JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY;

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS,

AND A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.

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FOR THE YEAR

1897.

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JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

FEBRUARY 1897.

TRANSACTIONS OF THE SOCIETY.

I.—*A New Calculating Machine.*

By Edward M. Nelson, F.R.M.S.

(*Read 16th December*, 1896.)

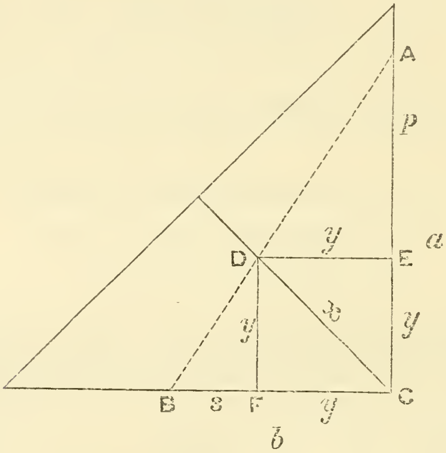
This calculating machine, which has been made by Messrs. Watson, was designed by Mr. Tamblyn-Watts, and as it possesses much interest I ask leave to bring it before the Society, for the particular calculation that is performed by it is specially important to optical workers, and hence also to microscopists.

The equation which this instrument is designed to solve is $\frac{1}{x} = \frac{1}{a} \pm \frac{1}{b}$; this is of frequent occurrence in optical formulæ, for by it not only is the focus of two lenses in contact as well as the position of conjugate foci found, but also many other problems are determined.

To solve then the equation by the ordinary method the reciprocals of two figures have to be looked up, these have to be added or subtracted from one another, and lastly the reciprocal of the answer must be found. Now all these several steps are performed at one time by this instrument, which consists, as you will observe, of two scales placed at right angles to one another. Each of them is divided into 100 similar divisions, and each division is subdivided into 5 smaller divisions. Now as a half of one of these small divisions can be easily estimated, these scales may be read to three significant figures. The third scale bisects the right angle, and is divided into 50 equal parts, each of which is subdivided into 5 smaller ones. These divisions, however, are not the same as those on the other two scales; in fact this third scale is not essentially necessary, it is only inserted for convenience, as will be presently seen.

In order to solve the equation by means of this instrument all that is required is to stretch a piece of cotton thread from the point where (a) (fig. 1) is indicated on A C to the point where (b) is indicated on B C; the answer is found at the point where the thread crosses D C (see dotted line). The correctness of the result may be demonstrated as follows. Let A C $= a$ and B C $= b$; from the point D, where the thread (dotted line) cuts the diagonal, draw D E and D F perpendicular to A C and B C respectively. Call A E, p; E C, y; and B F, s.

FIG. 1.



Because the angle D C E is half a right angle, and D E C a right angle, therefore C D E is also half a right angle, and consequently equal to D C F. Therefore D E = E C $= y$, and D E C F is a square. Because A B meets the two parallels D F, A C the angle B D F is equal to the angle D A E, consequently their tangents are equal, thus

$$\frac{s}{y} = \frac{y}{p}, \quad \text{and} \quad s = \frac{y^2}{p}; \quad a = p + y;$$

$$b = y + s = y + \frac{y^2}{p} = \frac{y(p + y)}{p}.$$

Therefore

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{p + y} + \frac{p}{y(p + y)} = \frac{1}{y}.$$

In order to find then the sum of $\frac{1}{a} + \frac{1}{b}$ place a T-square against A C to find the point E, where the perpendicular D E from the point D meets A C; then E C is the required answer. The scale on the diagonal line therefore is not required to obtain a solution, but it is obvious that the scale E C may be transferred to C D, then the answer can be read off directly at the point D without the use of the T-square. For as $x = y\sqrt{2}$ it is only necessary to make the divisions on C D $\sqrt{2}$ times larger than those on A C or B C. For example, if the divisions on A C or B C were one inch apart those on C D would have to be 1·4142 inches apart.

To solve $\frac{1}{x} = \frac{1}{a} - \frac{1}{b}$, whilst taking out ($a$) on A C as before take (b) out on D C, instead of on B C, and read the answer on B C.

Examples.

Let

$$a = 2{\cdot}1, \quad \text{and} \quad b = 6{\cdot}5;$$

then if

$$\frac{1}{x} = \frac{1}{a} + \frac{1}{b}, \quad x = 1{\cdot}59;$$

but if

$$\frac{1}{x} = \frac{1}{a} - \frac{1}{b}, \quad x = 3{\cdot}10.$$

By having the diagonal line graduated much trouble and inconvenience is thereby saved.

I am sure the thanks of all optical workers are due to Mr. Tamblyn-Watts for such a simple labour-saving machine.

II. — *On the Male of Rhinops vitrea.*

By Charles F. Rousselet, F.R.M.S.

(*Read* 16*th December*, 1896.)

Plate I.

Although Ehrenberg actually figured two male rotifers in 1838 he did not recognise them as such, but described them as new species, and for ten years after the publication of his great work the Rotifera were all considered hermaphrodite. The male of *Hydatina senta* Ehrenberg named *Enteroplea hydatina*, and he noted particularly that this was the only rotifer of which he could with certainty say that it had no trace of mastax and jaws. His second male rotifer he named *Notommata granularis*; it is the male of a *Brachionus*, probably *pala*. Ehrenberg found some *B. pala* and also *Notommata* (*Notops*) *brachionus*, carrying clusters of small eggs unlike the ordinary eggs, and out of these small eggs he saw his *N. granularis* emerge; and he came to the extraordinary conclusion that *N. granularis* laid its eggs on the back of *N. brachionus*, *Brachionus pala*, and other species of *Brachionus*, which reminded him of the story of the cuckoo, and for a time these small eggs were called cuckoo's eggs. All through his work Ehrenberg has described the contractile vesicle and lateral canals as the male organs of rotifers, and he was so convinced of the monœcious character of the class, that the idea of a separate male rotifer never for a moment entered his head. In 1851 Dr. J. Weisse had repeated all these observations, and in addition had discovered the new species *Diglena granularis*, whose eggs, as he thought, he found lying amongst those of *Diglena catellina*, and he also noted that *D. granularis* had no jaws. Afterwards he came to the conclusion that *Enteroplea hydatina*, *Notommata granularis*, and *Diglena granularis* were not different species, but that they were imperfectly developed, as yet toothless, young (" unvollendete, noch zahnlose Junge") of respectively *Hydatina senta*, *Brachionus pala* and *urceolaris*, and *Diglena catellina*.

