expensive form of the same instrument. The difference is partly in the coarse adjustment, which here is a spiral rack and pinion. The draw-tube is engraved in millimetres, and at once records the exact amount of mechanical tube-length in use. Another addition is a rack and pinion focussing and screw centering substage; the milled head of the focussing substage pinion is extended beyond the legs of the tripod, thus placing the focussing adjustment of the substage always within easy reach, even when the instrument is used in a vertical position. By these means all the requirements for the very highest power work are secured, and the very best condensers and highest power object-glasses can be successfully manipulated.

"Fram" Microscope.—The "Fram" Microscope, recently brought out by Messrs. W. Watson and Sons, is illustrated in fig. 116. The object of this design is to produce a Microscope of the highest class at a very moderate price. The working parts are fitted and finished by hand, so as to obtain the smoothest and most precise action. The foot is of the tripod pattern with a spread of 7 in., and the instrument is absolutely steady in any working position. The coarse adjustment is Watson's diagonal rack and pinion, and the fine adjustment is the lever pattern applied to all the instruments manufactured by the firm, which has been tested for many years, and found satisfactory. One revolution of the milled head moves the body 1/300 in., thus giving very exact adjustment for high-power work, while the compensating screws provide a remedy for any slackness that may arise after a long period of use.

The coarse and fine adjustments are of the pattern adopted by Messrs. Watson in all their Microscopes. The stage, which is large, is of the Nelson horse-shoe shape, and the fittings are of the universal size throughout. The body with the draw-tube closed measures less than 6 in., and with the draw-tube extended 10 in.; it is therefore permissible to use objectives corrected for either the Continental or English tube-lengths. The lower end of the draw-tube is provided with the universal thread. In its plainest form the Microscope is provided with the ordinary tube fitting beneath the stage, to carry the condenser, &c., and is arranged to be turned aside from the optical axis when not required. This can be replaced by a compound substage, fitted with rack and pinion focussing and screw centering adjustments. A sliding bar having a new form of spring fitting, affording a very smooth motion, has been designed for the instrument. The objectives are so mounted as to be approximately in focus when revolved on a nose-piece, and the eye-pieces are all arranged to work in the same focal plane.

Fig. 116.

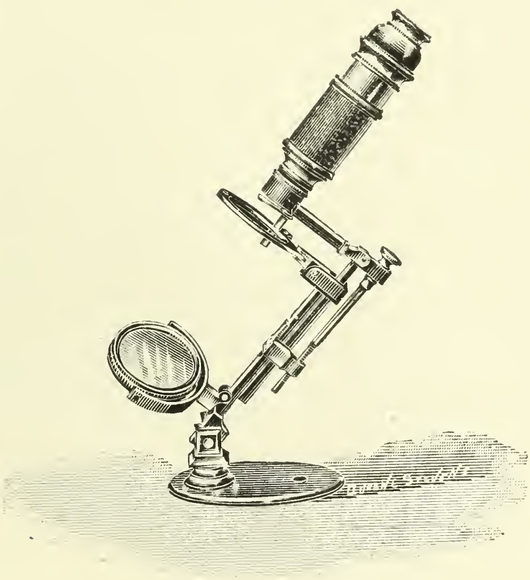


Old French Microscope.—The President* exhibited, at the meeting of the Society on October 14th, an old French Microscope, which, if its date could be accurately determined, might be of considerable interest. The body has an archaic look about it, reminding one of Joblot's (1718), but the rack and pinion focussing to the stage prevents its date being put earlier than about 1765. Below the stage is a short piece of conical tube, and below that is a wheel of graduated diaphragms. This conical tube is a survival of the black ivory cone, mentioned by Henry Baker in his description of Culpeper and Scarlet's Microscope in 1743.

An interesting point is that there is no known instance of a wheel of graduated diaphragms between the years 1702 and the establishment of achromatism 1825–30; so that if the date of this Microscope could be established prior to 1825, it would be the earliest example of the reintroduction of the wheel of graduated diaphragms since 1702.

Microscope by John Cuff.—The President exhibited an interesting old Microscope by J. Cuff of Fleet Street (fig. 117), which in its day

Fig. 117.



was called "an improvement on Ellis's Aquatic Microscope" (1755). It differs, however, from that instrument in seven points.

(1) A compound body having a single eye-lens (no field-lens) can be attached.

(2) It is provided with a fine adjustment of the John Marshall type (lens and not stage focussing).

(3) The stage has lateral movement on a pivot.

(4) The instrument is inclinable.

(5) The pillar is mounted excentrically on its oval base-plate, and it is capable of rotation, which gives the Microscope greater stability in different positions.

(6) It can be folded up for portability.

(7) A clip is provided to clamp the slide to the stage, and this is

the earliest known example of a slide-clip, as distinguished from the spring, plates, &c., in vogue at that time.

This model has played an important part in the evolution of the Microscope; for it was copied in 1771 by Adams, who added a rack and pinion to the forward movement of the body over the stage. It was also the type copied by Raspail for his Microscope, which seventy years later was very popular in France.

Notes.—(*a*) The lateral movement of the stage may be considered as a modification of the stage of Benjamin Martin's "Universal Microscope" (1740).

(*b*) The forward movement of the body over the stage is effected by a *sprung* slide.

(*c*) The manner of clamping the slide to the stage is the same as that still employed by Powell in his iron Microscope, and is the prototype of the spring-clip at present so largely used on Continental Microscopes.

(*d*) This instrument is the earliest known example of a pillar, mounted excentrically, and rotating on its foot to increase the stability. This idea was copied by George Adams in 1771. It was reinvented by Mr. A. McLaren.* It has also lately been introduced by Messrs. Ross & Co.† It ought to be pointed out that the pillar of John Marshall's Microscope, 1704, was also mounted excentrically, and was capable of rotation, inasmuch as it had a ball-and-socket joint at the bottom. This, however, was not meant to increase the stability, but to swing the Microscope clear of its base, which was necessary for purposes of illumination, there being no mirror. Stability in John Marshall's Microscope was obtained by fixing lead to the bottom of the box.

Speaking to-day with our fuller knowledge of the essential points of a Microscope, we should severely criticise Cuff's Microscope. The attachment of the stage to the pillar by a pivot cannot be commended, neither can the hinged joint on the limb which carries the body. Both these devices deprive the instrument of all steadiness, and render it fit for work with the lowest powers only. The designer evidently thought that the transverse motion of an object was better secured by a pivoted stage than by the pushing of a slider between two plates compressed by a stiff spring; in this he was probably right, for we must compare the instrument with those in use at that time, and not with our modern stages. The hinged joint in the limb was to allow the Microscope to be placed in a horizontal position, so that any object held in the stage forceps might be examined with a Lieberkuhn with direct illumination, which was a method much in vogue at that time. In brief, it was a throw back on what has been termed "the telescope mount."

The probable date of this instrument, which is signed, is *circa* 1760.

(2) Eye-pieces and Objectives.

Improved Huyghens Eye-piece.‡—Dr. Hugo Schroeder begins a discussion of the principle of this eye-piece by pointing out that, as is well

* Journ. R.M.S., 1884, ser. ii. vol. iv. fig. 9, p. 111.
† Journ. R.M.S., 1894, pp. 507–8, figs. 39 and 40.
‡ Central-Ztg. f. Opt. u. Mech., No. 10, May 15, 1898, pp. 91–3.

known, it fulfils the conditions of achromatism, viz. that $\Delta = \frac{P + p}{2}$, where the letters have their usual meanings. It is clear that P and p may have an infinite number of separate values, and may yet give the same value for Δ. Which of these infinite values are the best? For the last century it has been usual to put $P = 3p$, and "Huyghens' ocular" usually has this construction. Dr. Schroeder admits that in this form the combination is not ill adapted for high magnifications, but considers it ill suited for weak magnifications, and the nearer Δ approaches the value unity the worse the combination is. The necessary insertion of a stop which excludes half the field of view is a grave defect. He has therefore recalculated the equations, and after several years' experience gives a table for the decimal values of P from 1 to 3, from which the following lines are extracted.

The conditions underlying the table presuppose (1) that both lenses are plano-convex; (2) that they are of the same material; (3) that in the first approximation the various coloured images are brought to the same size; (4) that the eye-point is exactly at the half-focus of the eye-glass, in order that the observer should not come too near the lens.

F = Objective focus.
P = Field-lens focus.
p = Focus of the eye-lens.
Δ = Distance of both lenses with respect to their cardinal points.
s = Distance of field-lens from the objective.
E = Equivalent focus of the ocular.
L = Length of the instrument from the first to the last lens.
m = Magnification of the instrument.
d = Distance of diaphragm from the field-lens.
D = Distance of objective image from the field-lens.
f = Focal length of the primary rays after quitting the field-lens measured therefrom.
δ = Diameter of the diaphragm in the focus of p.
Θ = Half the visible field of view.

P	p	Δ	s	F	m	d	D	E	f	L	2 Θ		δ max.
1·0	1	1·00	2·00	2	2	0	0	1	2·00	3·00	28°	58'	0·500
1·5	1	1·25	4·50	4·80	4·00	0·25	0·300	1·200	2·25	5·75	38	56	0·667
2·0	1	1·50	10·00	10·67	8·00	0·50	0·667	1·333	2·50	11·50	47	10	0·800
2·5	1	1·75	27·50	28·57	20·00	0·75	1·071	1·429	2·75	29·25	54	4	0·909
3·0	1	2·00	∞	∞	∞	1·00	1·500	1·500	3·00	∞	60	0	1·000

New Microscope Objective for Zoological and other Biological Investigations under Water.*—Dr. H. Hartwig, of Jena, describes the above apparatus, which has been made to his designs by the Zeiss firm.

* Zeitschr. f. wiss. Mikr., xv. (1898) p. 162.

He considers that Zeiss' water-immersion system D* is usually the best to use for the observation of living creatures in water-chambers. In many such cases, however, the desideratum is not so much a lens of powerful resolution and high magnification as of extended field of view and deep penetration. His new objective is constructed to meet this want, and he names it the "Planktonsucher."

The Planktonsucher has a front focus of 35 mm., a working distance of 36 mm., and a numerical aperture of 0·11. For a tube-length of 160 mm. and Zeiss' Huyghens' oculars 1 to 5, the following values are obtained for the diameter of the objective field and for the magnification:—

Huyghens Ocular.	Objective Field. mm.	Magnification.
1	3·5	25
2	3·3	35
2*	4·2	35
3	2·4	50
4	2·0	60
5	1·7	80

In consequence of the use of the new Jena glasses, which after many years' experience have proved extraordinarily durable, a very good correction-position could be given to the system. The image is completely plane and free from astigmatism quite close up to the periphery, even when ocular 2* with its extended view-field is used, so that adjustment affects the whole view-field uniformly. As the interference of the ray-pencils is almost apochromatic, the images display a clean-cut distinctness. In order to be able to carry on observations in water, the lenses are fastened on the end of a cylindrical nickelled brass tube, so that entry of the water is impossible.

In order to secure small creatures on the floor of the water-chamber, three narrow glass bars are cemented on to the floor, and a cover-glass placed on them (below the water-level), so that the objects are enclosed in a thin stratum, which stratum can be explored without altering the adjustment of the objective.

(3) Illuminating and other Apparatus.

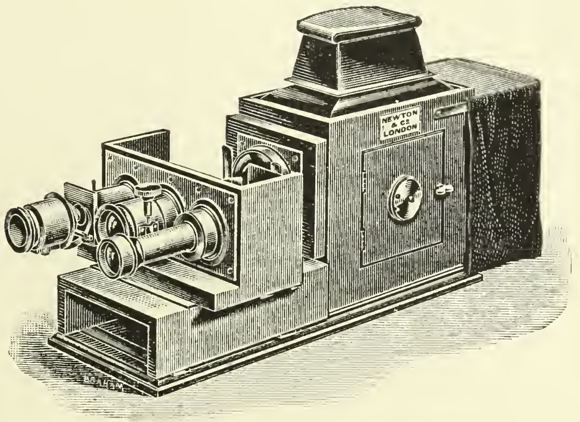
"Newtonian" Universal Science Lantern (Ives and Newton's Patent).—This lantern has been devised with a view to producing an instrument which shall be extremely portable and which shall yet be capable of producing, with a minimum of trouble and rearrangement, most of the experiments required by science lecturers. As shown in the illustration (fig. 118), it is fitted with lantern-slide front, microscopic attachment, and spectroscopic front. The lantern is so fitted that any one of the three fronts can be exchanged for the other by simply sliding the front from the centre to the one side or the other as may be required.

The first front is for showing the ordinary slides or diagrams, and comprises a 4-in. double condenser and 8-in. best double achromatic front lens, exhibiting slides as well and clearly as any lantern that is made.