But before this date, in 1848, Mr. Brightwell had made the important discovery and recognised the first male rotifer in *Asplanchna brightwelli*, and in 1850 Mr. Gosse had found the male of *A. priodonta*. Then, in 1854, Dr. Leydig discovered the male of *Asplanchna sieboldi*, and declared his opinion that *Enteroplea hydatina*, *Notommata granularis*, and *Diglena granularis* were the males of the species with which Weisse had already associated them, although he himself had had no opportunity of seeing these males. In 1855 Prof. Cohn confirmed Dr. Leydig and more fully figured and described the males of *Hydatina senta* and *B. urceolaris*, and in 1856 Mr. P. H. Gosse published his celebrated paper, 'On the Diœcious Character of the Rotifera,' in which he figured and described the males of *Brachionus pala, rubens, amphiceros, bakeri, angularis, dorcas,* and *mülleri, Sacculus viridis, Polyarthra platyptera* and *Synchæta tremula,* which fully established the diœcious character of the Rotifera. Of late years a large number of other male rotifers have been discovered, and quite lately (in April last) our Journal reproduced two fine drawings of the male of *Stephanoceros eichhorni,* the discovery of which is due to Mr. John Hood; the total number of species of which the males have been recorded is now about 64, a few of which, however, are doubtful.

The chief characteristics of all male rotifers so far described are: their diminutive size, and the total absence of a mouth, mastax, jaws, œsophagus, gastric glands, stomach, and intestine, the ovary being replaced by a large sperm-sac.

In the male of *Rhinops vitrea* (plate I. figs. 1 and 2) which it is my privilege now to describe, the conditions are altogether at variance with what have so far been considered the essential characters of male rotifers, and quite a new type of male is here found to exist.

At an excursion organised by the Quekett Microscopical Club to Esher on the 2nd of May last, we came upon a small pond which was found to contain *Rhinops vitrea* in considerable numbers, and as usual I filled a bottle of strained water from this pond. Upon examination of this water at home in a trough I observed a small elongated rotifer of somewhat different shape swimming swiftly among the more bulky and slower female *R. vitrea*; it attracted my attention and I thought it might possibly be the as yet unknown male of this species, especially as it played round the females according to the most approved fashion in Rotiferland, and a number of females had large spiny resting eggs, known to be the result of fertilisation, in their body-cavity. I therefore isolated a few specimens in a compressor for examination with a high power, and soon discovered that it was not only a male, but a male possessing fully developed jaws and functional digestive organs. The internal organs differed in no way from those of the female, except that the ovary on the ventral side was replaced by a rounded sperm-sac, in which the spermatozoa could be seen wriggling, prolonged into the usual copulatory organ. It was next necessary to demonstrate that this was really the male of *Rhinops,* so I isolated two stout females, the young in this species being always developed in the uterus within the body and brought forth alive, as in *Asplanchna,* and after a few hours I found several of the same males swimming about with the two females. I also isolated some other females so as to get some quite young females to compare as to size and shape with the males, and from these I found that the newly born females are considerably larger in bulk than the males, and that they resemble absolutely the adult females in shape, though somewhat smaller in size; moreover, the ovary with bright germ-cells is seen very distinctly in the young female.

As will be seen by the accompanying figures, for which I am indebted to my friend, Mr. F. R. Dixon-Nuttall, and also by the mounted slide under the Microscope in the room, the shape of the male of *Rhinops vitrea* differs somewhat from that of the female; the body becomes suddenly narrower in the lumbar region, whilst in the female it tapers very gradually down to the toes. The body is very lithe and soft, bending constantly in every direction. The corona with its proboscis-like dorsal projection resembles that of the female in every way, and two red eyes are in the same manner situated near the extremity of the proboscis, each having a minute spherical crystalline lens imbedded in the red pigment. A dorsal antenna is seen on the dorsal side, a little below the eyes (this antenna is also present in the female), and the two lateral antennæ are very conspicuous at the projecting angle of the lumbar region, each furnished with a brush of abnormally long setæ; in the female the lateral antennæ are very small. The foot is short, consisting apparently of one joint containing the two foot-glands, and terminating in two minute toes.

The chief characteristic and the most abnormal feature about this male is the possession of functional jaws and intestine. The jaws are like those of the female in structure, but in one specimen I thought the right malleus shorter than its companion on the left side. The œsophagus is a thin, narrow tube leading to an elongated thick-walled stomach, with two gastric glands attached, and continued behind into a narrow intestine, all ciliated in the interior. The jaws were frequently moving, but the contents of stomach and intestine were very slight and of a greenish tinge, without solid particles of large size. It seems clear, however, that the male of *Rhinops* can take in some food, and therefore sustain life and live longer than all other known male rotifers. No trace of an ovary could be found, but in its place, ventral to the intestine, is a rounded sperm-sac, at the lower end of which the spermatozoa could be plainly seen in motion, terminating in a duct with the usual retractile and ciliated copulatory organ. A small contractile vesicle and lateral canals with flame-cells attached are present as usual.

In swimming the movements of these males were very lively, turning, bending, and twisting continually, and contrasting markedly with the slower gliding motion of the females.

In size the males are 1/135–1/120 in. (0·188–0·212 mm.), or a little over half the size of the females, and much more slender, on account of the narrower posterior part of the body.

The discovery of this male opens up interesting questions as to the evolution of the male rotifers, which in the great majority of cases are little more than perambulating bags of spermatozoa, living a very short and merry life. The most rudimentary male I have yet seen is that of *Polyarthra platyptera*, which can hardly be distinguished from a *Vorticella* which has become detached from its stalk. It seems evident, however, that the males are simply degenerated forms, though why degeneration should have occurred at all must still remain a mystery; in some species degeneration has been carried further than in others, whilst in *Rhinops vitrea* it seems to have yet scarcely begun.

In a large number of families the males are now known; the Philodinidæ, however, form a conspicuous exception, as no single male of the genera *Philodina*, *Rotifer*, *Callidina*, or *Adineta* has yet been discovered. It has been proved by M. Maupas that the so-called winter eggs (which occur at all seasons) are those which have been fertilised by males; both Dr. Janson and Mr. D. Bryce have observed spiny resting eggs in several species of *Callidina*, and it is therefore not too much to infer that male *Callidina* must exist. May it not be possible that the males in this family have jaws like the females, and have been overlooked, because the moment a Philodine was seen to have jaws it has been dismissed as an impossible male? I would suggest to those who have made this family their special study to look for males, with sperm-sac instead of ovary, amongst Philodines showing fully developed jaws and digestive tract.

I conclude this paper with a list of all Rotifers, 64 in number, whose males are known, with the names of the authors who have figured and described them:—

Stephanoceros eichhorni Western, Dixon-Nuttall.
Floscularia campanulata Hudson, Weber.
„ *mutabilis* Hudson.
„ *calva* Hudson.
„ *ambigua* Hudson.
„ *coronetta* Hudson.
„ *gossei* Hood.
„ *pelagica* Rousselet.
„ *cucullata* Hood.
Apsilus lentiformis Metschnikoff.
Melicerta ringens Hudson.
„ *conifera* Gosse.
„ *tubicolaria* Hudson.
„ *janus* Hudson.
Limnias ceratophylli Gosse.
Œcistes mucicola Western.
Lacinularia socialis Hudson.
„ *natans* Western.
Megalotrocha alboflavicans Anderson.
„ *semibullata* Thorpe.
„ *procera* Thorpe.
Trochosphæra æquatorialis Thorpe.
Conochilus volvox Cohn, Hudson.
„ *unicornis* Rousselet.
Asplanchna brightwelli Brightwell, Dalrymple.
„ *priodonta* Gosse.

Asplanchna sieboldi Leydig, Daday.
„ *ebbesborni* Hudson.
„ *intermedia* Hudson.
„ *amphora* Western.
„ *triophthalma* Daday.
Asplanchnopus myrmeleo Western.
Ascomorpha (Sacculus) viridis Gosse.
Microcodon clavus Gosse.
Synchæta tremula Gosse.
„ *gyrina* Hood.
Polyarthra platyptera Gosse, Plate.
Triarthra breviseta (= *T. cornuta*) Plate.
Rhinops vitrea Rousselet.
Hydatina senta Hudson, Weber.
Cyrtonia tuba Rousselet.
Notops brachionus Hudson.
„ *clavulatus* Western.
Triphylus lacustris Western.
Copeus pachyurus Dixon-Nuttall.
Proales parasita (= *Hertwigia volvocicola*) Plate.
Diglena catellina Weisse, Weber.
„ *mustela* Milne.
Seison Grubii Claus.
Paraseison asplanchnus Plate.
Ploesoma hudsoni (*Bipalpus vesiculosus*) Zacharias, Wierzejski.
Salpina mucronata Hudson.
Euchlanis dilatata Cohn.
Metopedia lepadella Gosse.
Brachionus pala Gosse.
„ *rubens* Gosse.
„ *bakeri* Gosse.
„ *angularis* Gosse.
„ *dorcas* Gosse.
„ *mülleri* Gosse.
„ *urceolaris* Cohn, Weber.
„ *furculatus* Thorpe.
Anuræa aculeata Plate.
Pedalion mirum Hudson.

In addition to the above list the males of the following 31 species have been seen at various times by Mr. John Hood, Mr. G. Western, Mr. F. R. Dixon-Nuttall, or myself, but no figures or descriptions of them have yet been published.

Floscularia ornata.
„ *cornuta.*
„ *trilobata.*
„ *cyclops.*

Œcistes umbella.
„ *pilula.*
„ *crystallinus.*
„ *stygis.*
„ *velatus.*
Synchæta pectinata.
„ *baltica* (Gosse's species, which is not Ehrenberg's).
„ *tavina.*
Triarthra longiseta.
Notops minor.
„ *hyptopus.*
„ *pigmæus.*
Notommata naias.
Copeus collaris.
Proales sordida.
„ *petromyzon.*
Eosphora digitata.
Furcularia ensifera.
Diaschiza semiaperta.
Euchlanis lyra.
„ *oropha* (=*parva*).
„ *triquetra.*
Scaridium eudactylotum.
Distyla gissensis.
Pterodina patina.
„ *clypeata.*
„ *elliptica.*

III.—*Second List of New Rotifers since* 1889.

By Charles F. Rousselet, F.R.M.S.

(*Read* 16*th December*, 1896.)

In August 1893 I published in this Journal a list of 186 new species of Rotifers described since the publication of the Supplement to the Rotifera by Hudson and Gosse in 1889. Since then 109 more new names have been added, which I have tabulated in the list below, and I append a Bibliography of the works in which those new species are described or discussed.

My warning to avoid making new species out of slight varieties, and my recommendation to supply good figures and descriptions have unfortunately had very little effect. Out of 19 new species of *Brachionus* not less than seven are mere varieties of *B. bakeri*, and Mr. C. H. Turner has named a new American *Asplanchna* merely because he could find only one point at the extremity of the jaws of some *A. brightwelli* instead of two, the normal but variable form; if he were to examine all the dogs he could find for such minute differences it is certain he would have to make a distinct species out of every *Canis familiaris* living.

Some authors, again, have made new species with contracted spirit specimens of soft-bodied illoricate rotifers, such as *Floscularia, Notommata, Œcistes*, &c., of which they could not possibly know any real distinctive character; and an empty shell of Gosse's *Pompholyx complanata* has been absurdly described as a new species of *Notholca*, "with a posterior opening for the passage of the foot" when a foot does not exist at all in this genus! In a number of other cases the figures and descriptions are quite useless as aids to future identification.

If the duplication of names goes on at this rate it is certain great confusion will follow. A few protests against the practice have indeed been raised, and it would be very desirable and in the interest of science if students of the Rotifera would exercise more care and discretion, and avoid giving new names on the slightest pretext, when it is well known that in many cases the original figures and descriptions are not perfect or complete, and that most species are liable to considerable variation.

Where in the following list there is no doubt about the identity of the species with a known form that name has been added in brackets, and I have marked with a (?) those species which are bad, or quite insufficiently figured and described.

The numbers refer to the Bibliography at the end.

RHIZOTA.

Floscularia atrochoïdes Wierzejski (93).
„ *libera* Zacharias (96).
„ *cucullata* Hood (68).
„ *brachiurus* Barrois and Daday (60, 82) (?).
„ *trifidlobata* Pittock (80).
Œcistes syriacus Barrois and Daday (60, 82) (?).
Lacinularia elongata Shephard (87).
Conochilus leptopus Forbes (66) (= *C. unicornis* Rousselet).

BDELLOIDA.

Rotifer forficatus Barrois and Daday (60, 82) (?).
Callidina fusca Bryce (59).
„ *plena* Bryce (59).
„ *habita* Bryce (59).
„ *angusta* Bryce (59).
„ *eremita* Bryce (59).

New Genus.

Cypridicola parasitica Daday (63).

PLOÏMA. I. Il-loricata.

Asplanchna cincinnatus Turner (92) (= *A. brightwelli*).
Sacculus cuirassis Hood (69).
Synchæta triophthalma Lauterborn (78).
Polyarthra platyptera var. *remata* Skorikow (99).
Triarthra thranites Skorikow (99) (?).
Notops macrourus Barrois (60, 82) (?).
Taphrocampa viscosa Levander (79).
„ *clavigera* Stokes (88).
Pleurotrocha littoralis Levander (79).
„ *sigmoidea* Skorikow (99).
Notommata monopus Jennings (74).
„ *truncata* Jennings (74).
„ *mirabilis* Stokes (88, 84) (= *N. tripus*).
Copeus quinquelobatus Stokes (89, 90).
Proales caudata Bilfinger (58).
„ (*Notops*) *laurentinus* Jennings (74, 75).
Furcularia longiseta var. *grandis* Rousselet (81).
Bothriocerca longicauda Daday (62).

New Genera.

Adactyla verrucosa Barrois and Daday (60, 82) (?).
Microcodides doliaris Rousselet (81).

PLOÏMA. II. Loricata.

Mastigocerca hudsoni Lauterborn (77) (= *M. capucina* Wierzejski)
„ *setifera* Lauterborn (77).