The second front is a Microscope attachment, and is of more interest to the readers of this Journal, perhaps, than the other parts of the instrument, and is fitted with a movable substage condenser and low-power objective. The adjusting substage is so made that a spot-lens or dark-ground illuminator can be used, also a Lieberkuhn for illuminating opaque objects. A large Nicol can be used for showing crystals; rock sections by means of polarised light show well on the screen. The ease with which the Microscope can be shifted to the lantern front for showing photomicrographs makes the instrument especially useful to the lecturer.

The third front is for spectroscopic work, and is fitted with slit, direct-vision prism, and achromatic focussing lens, which project a brilliant spectrum on the screen without the necessity of placing the lantern at an angle. A comparison prism is also fitted, by which at the same time an image is projected on the screen of any medium of which the absorption spectrum is being shown.

Fig. 118.



The whole of this part of the apparatus can be lifted off, leaving a clear base-board, so that a vertical attachment, or photochromoscope, elbow polariscope, or any front can be substituted that may be wanted directly. The condenser is mounted on a hinge, and can be removed or put into position instantly. Either lime-light or the electric arc can be used in this lantern; and as it is made throughout in Messrs. Newton & Co.'s workshop, it is perhaps unnecessary to say that every detail has been carefully arranged, and that the workmanship is of a high class.

(6) Miscellaneous.

Abbe's Theory of the Microscope.*—Karl Strehl, of Erlangen, propounds the seven following propositions, which seem to him to be of fundamental importance for rightly understanding Abbe's theory of the Microscope.

"(1) Of the continuations of the plane-wave which falls perpendicularly on the primary optic axis and illuminates the object, only the direct continuation is a plane-wave, the deflected ones are by their very nature not plane-waves.

* Central-Ztg. f. Opt. u. Mech., No. 18, pp. 71–2 (2 figs.).

"(2) The diffraction-spectra are, according to Abbe (in monochromatic light), set up as the real images generated by the system, and due to the bright parts of the virtual diffracted appearances generated by the objective structure in the image-forming infinitely distant planes.

"(3) The stereometric place for equality of phase is not so much the image-forming focal plane, as a spherical surface concentric to the image-point and generated by the image-forming focal point.

"(4) The direct primary maximum lies at the image-forming focus, but the deflected secondary maxima do not lie in the image-forming focal planes; the collective diffraction-spectra are not aplanatic images.

"(5) The diffraction-spectra do not lie generally on a spherical surface, and even if they do, then this spherical plane is generally not concentric to the image-focus; generally the ray-paths have not equal distances between the diffraction-spectra and the image-focus, i.e. the diffraction-spectra are not in the same phase.

"(6) If the objective is aplanatic, then the locus of the real diffraction-spectra is formed with unequal phase by means of a spherical surface concentric to the image-focus; consequently it is easily understood that the normal microscopic image is erected at a definite point of the optical primary axis (i.e. at the centre of the spherical surface), and not in any desired point, so that the diffraction-spectra lie with equal phase in the focal plane.

"(7) When the surface (generated by the image-forming focus) is of such a kind that it contains the collective diffraction-spectra in the same phase, I call it the 'wave-surface' (*Wellenfläche*). This 'wave-surface' is constant for the aplanatic arrangement of the system."

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Artichoke as Nutrient Medium.†—M. M. Roger recommends artichoke as a nutrient medium, as many bacteria and yeasts grown on this substratum exhibit a characteristic appearance. With some species the infection-site assumes a green hue, with others it remains uncoloured. *B. subtilis* forms a deposit in 24 hours, the subjacent substratum being coloured green. Anthrax does the same in 3–4 days. Typhoid has no action on the substratum. *B. prodigiosus* when incubated imparted the green staining, though the red pigment did not form. At room temperature the cultures of *B. prodigiosus* exhibited the red colour, while the green staining was absent.

The author suggests that the green pigment is due to the oxidation of some constituent of the artichoke owing to the (vital ?) action of the microbes. That it is an oxidation process is obvious from the fact that when oxygen is excluded, the green pigment is not formed. The pigment is soluble in water, insoluble in alcohol, chloroform, and ether. Acids turn it red, while bases restore the green colour.

* 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.

† C.R. Soc. Biol., v. (1898) pp. 769-71.

(2) Preparing Objects.

Preparation and Fixing of Algæ.*—Prof. F. Oltmanns recommends the following process for the Florideæ. The algæ are placed in chromic-potassium-sublimate-glacial-acetic-acid, or in Rath's picrin-osmium-platinum-chloride-acetic-acid, and then, after a short time, in 70 per cent. alcohol, until they no longer impart to it a yellow colour. Rath's mixture fixes the chromatophores well. The preparation may then be stained by hæmalum or by very dilute solution of hæmatoxylin (at 60° C.), or by Heidenhain's hæmatoxylin-iron-alum. Carmin does not answer so well.

Isolating Ganglion-cells and Unstriped Muscle-fibres.†—According to Herr J. Arnold, ganglion-cells and unstriped muscle-fibres are easily isolated by the iodo-potassic iodide method. The objects may be placed for 2–3 days in 10 per cent. potassium iodide solution, and then for a similar time in iodopotassic iodide solution (5 drops of the strong solution to 10 ccm. of 10 per cent. potassium iodide solution), or the latter mixture may be employed from the start. In the first case the cells are better isolated, in the second they preserve their form more perfectly.

It is a very good thing to add a few drops of an aqueous solution of eosin to the isolating fluid.

Methods for Demonstrating Myxosporidia.‡—Herr F. Doflein used for his investigations on Myxosporidia material derived from sea- and fresh-water fish. It is indispensably necessary that living and fresh material should be studied, as the study of the finer morphology of the spores is a matter of extreme difficulty in clarifying media. The best fixative was found to be Flemming's solution, though sublimate, picro-acetic acid, and picro-sulphuric acid can be used with advantage, especially as after the latter reagents carmin stains can be employed; for, as is well known, after Flemming's solution these stains are not extremely successful. In order to obtain preparations of the forms inhabiting the urinary and gall-bladders, the following method was adopted. A drop of the fluid in which Myxosporidia were suspended was spread on a slide and fixed with one of the before-mentioned fluids. If the bile would not coagulate a little blood was added. In this way a crowd of Myxosporidia are fixed in a thin film, and can be further treated as a section. After fixation in Flemming's solution, the best pigments were safranin and gentian-violet, and the hæmatoxylin-iron. After the other fixatives, borax-carmin, Mayer's carmin, hæmatoxylin, hæmalum, hæmatoxylin-eosin, or orange G, Bismarck-brown, and methylen-green were useful occasionally. For showing up the walls and margins of cells, indulin is a useful accessory to iron hæmatoxylin.

Method for Demonstrating the Shape of Spaces and Passages in Embryos.§—Herr F. Hochstetter communicates an ingenious method which he devised for showing the changes occurring during the development of the membranous labyrinth. This method, with modification and

* Bot. Ztg., lvi. (1898) 1te Abth., p. 100.

† Arch. f. Mikr. Anat., lii. (1898) pp. 762–73 (1 pl.). See Zeitschr. f. wiss. Mikr., xv. (1898) p. 226.

‡ Zool. Jahrb. (Abth. f. Anat. u. Ontog.), xi. (1898) pp. 281–350 (7 pls. and 20 figs.). See Zeitschr. f. wiss. Mikr., xv. (1898) pp. 217–8.

§ Zeitschr. f. wiss. Mikr., xv. (1898) pp. 186–92 (1 pl.).

improvement, was applied to embryo lungs for the purpose of demonstrating the shape of the air-passages and saccules. The preparations are immersed for a short time in a mixture of two parts chloroform and one part oil of cloves. They are then removed, and dried on filter-paper. When the preparation begins to turn white (less than 5 minutes), it is transferred to oil of cloves. The spaces in the labyrinth are now filled with air or a mixture of air and chloroform vapour, and when examined by reflected light look as if they were filled with quicksilver. Though the picture may last long enough to take a drawing or a photograph, it is a transient one, owing to the absorption of the air by the oil of cloves. More lasting preparations were obtained from embryo lungs. In this case a solution of finely powdered Indian ink was used. The solution was sucked in through the trachea as the air disappeared from the lung, and in this way beautiful preparations of the shape of the air-passages and air-sacs were obtained.

The photographs given of lung preparations of the embryos of rabbits and fowl are excellent demonstration objects.

Removal of Pigment from Zoological Specimens.*—Dr. R. Jander recommends Fol's decalcifying solution for removing pigment from zoological specimens, such as mantle of Lamellibranchs, leeches, Arthropods' eyes, fish-skins, &c.

The solution consists of one per cent. chromic acid, 70 vols.; nitric acid, 3 vols.; water, 200 vols.

The pigment is removed in from 12 to 48 hours, according to the bulk of the object. The solution may be used for sections as well as for whole objects. Sections must be stuck on by means of some adhesive, such as very thin albumen.

The solution has the further advantage of fixing and decolorising simultaneously. The acids are easily removed by means of water.

Hardening Blood, Sputum, &c., on Slides.†—Dr. C. Ritter prefers slides to cover-glasses for making preparations of morbid and other fluids, such as blood, pus, sputum, urine. The fluid should be poured on, and the slides placed in glass capsules or vessels containing the fixative, such as osmic acid or formalin. The slides are made to rest on fillets or blocks with the film side downwards, so as to expose the surface to the action of the reagent.

Demonstrating Medullated Nerve-fibres.‡—Herr A. E. Smirnow demonstrates the medullated nerve-fibres in the molecular layer of the cerebellum by the Weigert-Pal and Golgi methods. The whole cerebellum of a freshly killed dog is placed in a mixture of 4 parts of 5 per cent. bichromate of potash and 1 part of formol for 1–8 weeks. The organ is then cut in half and immersed in 3–5 per cent. bichromate of potash solution, which is renewed daily for a week. After an immersion of from 2–5 weeks, one-half is treated by the Weigert-Pal method, and the other cut up into pieces of 1–2 cm. in length.

These pieces are placed in the following mixture:—Five per cent. bichromate of potash, 5 vols.; 2 per cent. osmic acid, 1 vol. After

* Zeitschr. f. wiss. Mikr., xv. (1898) pp. 163–5.
† Tom. cit., pp. 159–61 (2 figs.).
‡ Arch. f. Mikr. Anat., lii. (1898) pp. 195–202 (1 pl.). See Zeitschr. f. wiss. Mikr., xv. (1898) pp. 246–7.

1–1½ weeks, the pieces are transferred to a weak aqueous solution of nitrate of silver, and then for 48 hours or longer to a 1 per cent. solution thereof.

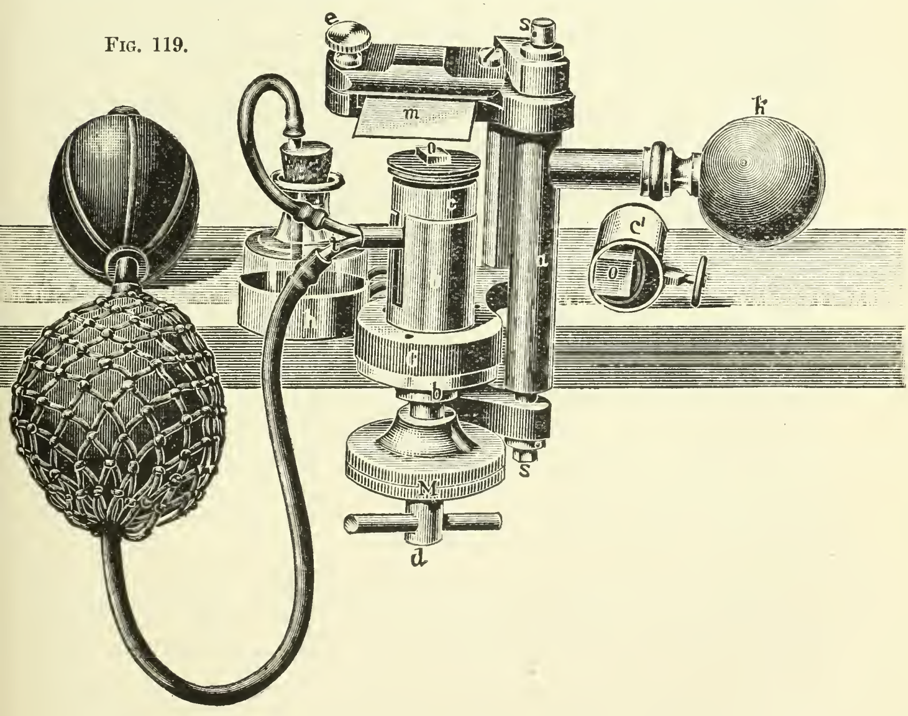
This modification of Golgi's method gave good results also with human cerebella or cerebra which had been kept for 2–3 days in a cool place.

Preparation of Diphtheritic Toxin without Meat.*—Prof. Spronck, having found that yeast favoured the production of the diphtheritic toxin, now prepares the toxin by the following method. Ordinary yeast, not brewer's yeast, is used. One kilo. is boiled in 5 litres of water for 20 minutes, the yeast being constantly stirred with a spatula. The decoction is poured out and allowed to stand 24 hours. To the supernatant fluid are then added 5 grm. of salt and 20 grm. of pepton. The fluid, which is slightly acid, is neutralised with soda, 7 ccm. of normal soda solution being added to the litre. It is then hot-filtered through paper, distributed into vessels, and sterilised at 120°. Thus prepared, the diphtheritic toxin is twenty times stronger than that prepared from old meat.