Mastigocerca lata Jennings (74).
„ *dubia* Lauterborn (78).
„ *fusiformis* Levander (79).
„ *curvata* Levander (79).
„ *mucosa* Stokes (88).
Rattulus sulcatus Jennings (74, 75, 58).
„ *palpitatus* Stokes (88, 84).
„ *bicornis* Skorikow (99) (= *R. bicornis* Western).
„ *collaris* Rousselet (83).
Diurella neapolitana Daday (62)
„ *brevidactyla* Daday (62) (?)
Dinocharis truncatum Whitelegge (95)
Stephanops emarginatus Bilfinger (58) (= *St. intermedius* Burn).
„ *bisetatus* Ternetz (91).
„ *variegatus* Levander (79).
Salpina macrocera Jennings (74).
„ *similis* Stokes (88, 84) (= *S. macracantha* Gosse).
Diplax videns Levander (79).
Diploïs trigona Rousselet (81).
Euchlanis plicata, Levander (79).
Cathypna leontina Turner (92) (= *Distyla ichthyoura* Shephard).
„ *appendiculata* Levander (79) (= *Distyla ichthyoura* Shephard).
„ *affinis* Levander (79).
Distyla spinifera Western (94).
„ *signifera* Jennings (75).
Monostyla truncata Turner (92) (?).
„ *tentaculata* Cosmovici (61).
„ *lamellata* Daday (64).
„ *ovata* Forbes (66) (?).
„ *hamata* Stokes (88).
„ *robusta* Stokes (88).
„ *bipes* Stokes (88).
Colurus margoi Kertész (76).
„ *agilis* Stokes (89).
Metopedia elliptica Turner (92) (?).
„ *dentata* Turner (92) (?).
„ *pterygoida* Dunlop (98).
„ *lepadella* var. *collaris* Levander (79).
„ *collaris* Stokes (88).
Pterodina incisa Ternetz (91).
„ *parva* Ternetz (91).
„ *bidentata* Ternetz (91) (= *L. emarginata* Wierzejski).
„ *crassa* Levander (79).
Brachionus rhenanus Lauterborn (77, 86, 97) (= *B. brevispinus* var. Ehrb.
„ *tuberculus* Turner (92, 97) (= *B. bakeri* var.).

Brachionus melhemi Barrois and Daday (60, 82, 97) (=*B. bakeri* Ehrb.).
„ *bursarius* Barrois and Daday (60, 82).
„ *caudatus* Barrois and Daday (60, 82) (=*Schizocerca diversicornis* var.? Daday.
„ *obesus* Barrois and Daday (60, 82, 97) (=*B. bakeri* var.).
„ *pyriformis* Barrois and Daday (60, 82).
„ *angusticollis* Kertész (76).
„ *quadristriatus* Kertész (76).
„ *bidentatus* Kertész (76).
„ *quadridentatus* Kertész (76).
„ *granulatus* Kertész (76, 97) (=*B. bakeri*).
„ *reticulatus* Kertész (76) (=*B. quadratus?* Rousselet).
„ *entzii* Francé (67, 86, 97) (=*B. brevispinus*).
„ *pentacanthus* Francé (67, 86) (=*B. pala* var.).
„ *cluniorbicularis* Skorikow (85, 86, 97, 99) (=*B. bakeri* var.).
„ *lineatus* Skorikow (99) (=*B. punctatus* Hempel).
„ *variabilis* Hempel (71).
„ *punctatus* Hempel (71).
„ *mollis* Hempel (71).

Anuræa aculeata var. *platei* Jägerskiöld (72).
„ *cochlearis* var. *recurvispina* Jägerskiöld (72).
„ *eichwaldi* Levander (79, 81) (=*A. cruciformis* Thompson).
„ *frenzeli* Eckstein (65) (=*A. aculeata*).

Notholca equispinata Cosmovici (61).
„ *orientalis* Barrois and Daday (60, 82) (=*Pompholyx complanata* Gosse).

New Genera.

Dictyoderma hypopus Lauterborn (77) (=*Ploesoma hudsoni* Imhof).
Chromogaster testudo Lauterborn (77).
Gastroschiza truncata Levander (79).

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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.†

Menstruation and Ovulation of Macacus rhesus.‡—Mr. W. Heape has published an abstract of the results of his investigations made on specimens of this monkey collected in Calcutta in 1891. The creature seems to have a definite breeding season, but it is quite certain that in different parts of India the breeding season occurs at different times of the year. Menstruation is marked by a number of prominent signs, and there is a regular menstrual flow. The tissue changes which take place during the menstruation of *M. rhesus* are very similar to those which the author has already described for *Semnopithecus entellus*. The results arrived at by the study of the second species entirely confirm the results led to by a study of *S. entellus*. The changes which take place in the eight stages into which the process of menstruation is divided are sketched. The author feels warranted in asserting that the regular occurrence of menstruation without ovulation, even though it be in the non-breeding season, is sufficient evidence that ovulation is a distinct process, and that it depends upon a law or laws other than those which govern menstruation.

No trace of a blood-clot within the follicle was seen, and therein the ruptured follicles of *M. rhesus* differ from what is usually described as a normal ruptured follicle in the human female. This difference between two animals, both of which undergo menstruation, is remarkable and

* 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.

‡ Proc. Roy. Soc. Lond., lx. (1896) pp. 202–5.

worthy of special attention. The author has some reason for believing that the difference may be due to the presence or absence of the breeding season in monkeys, and to periods in the human female which are in the one case favourable and in the other case not favourable to conception. If this be true the period of the human female which is unfavourable to conception would be comparable to the non-breeding season of monkeys, and the period favourable to conception with the breeding season of monkeys. It is not of course maintained that amongst civilised peoples at the present day there are definite breeding and non-breeding times. The comparison is in harmony with the view that at one period of its existence the human species had a special breeding season.

Amitotic Nuclear Division in the Egg of the Hedgehog.*—Mr. Matts Floderus gives a report of some observations on the ovary of the hedgehog, which appear to indicate the presence of an amitotic process of nuclear division in the germinal vesicle. Only a few instances of this process have been observed, especially in Vertebrates, and, as for Mammals, there is no other indication than that of Flemming, and the egg with which that observer had to deal was not normal. Under these circumstances, the author believes that his case presents some interest, although no general conclusions can be drawn from it. It is perhaps merely abnormal, and we will content ourselves with directing our readers' attention to the paper.

Oogenesis in the Mouse.†—Dr. J. Lange finds that two phases of oogenesis and follicle-formation must be distinguished in the mouse. The first is embryonic, the second begins after birth, and continues for a prolonged period. (1) A large number of germinal cells in the embryonic ovary form *primitive ova* (*Ureier*). At the time of birth the undifferentiated germinal cells form a membrana granulosa around the primitive ova. Thus arise primordial follicles. At an age of about four weeks complete follicles are found, but of these a large number atrophy. (2) At an age of 6–8 weeks a new proliferating phase sets in. Individual cells of the germinal epithelium differentiate into primitive ova; along with the adjacent indifferent germinal epithelial cells these are sunk into the stroma, and form primordial follicles. The formation of fresh follicles continues to an advanced stage in the life of the mouse.

Division of Ovarian Ova.‡—Prof. J. Janošík has made some remarkable observations on the ovarian ova of various Mammals, guinea-pig, rabbit, &c. The ovarian ovum may form, especially in young animals, regular polar bodies, or precisely similar bodies. Thereafter, without any fertilisation, it may divide into nucleated segments either equal or unequal. Besides these actual divisions, there are often fragmentations, especially in older animals. As division goes on, the membrana pellucida is lost, as in normal development after fertilisation.