(3) Cutting, including Imbedding and Microtomes.

New Microtome.†—M. P. Francotte describes a microtome made by Jung which has the following advantages (fig. 119). It is of

FIG. 119.



* Ann. Inst. Pasteur, xii. (1898) pp. 701–4.
† Bull. Soc. Belge de Microscopie, xxiv. (1897–98) pp. 18–21 (1 fig.).

moderate price. It is adapted for cutting objects imbedded in celloidin or in paraffin, or by the ether-freezing method. It is constructed of iron, the greater part of the surface being nickelled and the rest varnished. It is clamped to the table by a large binding-screw *d*, and if required to cut under water or alcohol, it is fixed to a board placed vertically.

The microtome proper is of the Ranvier type. The micrometer-screw is moved automatically by an excentric which is capable of adapting itself to one or more divisions of a graduated circle *b*. The requisite number of divisions is determined by the operator, each corresponding to a micron when the handle *k* is pushed forward. The excentric is set by merely turning a ring, and thus gearing the microtome for 1 to 36 microns.

The knife-carrier is attached to the vertical piece *a*, and moves on the pivots *s s* when the handle *k* is pushed backwards or forwards.

The illustration (fig. 119) shows the apparatus as arranged for ether-freezing.

(4) Staining and Injecting.

Weigert Methods of Staining.*—Prof. C. J. Herrick reports a series of experiments with the Weigert staining methods in studying the components of the cranial nerves in bony fishes, which rests largely on the myelination of the nerves. The results are given for the different fixing reagents, mordants, &c., and form a body of valuable suggestions for those who propose applying these methods to the lower Vertebrates.

Fixing and Staining Starch-grains.†—The results described on p. 639 were obtained by Herr J. H. Salter by the use of the following processes of fixing and staining.

Flemming's mixture was found, on the whole, to be the best fixing material. Sublimate-alcohol and picrin-alcohol also gave good results when the staining reagent used was acid-fuchsin.

For staining the plastid in which the starch-grains are imbedded, acid-fuchsin and iron-hæmatoxylin gave much the best results, especially when the fixing material used was sublimate; 20 grm. of acid-fuchsin were used in 100 ccm. of anilin-water. The starch-grains themselves may be stained by methyl-violet or gentian-violet in aqueous solution, both showing the stratification fairly well, especially if the section be first treated with a concentrated aqueous solution of orange G. For a double stain the material may be fixed by sublimate and stained by acid-fuchsin followed by methyl- or gentian-violet, the excess of violet being then removed by orange. The chloroplasts and leucoplasts, as well as the whole of the cytoplasm, take up the fuchsin, while the starch-grains absorb the violet.

Sudan iii., a Selective Stain for Fat.‡—Dr. A. G. Nicholls confirms the observation of Rieder, who found that Sudan iii. is useful for histological work, especially for differentiating fat. A saturated solution of Sudan iii. in 96 per cent. alcohol is, after filtration, diluted two-thirds

* N. York State Hospital's Bull., Oct. 1897. See Amer. Nat., xxxii. (1898) p. 802. † Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxxii. (1898) pp. 118–21.
‡ Microscopical Bulletin, xv. (1898) p. 31.

with 50 per cent. alcohol, and filtered again. Sections, after a few minutes' immersion, are washed in 60–70 per cent. alcohol, drained, and mounted in glycerin or Farrants' medium. Fat is stained a carmin-red, but the colour is a golden-yellow if the particles be small.

Microchemical Staining of Cell-walls.*—M. J. Chalon records the results of a new series of experiments made on the following vegetable tissues:—pine, willow, *Cordyline*, mistletoe, *Dracæna*, agave, hemp, cotton, rose, maize. All the material was first treated with eau de javelle to destroy the starch and cell-contents, the cell-wall being the only part experimented on. The single stains used were, hæmatoxylin, benzo-azurine, magdala-red, benzo-purpurin, naphthol-black, coralline, methylen-blue, orseille.

The double stains were, campeachy and fuchsin, fuchsin and methylen-blue; alum-carmin and methylen-blue or iodine-green; carmin, campeachy and methyl-green; prussian-blue and safranin; campeachy and benzo-purpurin, anilin-blue and magenta.

These double stains were tried on palm, iris, pineapple, ketinie, maize, *Cordyline*, mistletoe, willow.

Further experiments and the conclusions are promised later.

New and Rapid Method for Double Staining Blood.†—Dr. R. Garcia fixes and stains blood in the following way. A drop of blood and a drop of sterilised bouillon are mixed together on a cover-glass. When the mixture is dry, the cover-glass is placed on a slide and the film fixed by heating the slide over a flame. This takes scarcely a minute. For staining the author employs eosin and methylen-blue in simple solution; the stains are used successively, the superfluous fluid being washed off each time with water, after which the preparation is mounted in balsam. The whole process takes about 5 minutes.

It is preferable to use the eosin before the methylen-blue; and in order to make the bouillon more durable, a few drops of formol may be added.

Neutral Red for Staining Hæmoglobigenous Granules.‡—Dr. E. Giglio-Tos demonstrates the hæmoglobigenous granules in the erythrocytes of certain animals—lamprey, fowl embryo, frog, guinea-pig, &c.—by means of a saturated solution of neutral red in 0·8 per cent. sodium chloride.

A drop of the staining solution and a drop of the blood are mixed together on a slide, and a cover-glass imposed. In 5–10 minutes the preparation may be examined.

Modification of Van Ermengem's Method of Staining Flagella.§—Dr. J. W. W. Stephens has obtained beautiful results from a modification of Van Ermengem's method,‖ which consists in using "largin," one of the many compounds of silver and albumen, instead of nitrate of silver. The usual procedure is followed, the silver bath being a 2 per cent. largin solution which contains about 0·2 per cent. of silver. The film may be passed from silver to gallic acid three or four times, or oftener.

* Bull. Soc. Roy. Bot. Belgique, xxxvii. (1898) pt. ii. pp. 12–29.

† Crónica Médic.-Quir. Habana, xxiii. No. 23. See Zeitschr. f. wiss. Mikr., xv. (1898) pp. 236–7.

‡ Zeitschr. f. wiss. Mikr., xv. (1898) pp. 166–71.

§ Lancet, 1898, ii. p. 874.

‖ Cf. this Journal, 1894, p. 405.

The film thus passes through (1) largin, from 2 to 10 minutes; (2) gallic acid, 2 to 10 minutes; (3) largin, till clear; (4) gallic acid again if necessary, and so on.

The cover-glasses should always be burnt on a piece of wire gauze to remove all fat.

By this method clean well-stained preparations can be obtained with ease and certainty.

Staining Intestinal Canal by Van Gieson's Method.* — Dr. W. Möller recommends Van Gieson's method for staining sections of intestinal canal. The method was originally intended for the central and peripheral nervous system, and consists in staining first with hæmatoxylin, and afterwards with a mixture of acid fuchsin and picric acid. The author adopts the following modified procedure. (1) Stain for half an hour in Delafield's hæmatoxylin. (2) Immerse in distilled water for 12–24 hours. (3) Stain for 1/2–1 minute in Van Gieson's mixture, which is composed of 150 ccm. of a saturated aqueous solution of picric acid, and 3 ccm. of a saturated aqueous solution of acid fuchsin. (4) Wash in distilled water (1/4–1/2 minute). (5) Dehydrate in 90–96 per cent. alcohol (2–5 minutes). (6) Transfer to absolute alcohol for 1 minute. (7) Origanum oil; (8) Canada balsam. To the water (4) and the spirit (5) must be added a few drops of Van Gieson's solution to prevent the too great extraction of the picric acid.

The material dealt with had been kept in spirit for years, and the sections were "celloidin-sections."

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

New Method for Fixing Paraffin Sections to the Slide.†—Herr K. Koninski's gelatin-formalin method is based on the fact that formalin renders gelatin firm and insoluble. The slides are covered with a thin film of gelatin, after the manner of photographers. When the gelatin has set the plate is ready. Upon the dry plate are arranged the ribands of sections, and having been smoothed down by the aid of warm water, any excess of water is poured off. The plate is then warmed until the gelatin is liquefied. The superfluous gelatin is removed with bibulous paper, and the plate allowed to dry. When dry it is placed in pure formalin for about 10 minutes. Thus fixed the gelatin film holds the sections so firmly that the slide may be immersed in boiling water without fear.

(6) Miscellaneous.

Microscopic Detection of Phosphorus-containing Compounds.‡— Prof. A. B. Macallum discusses the difficulties connected with the microscopic detection and localisation of compounds containing phosphorus, and especially the value of the reducing agents hitherto employed after the use of ammonium molybdate for the purpose. He finds that pyrogallol is unreliable, and recommends the use of a recently prepared aqueous solution of phenylhydrazin hydrochloride of 1–4 per cent. strength. This, in the absence of alcohol or a caustic alkali, gives a green colour where phospho-molybdate compounds are present, but only

* Zeitschr. f. wiss. Mikr., xv. (1898) pp. 172–7. † Tom. cit., pp. 161–3.
‡ Proc Roy. Soc. Lond., lxiii. (1898) pp. 467–74.

a faint yellow reaction where ammonium molybdate alone is present; the great advantage of this reducing agent being that it is not necessary, as in the case of pyrogallol, to remove uncombined ammonium molybdate before subjecting the tissues to the reducing process. The method is as follows:—The tissues, either fresh or hardened in alcohol, are subjected, for periods varying from 10 minutes to 48 hours, to the action of a nitric-molybdate solution made by dissolving one part by weight of pure molybdic acid in four parts by weight of strong ammonia, and adding thereto slowly fifteen parts by weight of nitric acid sp. gr. 1·2. The reagent acts best at a temperature of 35° C., and the action is progressive; the inorganic phosphates are first affected, then the lecithin, and finally the organic phosphorus. When the reaction is completed, the tissues are exposed to the phenylhydrazin hydrochloride solution for a minute or two, washed in distilled water, dehydrated, cleared in oil of cedar, and mounted in balsam. The lecithin may be removed from the tissues before the phosphorus test is applied by extracting with ether and then subjecting to prolonged (five hours) treatment with boiling ethyl-alcohol in a Soxhlet apparatus. The inorganic phosphorus may be partially removed by treating the tissues with 20 per cent. acetic acid; but it is possible, by examining the preparations after the molybdate solution has acted for about 10 minutes, to determine the relative amount of inorganic phosphorus present; an increase of the reaction after the first 10 minutes demonstrates the presence of inorganic phosphorus.

Microchemical Demonstration of Alkaloids.*—Herr H. Barth, in an exhaustive article on the microchemical demonstration of alkaloids, states that alkaloids are present in some part of the fruit or seed, from the husk to the endosperm and embryo.

The reagents employed for determining the presence of the alkaloids were those ordinarily used in pharmaceutical and toxicological chemistry. These reagents were chiefly precipitants, and those which gave some characteristic colour. In a few instances the reagents gave better results when used as vapour than in solution.

The results of the author's observations appear to show that the functions of alkaloids are various, some being essentially excretory and protective, others, especially such as exist in the endosperm and embryo, are reserve substances and nutritive.

New Method for making Casts.†—Dr. G. A. Peters has invented a method for making casts by which the minutest details of the object are rendered visible. The process consists in spraying melted paraffin over the whole surface, at the same time cooling it by spraying ice-cold water, strengthening the mould with plaster of Paris, and removing it in as many sections as may be required. The mould is made of hard paraffin. The surface of an object requires no preparation unless covered with hair. It is in this case oiled, and covered by means of a spray with a cream composed of cornflour, glycerin, and alcohol. The paraffin is sprayed on through a special ejecting apparatus, which is practically nothing more than a spray surrounded by a hot-water jacket. The

* Bot. Centralbl., lxxv. (1898) pp. 225–31, 261–7, 292–300, 326–44, 369–78, 401–9, pl.).
† Brit. Med. Journ., 1898, ii. pp. 621–4 (5 figs.).

mould is then strengthened by a backing of plaster of Paris, and having been divided up into sections in the usual way by means of threads, is removed.

Though the procedure is somewhat cumbersome, the results are extraordinarily good.

Lee and Mayer's Outlines of Microscopical Technique for Zoologists and Anatomists.*—The general scope of Mr. N. Bolles Lee's work on microscopical technique is too well known to English microbiologists to require any description.

Herr P. Mayer, of Naples, has recently brought out a German edition which, while purporting to be a translation, is really a revision. The work has been much improved by the alteration and the care bestowed on it.

Cement for Glass.†—The following mixture is recommended for cementing glass used in aquaria. Gum elastic is dissolved in benzin till the fluid has a syrupy consistence. White lead and linseed oil varnish are rubbed up to a paste and mixed with the gum solution. The cement may also be used for sticking glass to wood.

Bone-Corrosion Preparations.‡—Dr. Stanislaus von Stein describes a new method of obtaining models in caoutchouc of the inner ear. The first necessity is that the temporal bone should be thoroughly cleaned; to effect this it may be injected with hot concentrated soda solution. When clean it is to be injected with "Rosa-Kautschuk" dissolved in chloroform, and placed for twenty-four hours in a beaker filled with solution which is allowed to slowly thicken. The bone is then reinjected if necessary, allowed to dry completely, and the caoutchouc scraped from the surface except over the openings. The next process is that of vulcanisation, accomplished by placing the bone in a cuvette in a thin plaster of calcium sulphate, closing the cuvette tightly, and placing it for an hour and a half in a vulcanising apparatus. It is then taken out of the cuvette, the adherent sulphate removed in water, and the preparation decalcified by being placed in a solution containing hydrochloric acid in the proportion of 1 to 5. The perfectly hard preparation is then washed, dried, and varnished. The advantages of the method are claimed to be its rapidity and cheapness, and the permanence and excellence of the result.

As a Frontispiece to the current volume, we give a reproduction of an excellent photograph, taken by Mr. Washington Teasdale, which may interest our older Fellows, of the room in King's College, where the meetings of the Society were held from the year 1867 until we moved to the present rooms in Hanover Square in 1890.

* Berlin, 1898 (Friedländer u. Sohn). See Bot. Ztg., lvi. (1898) 2te Abth., pp. 185-6.
† Zeitschr. f. angew. Mikr., iv. (1898) p. 109.
‡ Anat. Anzeig., xv. (1898) pp. 112-6.

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on October 19th, 1898, at 20 Hanover Square, W., The President, E. M. Nelson, Esq., in the Chair.

The Minutes of the Meeting of June 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 Meeting were voted to the donors.

	From
Zahn, J., Oculus Artificialis. (2nd edition, Nüremberg, 1702)	*The President.*
Catalogue of Tertiary Mollusca. Part I. (8vo, London, 1897)	*The Trustees of the British Museum.*
Annual Report of the Board of Agriculture. (8vo, London, 1898); The Journal of the Board of Agriculture. Vol. v. No. 2. (8vo, London, 1898)	*The Board of Agriculture.*
Lafar, F., Technical Mycology. Vol. i. (8vo, London, 1898)	*The Publishers.*
Photography Annual for 1898. (8vo, London, 1898)	*Mr. P. E. B. Jourdain.*
The Illustrated Annual of Microscopy. (4to, London, 1898)	*The Publishers.*
Journal of Proceedings of the Dublin Microscopical Club, 10 parts	*The Dublin Microscopical Club.*
Annual Reports (18th to 23rd) of the American Microscopical Club	*President of the American Microscopical Club.*
Portrait of Mr. Henry Perigal	*Mr. R. W. Craigie.*
Two Portraits of Mr. Henry Perigal; A Solar Microscope	*The Executors of Mr. Henry Perigal.*
A Microscope by Benjamin Martin	*Mr. Alfred E. Fryett.*
A Photograph of the Society's Room at King's College	*Mr. Washington Teasdale.*
8 Slides of Diatoms, 2 Test-plates, 2 Micrometers, and 1 Diffraction-plate	*Mr. H. J. Grayson.*

The President said that Messrs. Baker had sent for exhibition one of Reichert's Microscopes fitted with a reflector placed in the tube higher up than the back lens of the objective, by means of which the light was thrown upon the object through the objective. The idea was very old, and when first adopted it was thought to be useful in the examination of diatoms. It became obsolete for a time, but had now been revived for use in steel-works for examination of the fractures of the metal, for which purpose this method of illumination was said to be specially advantageous. He was very glad to see the use of the Microscope extending in this way to the processes of manufacture. This illuminator was figured in the Journal last year, p. 334, but it had not been exhibited at their meetings until now.

Mr. C. Beck exhibited four new Microscopes mounted on true tripod stands, the chief point about which was that they were well made, but got out at a very cheap price. They did not greatly differ from some of the other forms being made, but he might point out one improvement which he thought would be appreciated : this was that the milled head of the substage pinion came entirely outside the stand.

He also exhibited a centrifuge which was an improvement upon the one exhibited at a former meeting of the Society. They had found that the number of parts could be reduced without impairing the result, and the instrument could consequently be made at a reduced cost. It was also now fitted with two aluminium guides for test-tubes, and with a lighter frame for carrying two small glass tubes with thermometer bore for use in determining the proportionate number of blood-corpuscles. There were also other tubes to be used for milk and for sedimentary bacteria.

The President said he was much pleased with these model Microscopes shown by Mr. Beck, which carried out one of the ideas he had always aimed at—the production of a really well made but not too expensive Microscope for students' use. He thought the position of the milled head of the substage outside the stand was a great improvement.

These Microscopes are described and figured on pp. 671 and 672.

Messrs. Watson and Sons exhibited and described another Microscope named the "Fram," specially designed for students' use, which is described and figured *supra*, pp. 673 and 674.

The President thought this was a very suitable form of students' Microscope, which again carried out his ideal of a really good small Microscope. He was very glad to see the efficient state which instruments of this class had attained in the hands of Messrs. Beck and Messrs. Watson.

The thanks of the Society were unanimously voted to Messrs. Baker, Beck, and Watson and Sons for their exhibits.

The President exhibited an interesting old Microscope by John Cuff, of Fleet Street, and an old French Microscope, descriptions of which will be found *supra*, pp. 674 and 675.

The President said that he had received another packet containing specimens of micro-ruling from Mr. H. J. Grayson, of Melbourne, who in 1895 sent some specimens of his excellent work to the Society for exhibition. These rulings were of four kinds, two being micrometers, and two test-plates. The first was a most beautifully ruled plate containing ten bands, being the inch divided into thousandths, two-thousandths, &c., up to ten-thousandths. A photomicrograph of this plate was also sent. This would be handed round for inspection, and he hoped the Fellows would kindly examine it with a hand-lens, as it was the finest photomicrograph of ruled bands he had ever seen. As all these ruled slides were mounted in realgar with a refractive index of over 2·5, the lines stood out with a distinctness and brilliancy such as had not been seen before. The next plate was also a very useful one, as it contained hundredths and thousandths of an inch, and fourths, tenths, and hundredths of a millimetre. Critical micrometric measurements had been made of this plate, and it was found to be accurately and evenly spaced—and in brief was one of the best micrometers he had ever handled. It, like the others, was mounted in realgar. The gift of these beautiful micrometers to the Society would, he was sure, be much appreciated by the Fellows who would now have in their cabinet two accurate micrometers for the purpose of comparison. The other two were test-plates, the first of which had twelve bands varying, with intervals of 5000 lines, from 5000 to 60,000 lines per inch. The other contained ten bands varying, with intervals of 200, from 200 to 2000 lines per millimetre. These also were mounted in realgar.

The second portion of Mr. Grayson's packet consists of test diatoms mounted in realgar, the following being some of the species:—*Pleurosigma angulatum*, *P. elongatum*, *P. balticum*, *Frustulia saxonica*, *Navicula rhomboides*, *Pinnularia nobilis* with hoops, and *Amphipleura pellucida*. Specimens of *N. rhomboides* and *Pinnularia* were also mounted in styrax for the purpose of comparison. He might mention in passing that the *A. pellucida* slide contained also an interesting *Nitzschia*, the resolution of which was more difficult than that of *A. pellucida*. The packet was received just after their last meeting in June, so that the slides had been here during the hot summer, and they had also stood the heat and rough handling in the post from Melbourne, and as yet showed no signs of crystallisation, and Mr. Grayson said that from the method adopted there was no fear of this taking place; if so, a great desideratum had been accomplished. A specimen of ruling suitable for a diffraction grating was included in the packet.

He had great pleasure in moving that the very hearty thanks of the Society be given to Mr. Grayson for his very useful presents. Put, and carried by acclamation.

Mr. J. Newton Coombe's paper, 'The Reproduction of Diatoms,' was read by the Secretary, and was illustrated by a series of lantern slides.

Mr. A. W. Bennett, in response to the President, said that not being a diatomist, he rather shrank from saying anything upon the subject. The study of diatomy had gone through three stages: in the first, these organisms were brought under notice by microscopists because of the extreme beauty of their siliceous forms, and their uses as tests for the powers of the Microscope; then followed their classification, and the determination of species, and with this the excessive multiplication of species which was so greatly to be deprecated; and then came the study of these forms with a view to the determination of their life-history. It was very remarkable, however, notwithstanding all that had been done, how very much they had yet to learn as to the life-history of the diatoms. In the writings of Smith, Thwaites, and others of the older diatomists, they found a few observations on their life-history; but with these exceptions, very little had been determined on this point till within the last few years. It is a familiar fact that many of the lower vegetable organisms multiply in two different ways, by a sexual and a non-sexual process, the non-sexual mode being often the result of an abundant supply of nutriment, the sexual mode of a deficiency in this respect. There can be no doubt that diatoms multiply in both ways. The paper which had been read appeared to throw new light on these various modes of reproduction, and seemed to point to the removal of the diatoms from the Protophyta, where they are placed in the Journal of the Society, to a position among the Conjugatæ, near to the desmids.

Before the reading of Mr. Newton Coombe's paper, the lantern-slides described below were exhibited, illustrating the formation of megafrustules of freshwater diatoms, and of the cysts referred to in Wm. Smith's 'Synopsis,' and erroneously supposed to contain "broods of young diatoms," and to be a stage in the reproductive process.

Nos. 1, 2, 3, and 4 (taken at a magnification of 312 diameters) were photos of cysts containing various species of diatom, *Synedra radians* (1), *Gomphonema acuminatum* (2), *Eunotia pectinalis* (3), *Meridion circulare* (4).

No. 5, of the same magnification as the cysts, was that of a Rhizopod, similar to those which formed the cysts, but with its tentacles contracted after death. The creature spreads its amœba-like body over the diatoms, and after digesting their contents, makes its exit from the cyst by means of a small opening which can generally be detected by careful focussing. Mr. Coombe was led to the conclusion that the cysts did not contain "broods of young diatoms," as supposed by Wm. Smith and others, by discovering several containing two quite distinct species of diatoms mixed together.

No. 6 was that of two frustules of *Cymbella lanceolata* lying side by side in a cyst (secreted by the diatoms) prior to conjugation (× 312).

No. 7 showed the same species of diatom, with two megafrustules fully formed, as the result of conjugation of the parent frustules (× 312).

No. 8 was that of two frustules of *Cymbella parva*, showing the actual intermingling of their contents prior to the formation of two megafrustules (× 325).

No. 9 showed the formation of two megafrustules of *Cymbella cistula* after conjugation (× 325).

No. 10 showed *Cymbella lanceolata* in cyst after conjugation, and the formation of two megafrustules, one of which had only just emerged from the parent frustule, and had not yet begun to silicify. The entire outline of this undeveloped frustule can be traced in the photomicrograph (× 200).

Nos. 11, 12, 13, and 14 were further illustrations of the formation of megafrustules of *Cymbella* after conjugation (× 300 about).

No. 15 was that of a single frustule of *Cymbella lanceolata*, forming a megafrustule *without conjugation.*

Nos. 16, 17, 18, and 19 illustrated a mode of conjugation differing from the preceding, in that the contents of the conjugating frustules, instead of growing, after emergence and union, in a direction parallel to the longer axis of the diatom, grow at right angles to the longer axis, with the result that the two megafrustules lie across the two microfrustules. It is difficult to take anything like a satisfactory photomicrograph of the two pairs of frustules which, from their position, as indicated, are necessarily in different planes from each other. The only genera in which Mr. Coombe had met with this particular mode of formation of the megafrustules were *Epithemia* and *Amphora*. No. 19 showed the newly emerged megafrustules in the latter diatom growing as in the preceding cases of *Epithemia*.

The writer believed this to be the first recorded case of the mode of formation of the megafrustule in the genus *Amphora* ($\times$ 312).

Nos. 20 and 21 are believed to be the first recorded cases of the formation of megafrustules of *Synedra radians*.

The bulb-like appearance in the middle of the megafrustules occurs in almost all the specimens examined ($\times$ 312).

No. 22 was that of the formation of two megafrustules of *Amphipleura pellucida*, presumably after conjugation, as in the case of *Cocconema* ($\times$ 325).

No. 23 is curious as being a case of the formation of a megafrustule of *Nitzschia*, photographed after the gathering, in which it was found, had been boiled in nitric acid ($\times$ 325).

The Secretary said that there was another paper on the Agenda, being Part III. of Mr. F. W. Millett's 'Report on the Recent Foraminifera of the Malay Archipelago.' This paper, although one of considerable value, was so highly technical that it was proposed, as in the case of Parts I. and II., to take it as read. It would of course appear *in extenso* in the Journal.