Embryonic Variations and Growth.§—Dr. A. Fischel has studied the variability and growth of duck-embryos. Individual variations in length occur at all stages, and affect both the whole and its parts. An

* Bih. K. Svenska Vet. Acad. Handlgr., xxi. iv. No 2 (1895) 12 pp. and 1 pl.
† Verh. Phys. Med. Ges. Würzburg, xxx. (1896) pp. 55–76 (1 pl.).
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§ Morph. Jahrb., xxiv. (1896) pp. 369–404 (1 pl. and 10 figs.).

embryo may be more than one-half larger than another of the same stage, and one with a single protovertebra may be as long as another with twelve. His results, taken along with those of Bonnet, Keibel, Mehnert, and Oppel, lead him to conclude that the variations in size also represent differences in the internal structure of the parts.

There seems to be no constant relation between the total length and the length of individual regions. In other words, proportions vary widely. Variations are commonest in the youngest stages, and decrease as differentiation increases. The correlations of the developing organs seem to have a regulating influence, narrowing the limits of variations in size and proportions.

Fischel agrees generally with His, that absolute and relative growth in younger and older stages vary inversely, the former being greatest at first, but gradually decreasing. He adds that the intensity of growth varies with the individual, though there is always a relation of dependence between the intensity of relative growth and the total length of the embryo. Zones of intense growth are distinguishable, and the growth both of the whole length and of the several regions is periodic. A "plus" of growth-energy in one region seems to imply a "minus" in another. The reasons for this remain obscure.

Tooth-Genesis in Canidæ.*—Dr. H. W. Marett Tims, in treating of the tooth-genesis in the Canidæ, tells us that his main object was to trace the order of cusp-development, and the interrelationships of the various cusps in the tooth of the dogs, and to examine into the evidence, thereby obtained, bearing upon important and interesting problems of phylogeny. The author has been led to profound disagreement with Prof. Osborn, and he thinks that there are still other objections which may be urged against the tritubercular theory. These we need not summarise here. Suffice it to say that neither the tritubercular theory nor the multitubercular theory satisfies the author, and he proposes instead the theory of "cingulum cusp-development." This theory, we are told, is supported both by palæontological and embryological evidence.

The following are said to be the points in its favour :—(1) It harmonises more fully with what is known of the development of the teeth than either the tritubercular or multitubercular theory, the primary cone representing the reptilian cone and being always present. (2) It is quite possible and easy thus to homologise the cusps of all teeth, except perhaps the derivatives of the multituberculate type. (3) It is in accordance with palæontological history. (4) No supposed rotation of cusps is required.

Dentition of Manatee.†—Prof. W. Kükenthal has studied an embryo of *Manatus latirostris* 6·85 cm. in length, and establishes as the dental formula of the embryo $\frac{3003}{3133}$. In the course of phylogeny, reductions took place first in the upper jaw, canines and premolars disappearing, while the incisors became rudimentary sooner than those of the lower jaw. The teeth of the lower jaw retained their function longer, but also became useless; the third premolar was the first to disappear; there-

* Journ. Linn. Soc., xxv. (1896) pp. 445–80 (8 figs.).
† Anat. Anzeig., xii. (1896) pp. 513–26 (10 figs.).

after the teeth in front of it were also reduced. In relation to the back teeth, Kükenthal finds evidence of no fewer than three successive dentitions taking part in the formation of the definitive tooth. The main mass is due to the first dentition, with its labial wall the prelacteal fuses; the second dentition forms the rudiment of a lingual papilla.

Development of Nostrils in Mammals.*—Dr. H. Tiemann has studied this in various Mammalian embryos. Olfactory areas, thickenings of ectoderm in the front of the head, become pits and then pockets. There is no groove or furrow communicating with the mouth, nor does the maxillary process share in forming the primitive nasal cavity. The modification of pits into nasal cavities is mainly due to marginal growth and to epithelial fusion of the lateral and median nasal process. This epithelial fusion is replaced in the anterior region by a mesodermic mass which forms firm tissue; posteriorly in the part towards the mouth the epithelial bridge persists for a time. But by separation of the side walls it becomes reduced to a thin membrane (membrana bucco-nasalis); and it is only when this at length ruptures that a communication between nasal cavity and primitive mouth-cavity is established.

Spermatogenesis in Salamander.†—Dr. Fr. Meves follows the successive generations of sperm-cells in *Salamandra maculosa*. He begins with the period of multiplication, describing the spermatogonia at rest and during division. The period of growth is next discussed. The third chapter has to do with maturation. The first maturation-division is heterotypic, the second homootypic, and there is no strict resting-stage between. Both are equation-divisions, not reduction-divisions. We have not been able to summarise this elaborate paper, but in a general way it may be said that the account given brings the spermatogenesis of the salamander into line with that observed in other cases. There is much agreement with Flemming, and very complete disagreement with vom Rath. Apart from the particular theme and such particular results as the absence of any reducing division, the memoir includes much general discussion of the cell and its parts and the processes of mitosis.

Influence of Light on the Pigmentation of Salamander Larvæ.‡—Prof. W. Flemming comments on Fischel's recent research as to the influence of temperature on the pigmentation of salamander larvæ. Flemming's observations, repeated year after year, show that the larvæ kept in dark aquaria remain dark, while those exposed to light, e.g. in porcelain dishes, become light, the temperature remaining fairly constant. Flemming also notes that the processes of the pigment-cells *may* persist in contraction, though they escape observation.

Segmentation of Nervous System in Squalus Acanthias.§—Dr. H. V. Neal has made a study of the neural segments and their relations to nerves in embryos of this fish, and he has been led to the conclusion that in it there exists in early stages a continuous primitive segmentation, serially homologous through the head and trunk. This is the neuromeric segmentation. In later stages there appears in the brain a

* Verh. Phys. Med. Ges. Würzburg, xxx. (1896) pp. 105–23 (1 pl.).
† Arch. f. Mikr. Anat., xlviii. (1896) pp. 1–83 (5 pls.).
‡ Tom. cit., pp. 369–74.
§ Anat. Anzeig., xii. (1896) pp. 377–91 (6 figs.).

secondary segmentation, which gives rise to an anterior cephalic tract which is a region *sui generis*. The author traces the development of the neuromeres, compares the structures of the segments of the brain with those of the spinal cord, and notes the relation of the neuromeres to the sensory and motor nerves, to the mesodermal somites, and to the visceral arches. Dr. Neal thinks that the most important conclusion to which he has been led by his studies is that there is a serial homology between preotic and postotic segments in the Vertebrate head. The reason for this is to be found in the unbroken continuity of the postotic and preotic neuromeres; their exact similarity on the grounds of relations with nerves, somites, and visceral arches; and, thirdly, the distribution of postotic fibres to preotic musculature.

Genital Ducts of Teleosteans.*—Herr G. Schneider has studied the development of the genital ducts in *Cobitis tænia* and *Phoxinus lævis*. The oviducts arise from nephridial funnels in the same manner as the Müllerian ducts of other Vertebrates. The vasa deferentia are homologous with the oviducts, and, like them, correspond to the Müllerian ducts in other types. In respect of this homology between vasa deferentia and oviducts, the Teleosteans are primitive. Schneider is also inclined to derive the central testicular canal in higher Vertebrates from the cavity of the testes in Teleostei, which, again, is homologous with the ovarian cavity.

Larval Development of Amia calva.†—Mr. Bashford Dean has an interesting paper on the larval development of *Amia calva*. He describes the habits of the larvæ, the typical stages from the second day before hatching to the end of the fifth week, and some features of the organogeny. The larvæ of the fifth week, though scarcely an inch long, have practically attained their adult conditions, even as to fins, scales, and teeth.

In the aquarium, the newly hatched fish remain inactive for several days lying on their side, attached to the floor by the sucking disc. Before the end of a week they have become restless, and in the second week (in natural conditions) they attend the male in immense swarms. There is ground for believing that the guardian's care of the young lasts for about four weeks.

Passing over the author's description of the larvæ of successive days, we shall note a few of his results as regards organogeny.

The formation of the mouth differs little from that in *Lepidosteus*, sturgeon, and Teleosts. At no time do the appearances add evidence to the view that the mouth is of gill-slit origin.

The anus is formed about the beginning of the second day; a hint of a proctodæum occurs; throughout the early stages in the growth of the tail region there is no trace of a neurenteric canal, the neural axis being solid to begin with.

The author gives a careful account of the origin of the liver as a broad dorsal fold of the gut, and amplifies his previous notes on the relation of yolk-sac to gut. Jungersen's results as to the pro- and mesonephros are virtually confirmed.

Brain and spinal cord originate from a solid ectodermic thickening;

* Mém. Acad. St. Petersb., ii. (1895) 20 pp. and 2 pls.

† Zool. Jahrb. (Abth. Syst.), ix. (1896) pp. 639–72 (3 pls. and 17 figs.).

Amia differs from the sturgeon in the mode of its brain development, mainly in its tendency to differentiate the roof of the epencephalon and to reduce the calibre of the infundibulum. The transitions towards Teleostean conditions are noteworthy. In fact the brain of the bony fish is so closely Amioid that it may reasonably be looked upon as but a high degree of specialisation of this neo-ganoidean type. The appearance of the hypophysis is late and inconspicuous. There appears to be no evidence that the auditory sac appears as in *Serranus.* The sucking discs are specialised pit-organs or sense-buds, precociously developed and enormously enlarged. Indeed precocious development is one of the most striking general features in the organogeny of *Amia.*

The general systematic conclusion is that the development of *Amia* confirms the palæontological evidence as to the derivation of Clupeoid Teleosts from Amioid Ganoids.

Blastoderm Margin in Salmonidæ.*—Herr Fr. Kopsch describes some experiments on trout embryos, which go to show that a concrescence in the manner formulated by His does not occur in Salmonidæ. On the cellular ring or margin of the blastoderm an embryogenic region must be distinguished from a portion which is not directly formative. In the embryogenic portion, which lies in the position of the first invagination, the portion near the middle line, whose cells form the head, must be distinguished from the cell-groups on each side, which in the course of development meet in the middle line and form the knob or *Knopf.* This represents a centre of growth from which trunk and tail are formed. In this formation, cells belonging to the non-formative portion do in the course of the growth round the yolk reach the *Knopf,* and are there used in the formation of the embryo.

Syncytium in Cleavage of Belone acus.†—Herr J. Sobotta describes an interesting stage in the development of this fish. When there are about eighty cells formed, the centre of the blastoderm develops quickly and becomes several layers thick, while the periphery remains a single layer. A few minutes later the peripheral cells become indistinct and form a syncytium. This happens repeatedly. The whole yoke syncytium in this case is observably due to a fusion of blastomeres.

β. Histology.

Relation of Centrosomes to Cytoplasm.‡—Herren K. Kostanecki and M. Siedlecki report at great length on the results of their study of *Ascaris* ova.

The attraction spheres merely represent areas free from vitelline substance. It is important, however, to distinguish the "microsphere," a particular portion of the whole mitom or aster, representing a special differentiation of the rays in the centre of the radiation. A detailed discussion of the archoplasm results in the conclusion that this conception, in Boveri's sense, cannot be sustained.

Throughout the whole cell there is a fine framework of plasmic threads, ending peripherally in a distinct marginal zone. The plasmic

* Verh. Anat. Ges. X. in Anat. Anzeig. Erg. Hft., xii. (1896) pp. 113–27 (10 figs.).
† Tom. cit., pp. 93–100 (5 figs.).
‡ Arch. f. Mikr. Anat., xlviii. (1896) pp. 181–273 (2 pls.).

fibrils of mitosis arise by a differentiation of this framework. A reticular arrangement is suggested, but not conclusively demonstrated. The fibrils around the centrosomes have an exquisite microsomal structure. The microsomes occur in groups on the fibrils at equal distances from the centrosome, and thus a concentric system appears. This mitom-system is indubitably the seat of the contractile forces of the plasm. The interfilar substance is probably trophic. The centrosomes are specific and essential parts of the cell, morphologically independent and persistent "organs," serving as insertion centres for the radii. The authors support on the whole the conclusions of Flemming, van Beneden, and Heidenhain; and besides stating their own results, give a useful—if somewhat prolonged—account of the views of others.

Protoplasm of Nerve-Cells.*—Dr. S. Ramon y Cajal finds that the cytoplasm of many nerve-cells, both of Vertebrates and Invertebrates, includes numerous chromatin patches. These are possibly of nutritive value, for the conducting part is the achromatic spongioplasm. The phylogenetic and ontogenetic phases of the distribution of chromatin in the cytoplasm of nerve-cells are:—(1) diffuse and inconspicuous, (2) peripheral, (3) circumnuclear and peripheral, (4) throughout the whole cell. There is a relation between the dimensions of the patches and the volume of the protoplasm, but not between the chromatin differentiation and the functional dignity of the cell. The nucleus of nerve-cells becomes simpler as differentiation advances, the nuclein being concentrated to one or two spherical nucleoli.

Nerve-Endings of Duck's Bill.†—Dr. L. Szymonowicz finds (1) that the tactile cells (*Tastzellen*) of Grandry's and Herbst's nerve-corpuscles are of connective-tissue origin; (2) that this differentiation of connective cells occurs under the influence of the nerve-fibres; (3) that Merkel's corpuscles (of epithelial origin) are sharply distinguished from Grandry's and cannot be brought into the same histological or histogenic group.

Inner Root-Sheath and Papilla of the Hair.‡—Herr Günther shows that the several layers of the skin are represented not parallel to the longitudinal line of the hair and the inner root-sheath, but at right angles thereto. In the inner root-sheath the basal cell = stratum cylindricum; the adjacent cells without keratohyalin = the lower cells of the stratum dentatum; the cells with keratohyalin = the upper cells of the stratum dentatum and the cells of the stratum granulosum. The limit of cornification in the internal root-sheath corresponds to the stratum lucidum, and the horny part to the stratum corneum. The inner root-sheath, with its matrices, is to be considered as an elongated piece of epidermis of protective, guiding, and fixing function.