On the motion of the President the thanks of the Society were unanimously voted to Mr. Coombe for his paper, and the exhibition of slides in connection with it; and also to Mr. Millett for his further communication.

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

The Society:—Photographic Portrait of Mr. Henry Perigal, by Mr. R. W. Craigie; two Engraved Portraits of Mr. Henry Perigal, and a Solar Microscope presented by the executors of Mr. Henry Perigal; a Microscope by Benjamin Martin, presented by Mr. Alfred George Fryett.

The President:—An old Microscope by Cuff, date circa 1760; an old French Microscope, date uncertain; Micrometer Rulings and Diffraction Plate, ruled by Mr. H. J. Grayson.

Mr. Charles Baker:—Reichert's Microscope for examining opaque objects.

Messrs. R. and J. Beck:—Four "British Students'" Microscopes; and a new form of Medical Centrifuge.

Messrs. Watson and Sons:—The "Fram" Microscope.

New Fellows:—The following were elected *Ordinary* Fellows:—Dr. Noble Benjamin Hall Dean, and Mr. Oliver Eaton.

MEETING

Held on November 16th, 1898, at 20 Hanover Square, W.
E. M. Nelson, Esq., President, in the Chair.

The Minutes of the Meeting of October 19th, 1898, were read and confirmed, and were signed by the President.

The President, on behalf of the Council, gave notice that at the next meeting of the Society the suspension of Bye-law 36 would be moved.

The President having requested Mr. A. D. Michael to take the chair, read a paper describing a very large binocular Microscope made and designed by a friend. The description was illustrated by an excellent photograph of the instrument shown upon the screen.

Mr. Michael said he was quite sure it would be the pleasure of the meeting to pass a very hearty vote of thanks to the gentleman who had so kindly sent the photograph, and also to the President for his remarks upon it, in which he had so clearly put before them the details of the construction of this very elaborate instrument.

A vote of thanks was accordingly put from the chair and carried unanimously.

Mr. Michael said that Mr. Curties had brought a number of slides of diatoms for exhibition that evening; and that Messrs. Beck also exhibited two of the original slides of *Amphipleura pellucida* mounted by Prof. Hamilton Smith in his high refractive medium. These were shown under 1/12-in. oil-immersion objectives of numerical apertures of 1·0 and 1·25 respectively, the diatom under the former satisfactorily showing resolution, while that under the latter was perfectly resolved.

Mr. Michael said they were much obliged to those gentlemen for their exhibits, and especially so to Mr. Curties for bringing before them so many excellent examples of the advantages of mounting these difficult objects in high refractive media.

Mr. Vezey said the exhibition sub-committee of the Council were particularly indebted to Mr. Curties on that occasion, because he had come to their assistance at very short notice; and had very kindly come down with this very beautiful series of slides, so that the Fellows of the Society and their friends should not come to the meeting and find there was no exhibition.

The thanks of the Society were then cordially voted to Messrs. Curties and Beck for their exhibits.

The Secretary said a paper had been received from Mr. Arthur William Waters, on 'Bryozoa from Madeira.' The paper itself was too long to be read *in extenso*, he would therefore give a short *résumé* of it, and it would be printed in full in the Journal.

Mr. Michael said they were greatly obliged to Mr. Waters for this paper, and also for the summary of its contents. A systematic paper such as this was not so much intended to be read and discussed at a meeting, as to be a permanent record, while as a work of reference to those who were studying the subject it would prove to be of considerable value. The Society was to be congratulated upon having such a paper to print in its Transactions.

The thanks of the Meeting were unanimously voted to Mr. Waters for his paper.

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

Messrs. R. and J. Beck:—Two achromatic 1/12-in. oil-immersion Objectives of N.A. 1·0 and 1·25.

Mr. C. Baker:—A selection of Diatoms mounted in high refractive media.

New Fellows:—The following were elected *Ordinary* Fellows:— Mr. John Henry Garnar, The Hon. Thomas Kirkman, Mr. Keith Lucas, Mr. Arthur E. T. Payne, Mr. George John Randell, Rev. James Redfearn, Mr. James Wedeles, Dr. James D. Whitley, Dr. Earley Vernon Wilcox.

INDEX OF NEW BIOLOGICAL TERMS, OR OLD TERMS WITH NEW MEANINGS, RECORDED IN THIS VOLUME.

α. ZOOLOGY.

β. BOTANY.

INDEX.

C.

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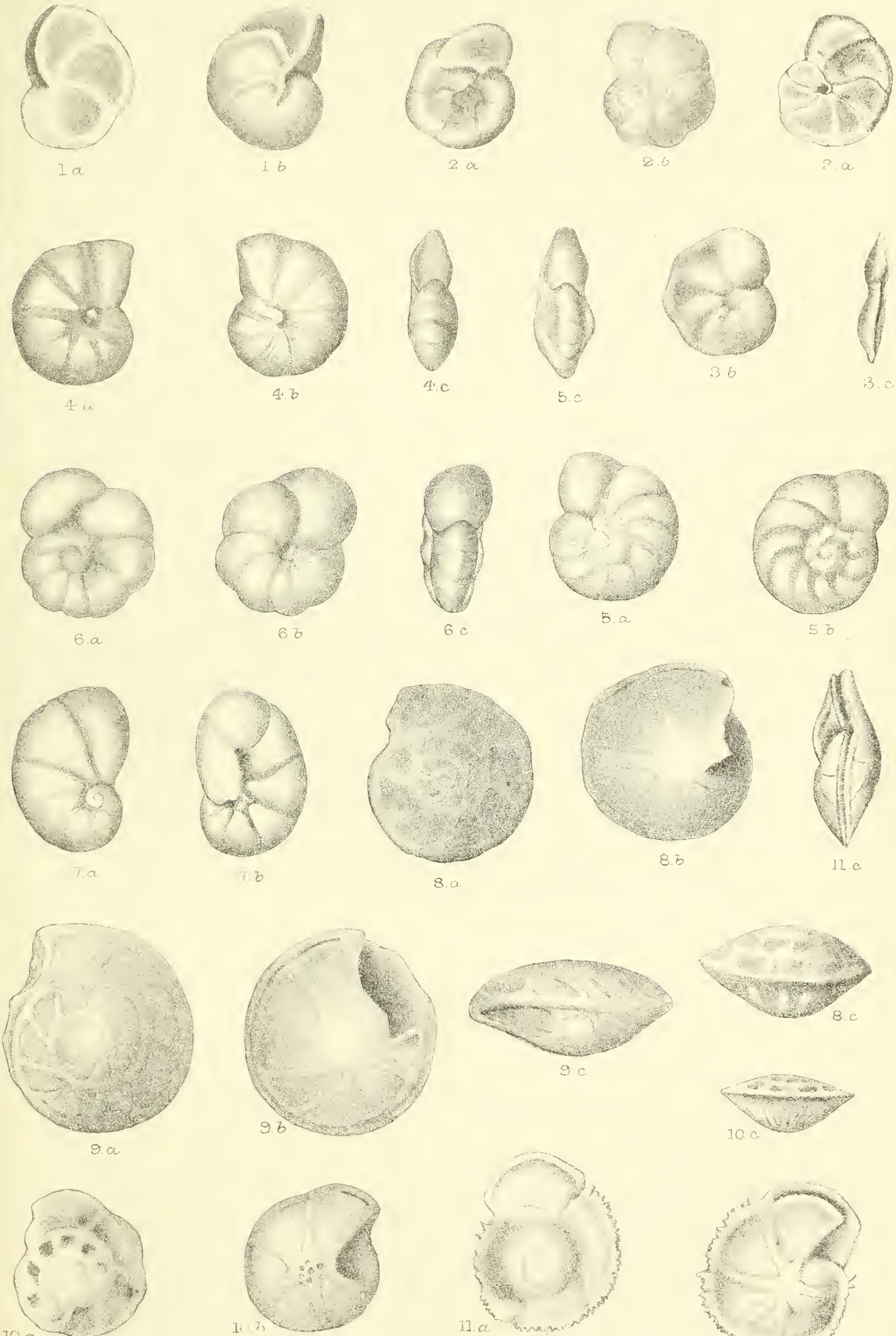
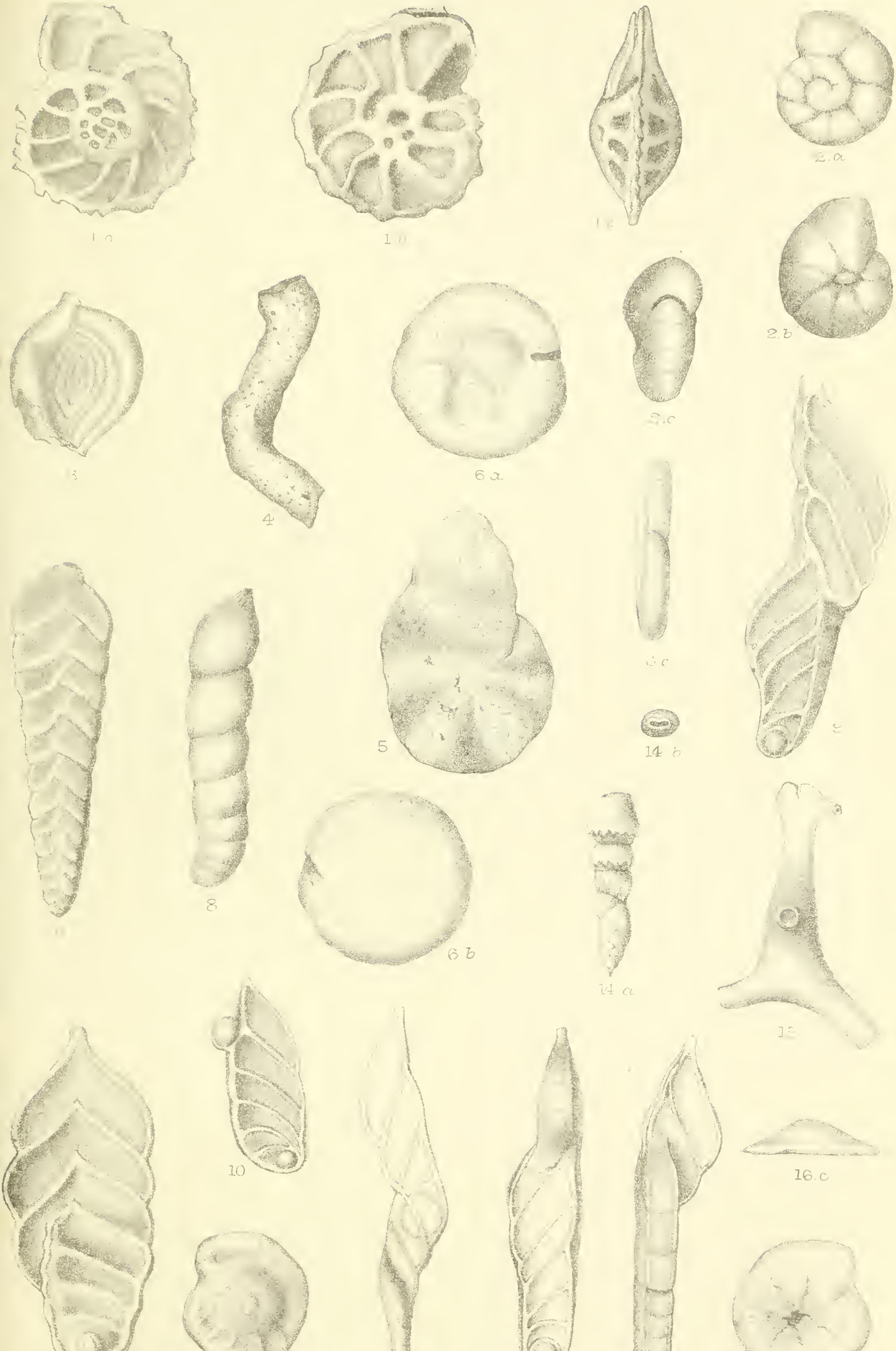


F. Chapman del ad nat.

West, Newman lith.