Pigment-Cells.§—Dr. A. Fischel refers to a recent paper by Prof. Lubarsch, where his views are placed in incorrect antithesis to those of Reinke. The main difference between Fischel's conclusions and Reinke's seems to be that Fischel finds two kinds of pigment-cells in the salamander's peritoneum, while Reinke finds only one kind. Fischel's two

* Ann. Soc. Espan. Hist. Nat., v. (1896) pp. 13–46 (6 figs.).
† Arch. f. Mikr. Anat., xlviii. (1896) pp. 329–58 (1 pl.).
‡ Verh. Anat. Ges. X. Vers. in Anat. Anzeig. Ergänzhft. xii. (1896) pp. 183–9 (5 figs.).
§ Anat. Anzeig., xii. (1896) pp. 526–8.

kinds are unconnected by transitional forms and behave differently under the influence of warmth.

Phagocytosis by Blood-Plates.*—Dr. S. Ramon y Cajal has demonstrated the occurrence of phagocytosis (of carmine particles and Bacteria) in the blood-plates of lower Vertebrates, such as the frog.

Function of Interstitial Cells of Testis.†—Herr J. Plato has studied the testes of cat, mouse, &c., and has been led to the conclusion that, in the cat at least, the interstitial cells serve for the absorption and storage of fat, which is used in the nutrition of the ripening spermatozoa. He has discovered fine canals, which conduct the stored material to where it is used up.

Regeneration of Mucus Epithelium of Intestinal Tract in Amphibia.‡—Dr. C. Sacerdotti finds that in the œsophagus and stomach of the frog and in the intestine of the newt, the mucus epithelium is formed from elements which acquire their function of mucus-secretion *before* they reach their final position. Their centre of formation is in the deeper strata of the gut-wall, whence the elements reach the surface, partly by the wearing off of the old superficial epithelium, partly because they are pressed out by younger elements which arise beneath them. Thus he confirms Bizzozero's conclusion that the mucus-cells are specific elements, and that the intestinal epithelia do not usually arise where they are seen in their fully differentiated state.

γ. General.

Sexual Dimorphism and Variation.§—Prof. J. Kennel gives the following summary of an interesting essay:—

Male and female are normally similar in those external characters which are not in direct relation with reproductive functions (sexual homomorphism).

The two sexes usually show parallel variations, a parallelism which may be due to the similar action of similar causes, or may be the result of transference from one sex to the other.

Deviations from previous characters may be gradually increased, or they may be of sudden origin (saltatory variation).

Variations are not planless, but arise according to the species in definite directions, not always in one, yet not in very many. It is thus that varieties and new species arise.

Variations in a definite direction may sometimes be increased in a high degree, even beyond the limits of utility and advantage (evolution-tendencies).

Conditions may arise in which external organs regress or degenerate to the advantage of reproductive function. This is especially true of the female sex, in which the reproductive function demands more material sacrifice and more complex substances. Thus arises "individually conditioned" sexual dimorphism.

At first this need not be transmitted, as it arises from similar causes

* Ann. Soc. Espan. Hist. Nat., v. (1896) pp. 5–12 (2 figs.).
† Arch. f. Mikr. Anat., xlviii. (1896) pp. 280–304 (1 pl.).
‡ Tom. cit., pp. 359–69 (1 pl.).
§ Schriften Nat. Ges. Jurjeff (Dorpat) ix. (1896) pp. 1–64.

in successive generations of females, yet it may become predominant, habitual, and hereditary, with transference to the males as well. If the transference to the males does not hinder in any way the male reproductivity, it may become a constant character, and thus arises a secondary similarity of the sexes. But if the transference be in any way antagonistic to the male reproductive functions, those forms which exhibit it will be eliminated.

In established sexual dimorphism the secondary sexual characters cease to be mixed, since the essential reproductive differentiation limits this both positively and negatively. If the gonads become rudimentary the limits are removed, and one sex may show the characters of the other, as in many, perhaps most, casual hermaphrodites.

The frequently regular occurrence of male and female characters on the two sides of the body depends upon a preponderance of one half of the body.

Useless organs degenerate not in consequence of disuse, but only in consequence of the greater use or development of other organs, by which their substance is claimed.

In Lepidoptera, sexual selection has but a slight rôle, if any, in the phenomena of dimorphism.

"Bipolarity" in Distribution of Marine Animals.*—Dr. A. E. Ortmann begins an interesting essay by stating the general interpretation of the similarity between Arctic and Antarctic marine animals. It has been expounded especially by Théel, Pfeffer, and Murray, and is as follows:—In association with the climatic differentiation which occurred at the poles at the beginning of the Tertiary period, certain polar members of the universal tropical fauna adapted themselves to the change. This adaptation occurred in a similar fashion at the two poles, and the gradual cooling having done its work, produced conditions of environmental uniformity which inhibited further change. As variation continued more abundantly in the warmer waters the distinctions between polar and tropical fauna became more and more marked.

Ortmann objects (1) that there is no warrant for supposing a decreasing transformability in polar animals; (2) that in many cases the similarity of north and south polar forms is secondary, and depends upon abyssal migration from one pole to the other; (3) the apparent bipolar distribution of deep-sea animals is only apparent, the facts are insufficient to warrant the induction; (4) in some cases the bipolarity is due to littoral migration from north to south; (5) the theory breaks down entirely when applied to Decapod Crustaceans.

Contrasts in the Marine Fauna of Great Britain.†—Prof. W. C. M'Intosh has put together some of the impressions made by an examination of the littoral fauna, and that within a few miles of the shore, at the four points of the compass in the British area; for the north, the Shetlands, for the south, the Channel Islands, for the east, St. Andrew's, and for the west the Outer Hebrides have been selected. It is, of course, impossible for us to analyse a paper which is full of details and names, so that we must content ourselves with quoting the conclusion. "Limited

* Zool. Jahrb. (Abth. Syst.), ix. (1896) pp. 571–95.
† Ann. Mag. Nat. Hist., xviii. (1896) pp. 400–15.

as the area we have been considering is, it is apparent that, while some forms are common to all, certain restraining influences check the spread of others, so that they become more or less characteristic of the several regions. Moreover, the mixed nature of the fauna shows that we have to do with several sources of origin, some of which date back to geological periods marked by a different arrangement of the land, and a consequent change in the temperature of the water."

Biological Examination of Lake Michigan.* — Dr. H. B. Ward edits a bulletin on this subject, describing the lake with its fauna and flora, and with special reference to the plankton. His general conclusions in regard to the plankton are the following:—The plankton is the source of food supply to all lake fish; its rapid reproduction affords a constant supply in spite of continued destruction. The amount of plankton in Lake Michigan in the (Transverse Bay) region examined is limited. The enormous area compensates for this limited amount. The plankton is uniformly distributed horizontally. In summer it is accumulated near the surface, and very little occurs below 25 metres, except near the bottom. The uniform horizontal distribution of the plankton indicates that the plankton-eating fish find food in limited quantities everywhere. The bottom flora and fauna are not enough to support large numbers of bottom-feeding fish within circumscribed areas. The well-known migrations of whitefish schools along shore seem thus to be correlated with the non-localised food supply. There is a plentiful supply of whitefish food on the old fishing-grounds. No reason can be assigned for the diminution in numbers except overcatching. By introducing suitable vegetation, the fish-producing powers of the lake might be vastly increased. Five appendices contain brief accounts of the aquatic plants, by H. D. Thompson; Protozoa, by C. A. Kofoid; Rotifera, by H. S. Jennings; Turbellaria, by W. M'M. Woodworth; and Mollusca, by Bryant Walker.