Folkestone-Gault Foraminifera



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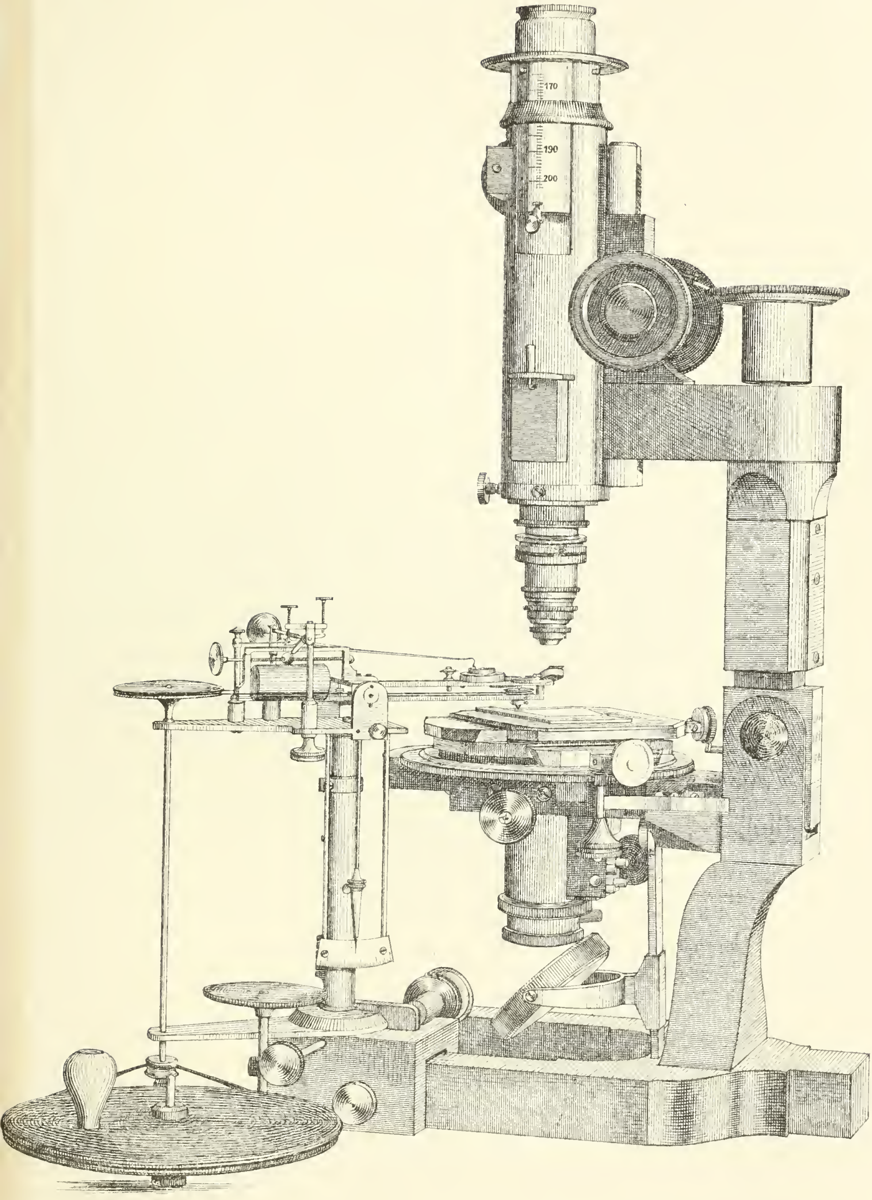

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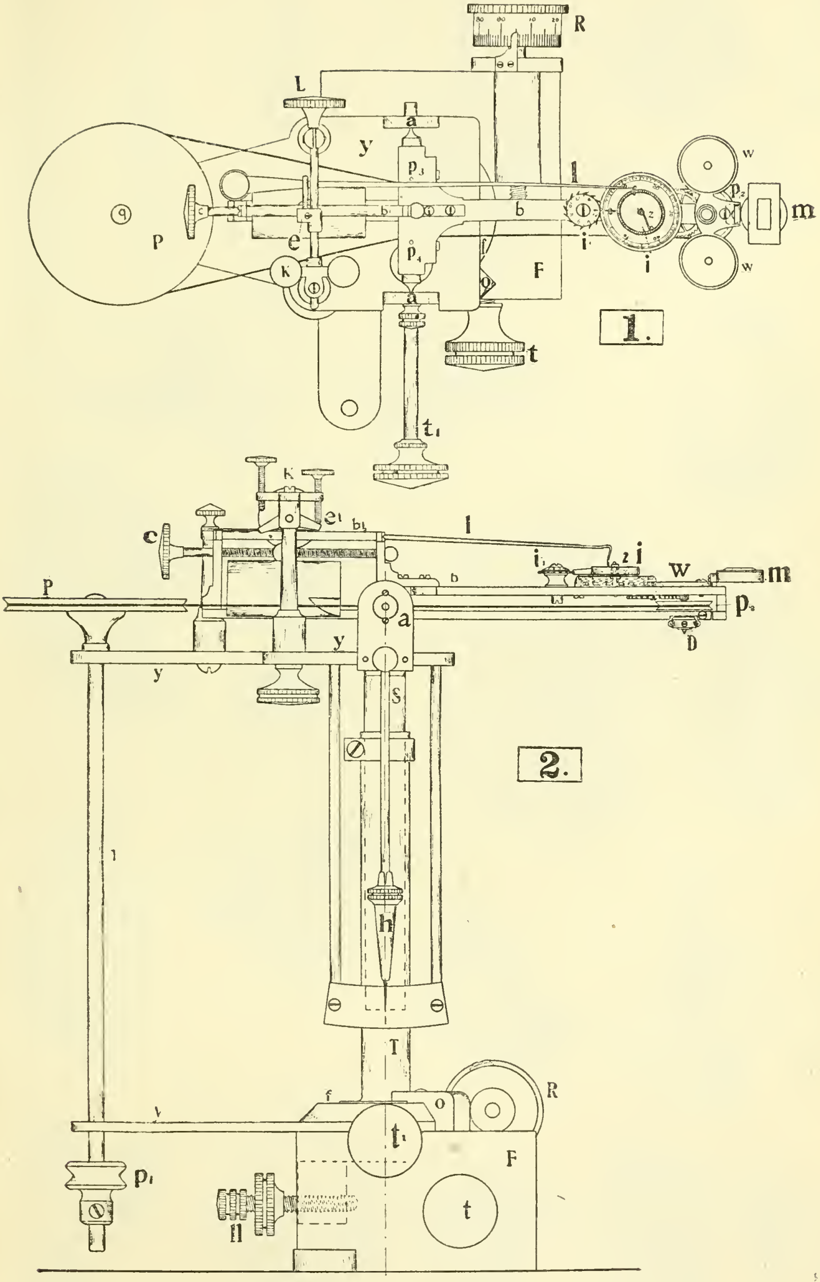
Jaggar's Micro-Sclerometer.



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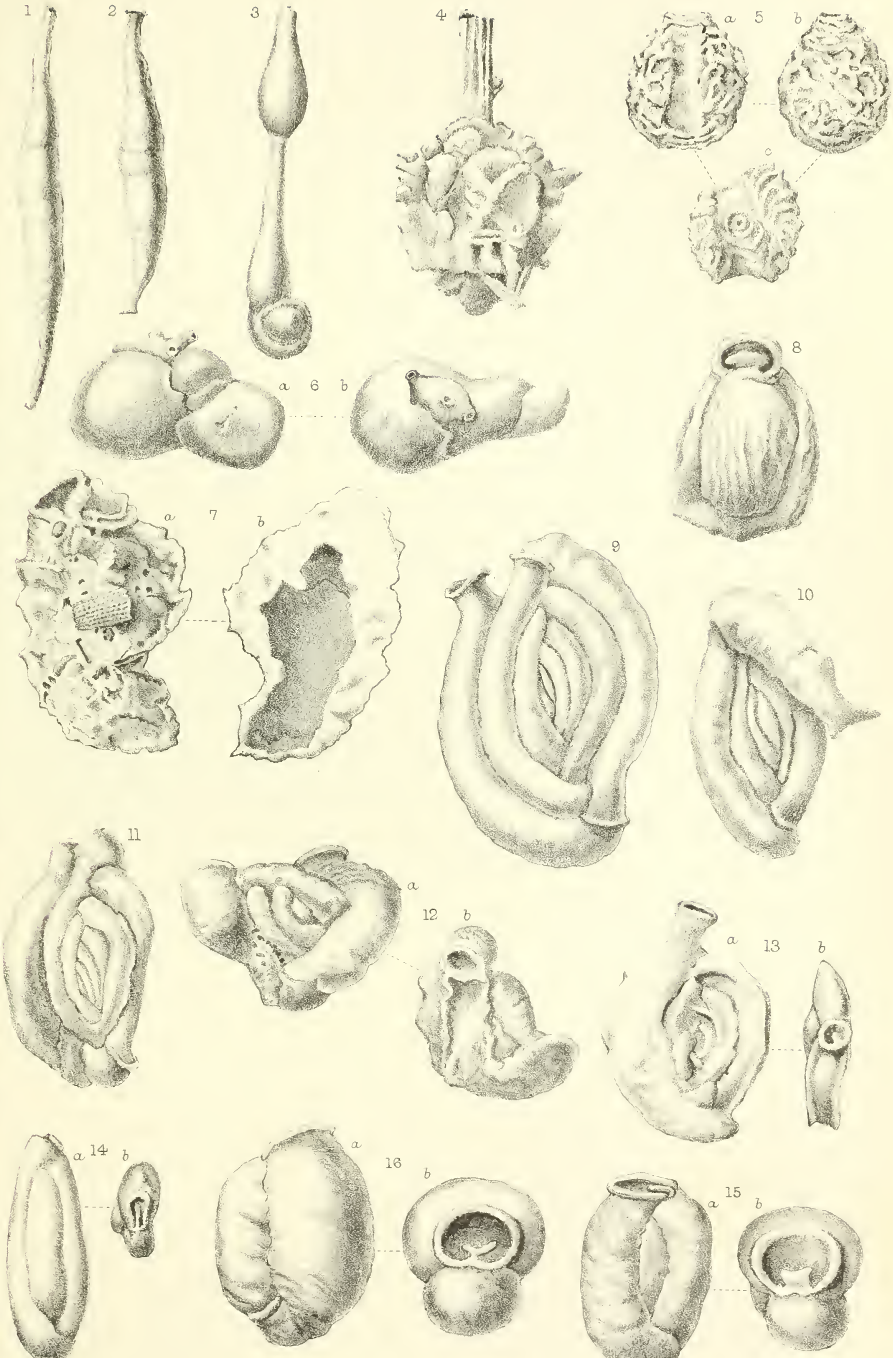
Jaggar's Micro-Sclerometer.



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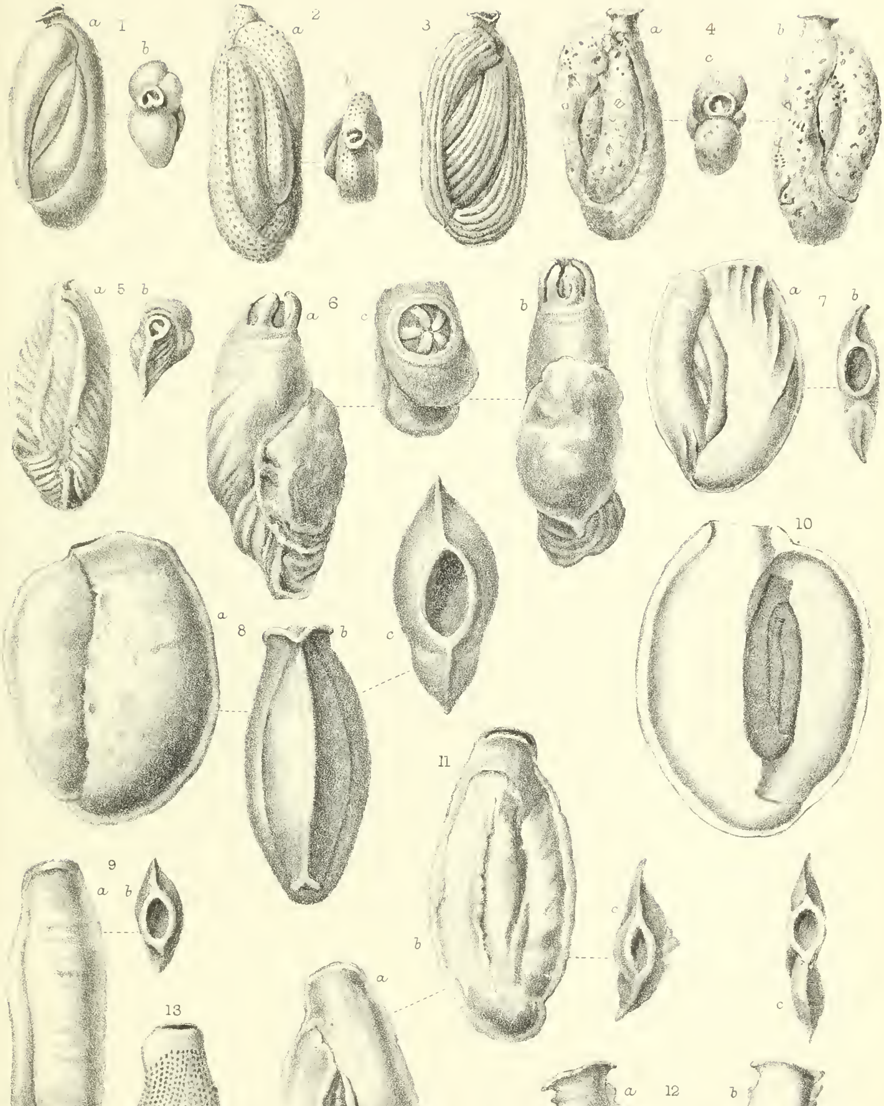

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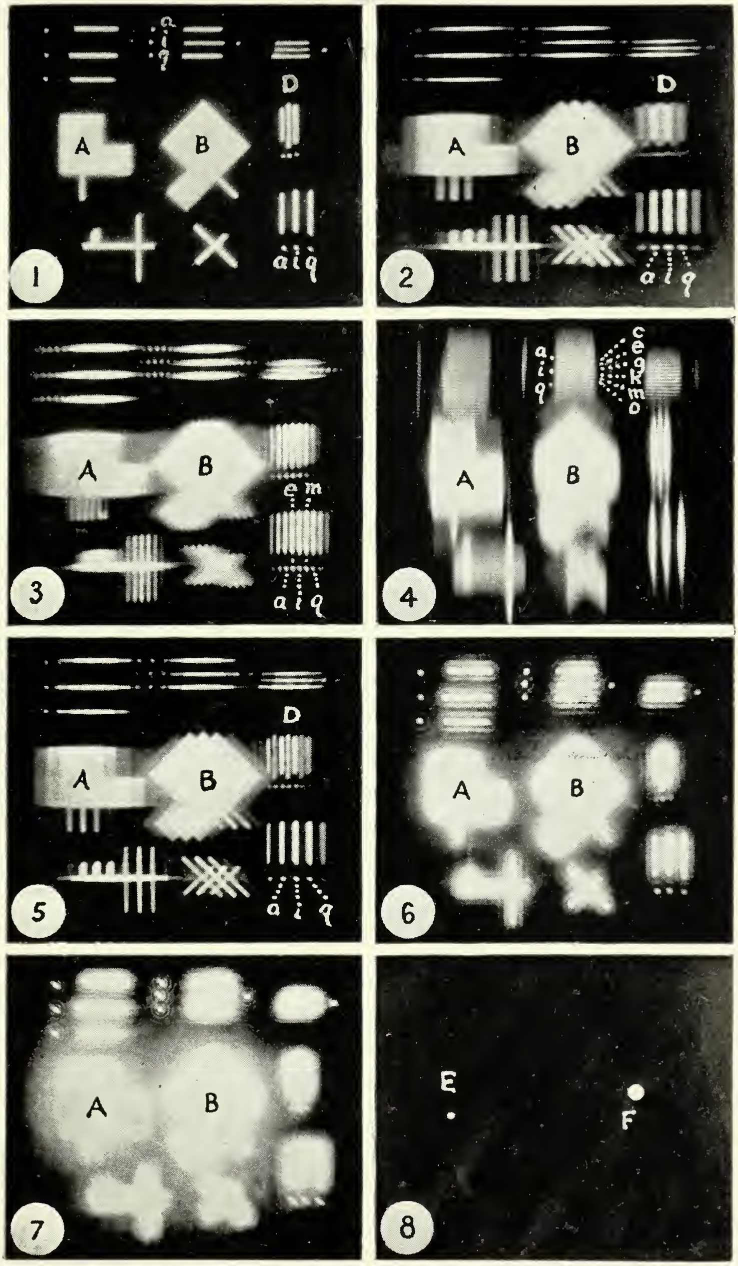

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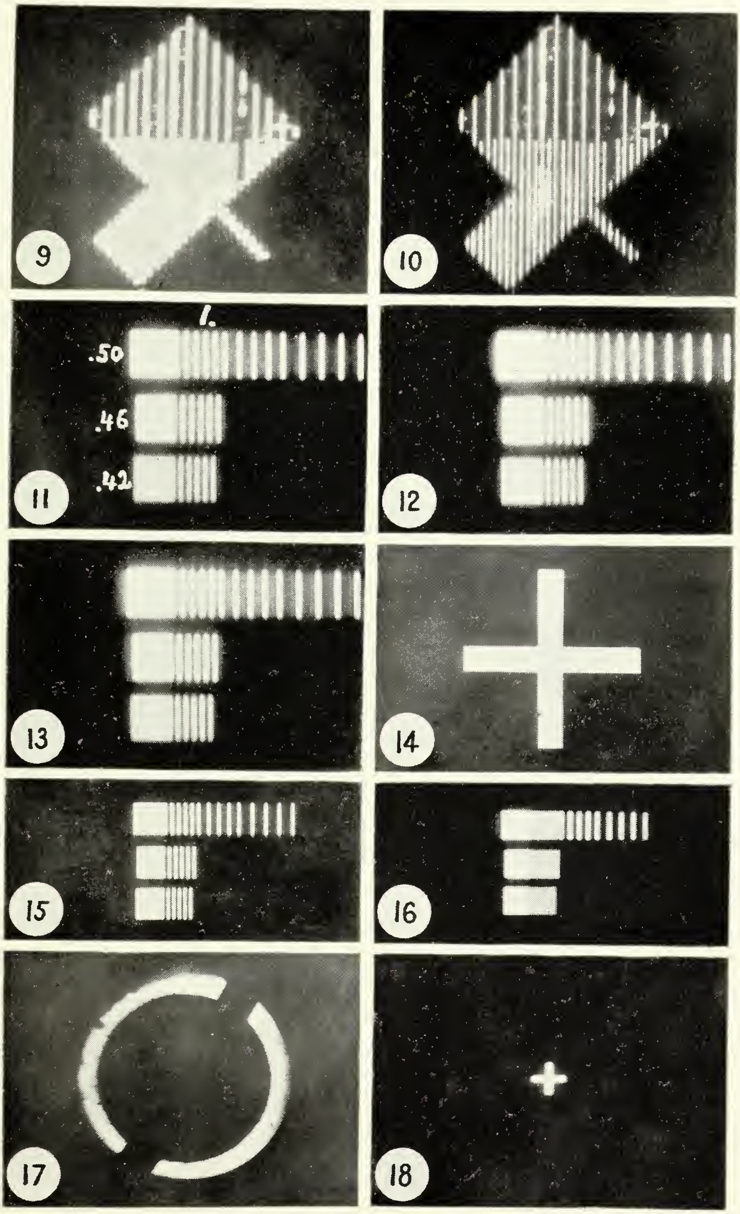

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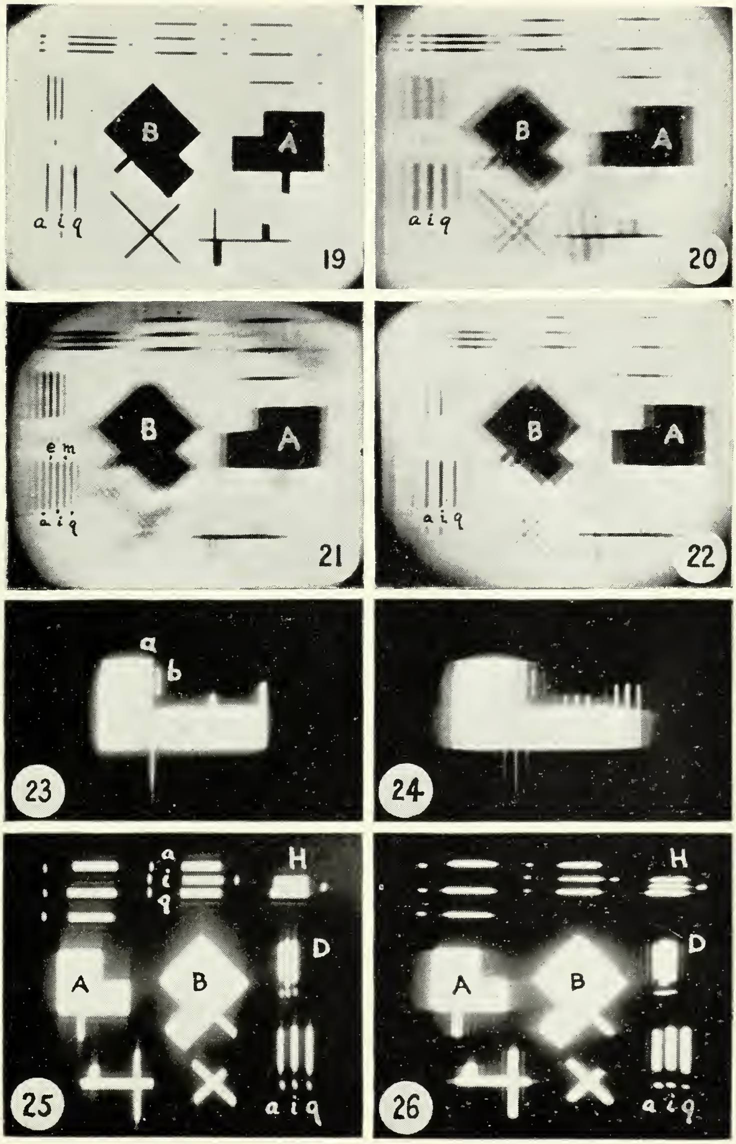

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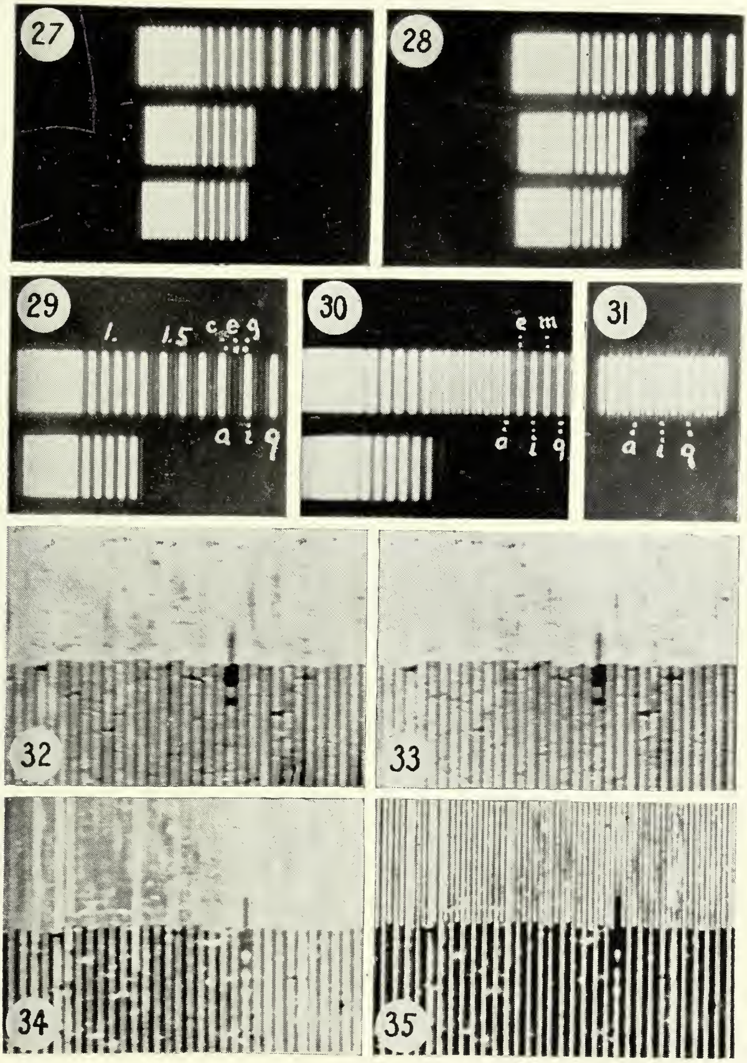

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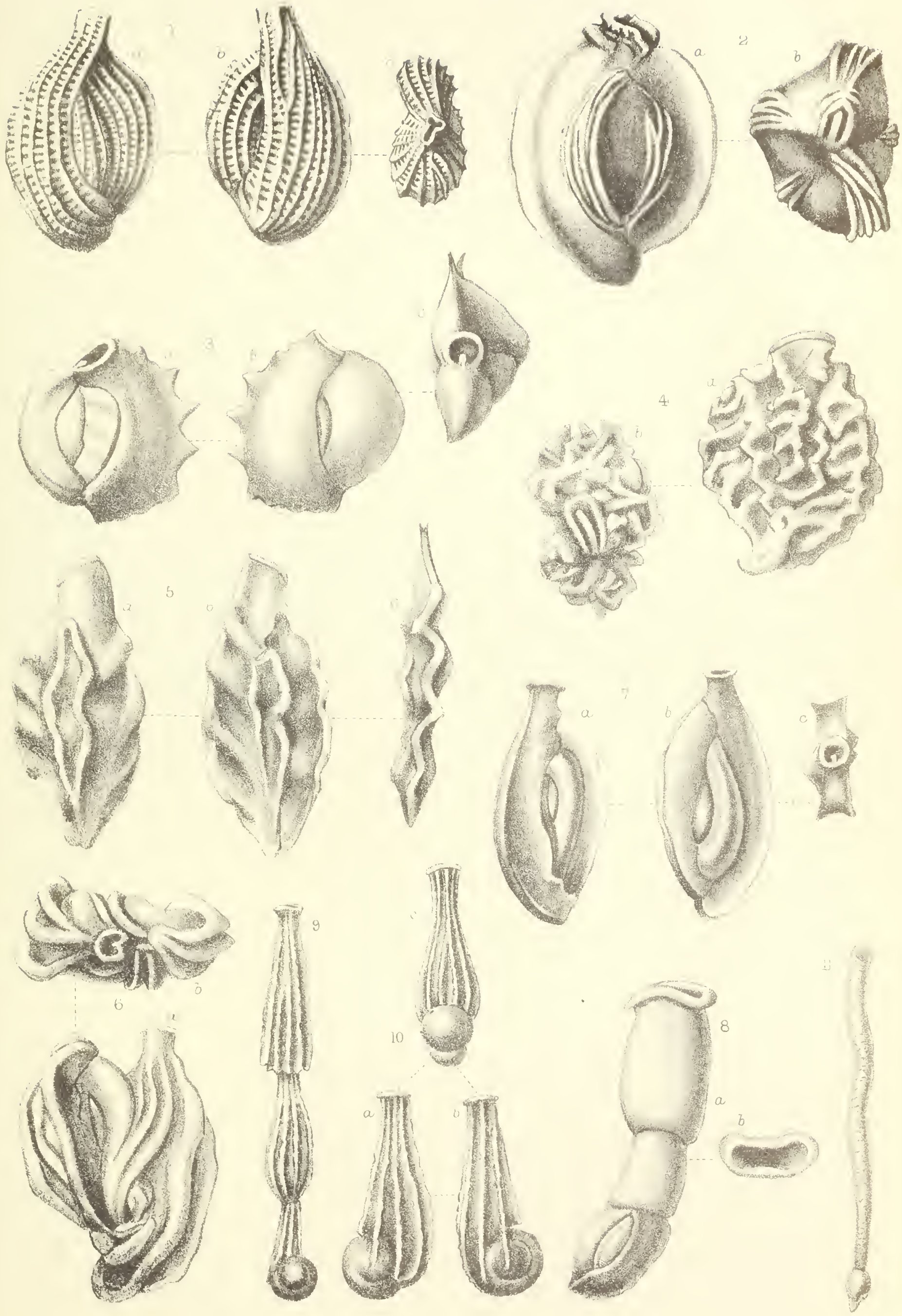

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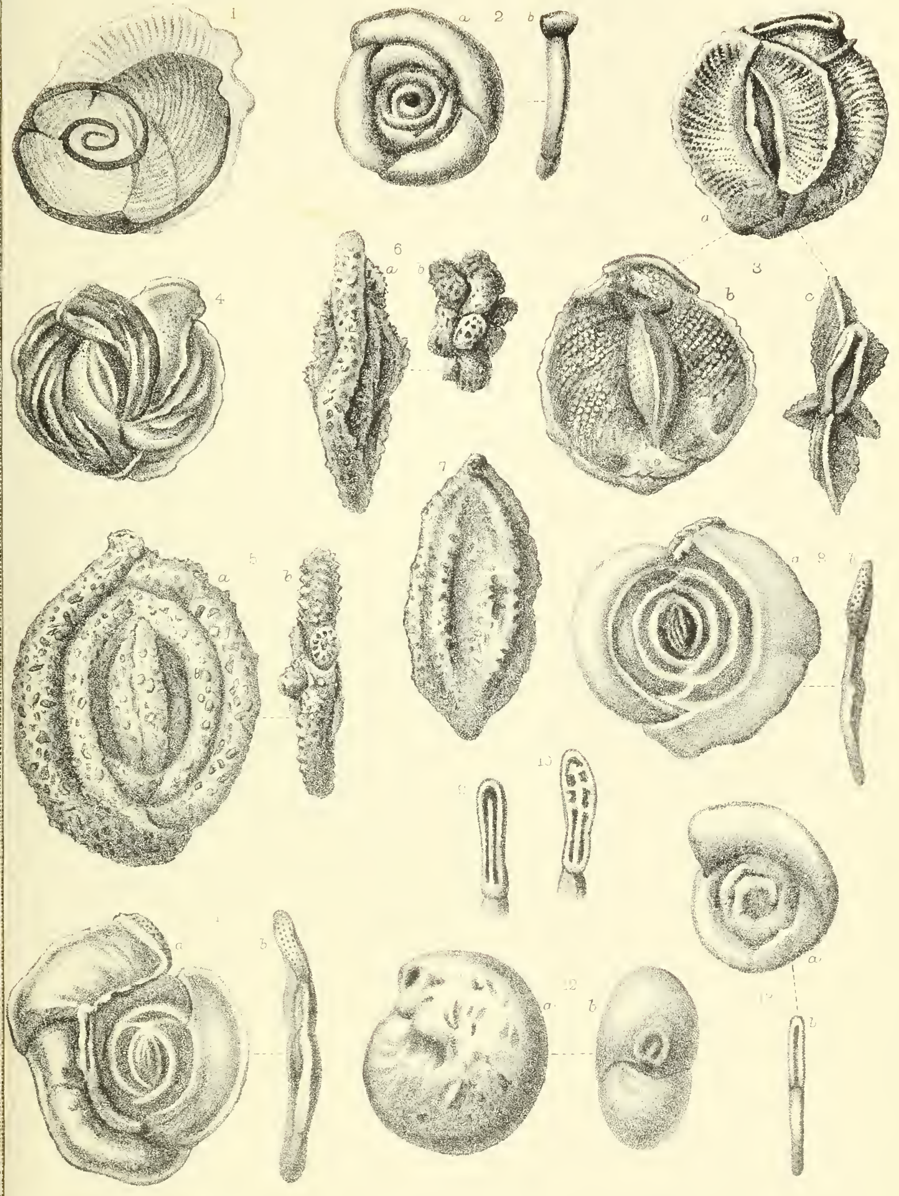

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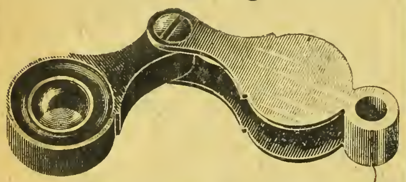

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a. Embryology.

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BOTANY.

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

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Muscineæ.

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Fungi.

Protophyta.

α. Schizophyceæ.

β. Schizomycetes.

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A. Instruments, Accessories, &c.

(1) Stands.

(3) Illuminating and other Apparatus.

(4) Photomicrography.

B. Technique.

(1) Collecting Objects, including Culture Processes.

(2) Preparing Objects.

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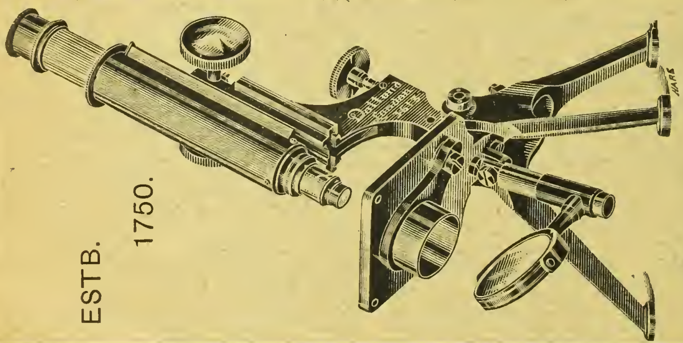

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VERTEBRATA.

a. Embryology.

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c. General.

Nematohelminthes.

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Incertæ Sedis.

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Echinoderma.

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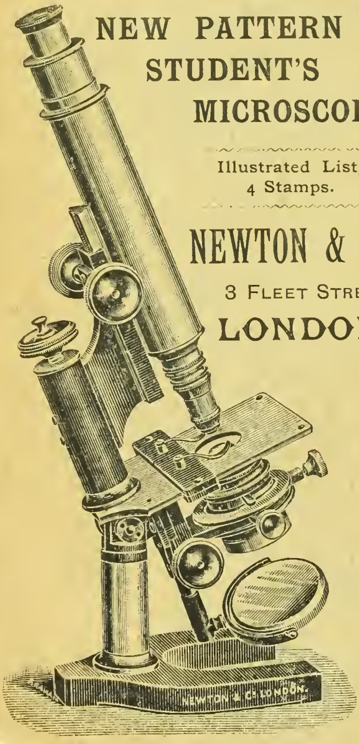

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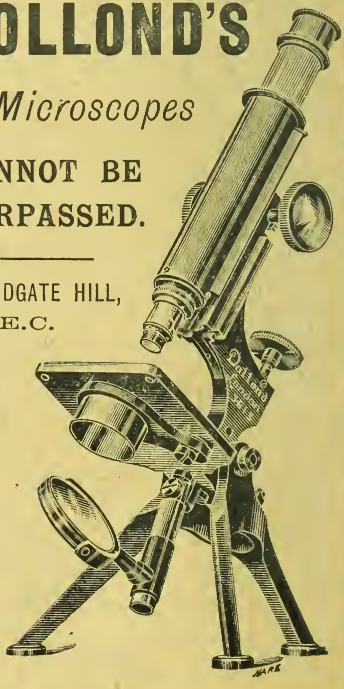

CONTENTS.

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β. Myriopoda.

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δ. Arachnida.

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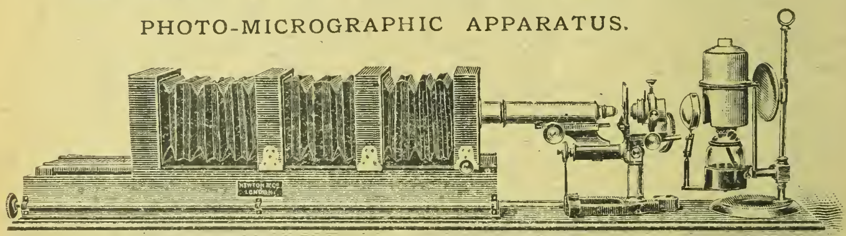

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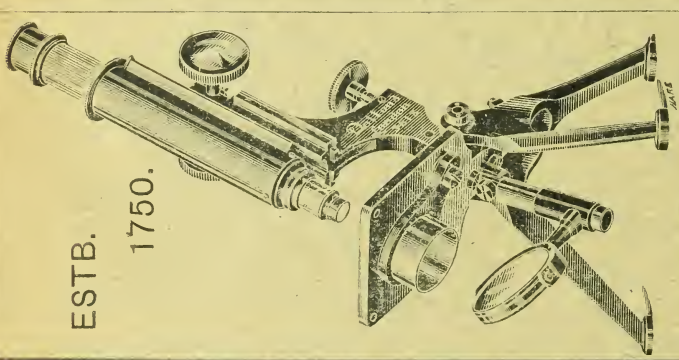

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VERTEBRATA.

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c. General.

Tunicata.

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(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).

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Muscineæ.

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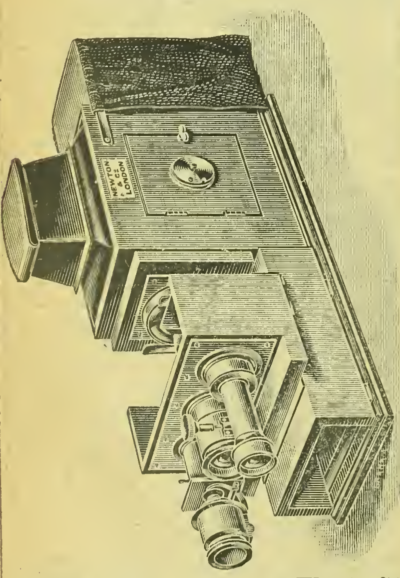

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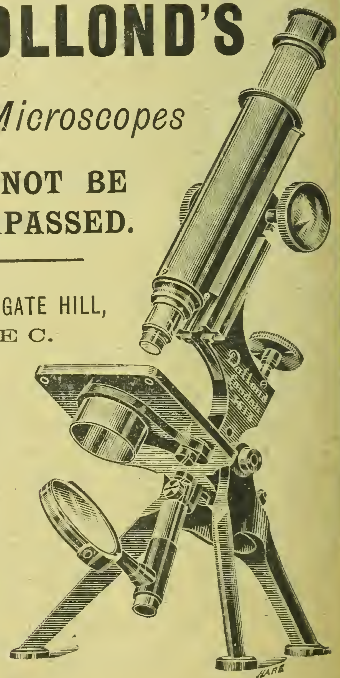

18

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CONTENTS.

TRANSACTIONS OF THE SOCIETY.

SUMMARY OF CURRENT RESEARCHES.

ZOOLOGY.

VERTEBRATA.

a. Embryology.

b. Histology.

c. General.

Tunicata.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

γ. Gastropoda.

δ. Lamellibranchiata.

Arthropoda.

α. Insecta.

β. Myriopoda.

γ. Protracheata.

δ. Arachnida.

ε. Crustacea.

Annulata.

Rotatoria.

Nematohelminthes.

Platyhelminthes.

Incertæ Sedis.

Echinoderma.

Cœlentera.

Porifera.

Protozoa.

BOTANY.

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

α. 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.

MICROSCOPY.

A. Instruments, Accessories, &c.

B. Technique.

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AND A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.

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B. Technique.

PROCEEDINGS OF THE SOCIETY.

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