Poisoning of Freshwater Animals by Hypochlorite of Lime.†— Prof. R. Dubois has investigated this not uncommon event. Trout are particularly susceptible, being readily asphyxiated. Other fishes resist longer, but eventually succumb. Crayfish and other freshwater animals also perish. Trout killed by hypochlorite of lime are readily recognised by their discoloration, &c., and should never be bought. Not that they are injurious, but the practice of thus poisoning them is quite fatal to the stream.

Tunicata.

Distribution of Doliolum.‡—Dr. A. Borgert has worked over the specimens of *Doliolum* collected on the 'Vettor Pisani' expedition. No new species were found, but the recording of *D. tritonis* and *D. nationalis* in the Pacific is new. The number of species found in the Atlantic Ocean is the same as that from the Pacific, but the actual species are not quite the same. Thus *D. rarum* Grobben is not known from the Pacific, nor *D. affine* Herdman from the Atlantic.

* Bull. Michigan Fish Comm., No. 6 (1896) 100 pp. and 5 pls.
† Ann. Soc. Linn. Lyon, xlii. (1895) pp. 49–52.
‡ Zool. Jahrb. (Abth. Syst.), ix. (1896) pp. 714–9.

INVERTEBRATA.

Freshwater Fauna of the Azores.*—Mr. J. Richard gives an account of the freshwater fauna of the Azores, as observed on the visits of the yacht 'Princess Alice.' A short account is here given of the Ostracoda, Copepoda, and Cladocera. Attention is called at the same time to the presence in the islands of *Plumatella repens*, and the discovery in them, for the first time, of the genus *Mermis*. It appears to be certain, notwithstanding some doubts, that the remarkable rotifer *Pedalion mirum* does exist in the Azores. The author recommends the study of the island of Flores, the peculiarities of which show that it merits a thorough zoological exploration.

Adelotacta Zoologica.†—Sig. F. S. Monticelli describes under this title (= of doubtful classification) two remarkable forms, *Pemmatodiscus socialis* g. et sp. n. and *Treptoplax reptans* Montic. The former is a very simple organism, corresponding to the gastrula type, with two layers of epithelium separated by a cœlomic cavity. The outer layer is a high ciliated epithelium with characteristic rhabditoid structures; the inner layer is lower and non-ciliated. A distinct ciliated mouth puts the gastrular cavity in communication with the outer world. There are no traces of organs or sexual elements, but the organism multiplies by division, which is, of course, an argument against its being a larva. It was found in cysts in the jelly of *Rhizostoma pulmo*. The author compares it to Korotneff's *Gastrodes parasiticus*.

The second form, which the author described in 1893, is also very simple, and has three strata—an external dorsal of flattened non-ciliated cells; an external ventral of elongated, clavate, flagellate cells; a median of large, irregularly polygonal elements in three rows. Adhering to the lower surface of the dorsal stratum are numerous refractive corpuscles or globules enclosed in modified cells. The animals were found adhering to the sides of the aquaria at the Naples Station. They change their form incessantly, like Amœbæ, and multiply by division. Monticelli compares it in detail with other forms, especially *Trichoplax adhærens*. He concludes that *Trichoplax*, *Treptoplax*, and *Pemmatodiscus* must at present remain Adelotacta.

Mollusca.

Indian Deep-Sea Molluscs.‡—Mr. E. A. Smith describes twelve new species of deep-sea molluscs, collected by the survey steamer 'Investigator.' Some of these are extremely interesting on account of their remarkable form and surface ornamentation; others are peculiar on account of their close similarity to species which occur in the North Atlantic; in one instance the author can find indeed no distinguishing features between the Atlantic and Indian Ocean specimens.

Mode of Life of Lima hians.§—Dr. J. D. F. Gilchrist has an interesting article on this mollusc, great quantities of which are to be obtained by dredging off Millport. The two organs of most importance are the

* Bull. Soc. Zool. France, xxi. (1896) pp. 171–8.
† MT. Zool. Stat. Neapel, xii. (1896) pp. 432–62 (2 pls.).
‡ Ann. Mag. Nat. Hist., xviii. (1896) pp. 367–75.
§ Trans. Nat. Hist. Soc. Glasgow, iv. (1896) pp. 218–25.

foot and the mantle, and the author gives an account of the chief purposes to which these are put. He points out that, in trying to understand the habits and mode of life of this animal, he has but raised a few questions which he cannot answer, and that many more questions remain to be raised. He is quite right, we think, in considering that this line of research is one that deserves increasing attention, and though it may be admitted to be a difficult work, it certainly offers a key to the solution of many scientific questions of the present day. It is a return to the older methods of Natural History study, but with increased means at our disposal for appreciating the significance of our observations.

γ. Gastropoda.

Hermaphroditism of Limpet.*—Mr. J. F. Gemmill reports some causes of hermaphroditism in the limpet, and makes some observations regarding the influence of nutrition in this mollusc. As is well known, the sexes are ordinarily separate, and the sexual apparatus is of the simplest kind. The author has lately found at Millport several limpets in which a gonad was not purely ovarian or testicular, but of a mixed character. Under the Microscope there were at once seen not only ripe ova and spermatozoa, but also segmenting ova, and even ciliated free-swimming embryos. This hermaphroditism is of a kind much simpler than is usually found in hermaphrodite species of the same order, and rather approaches the type seen in the common oyster. The peculiar habits and structure of the limpet may give a key to this occasional variation. As the limpet is solitary and practically fixed, and as it has no organs of copulation, and as no sexual congress of any kind has been observed, the meeting of ova and spermatozoa would seem to depend on chance, so that occasional hermaphrodites might be of benefit to the species. The number of such variations, however, is too small to allow this consideration much weight. Apparently they have till now escaped observation altogether, and out of about 250 specimens the author found only three hermaphrodites. With regard to the stations they occupy, limpets may be divided into high-level, middle-level, and low-level forms, and it is clear that the amount of nutrition which these three kinds would get would differ considerably. One might expect that if nutrition has any influence on sex, such an influence would make itself seen in the different proportions of male and female specimens at different tidal levels. In accordance with current theories it may be thought that the low-level limpets, with their richer nutrition, would show a relatively greater proportion of females over males. Figures, however, show that this is not so; and the conclusion must be come to that—in the limpet, at any rate—more abundant nutrition does not predispose to the female type. It must, however, be borne in mind that the female gonad of the limpet is not larger in bulk than the male, and does not, therefore, make special demands on nutrition.

δ. Lamellibranchiata.

Green Oysters again.†—Sig. D. Carazzi has made an elaborate study of the green oysters of Marennes. His chief conclusions are the

* Anat. Anzeig., xii. (1896) pp. 393–4.
† MT. Zool. Stat. Neapel, xii. (1896) pp. 381–431 (1 pl.).

following. Lankester and Chatin were in error in believing that the secreting cells or macroblasts contained the green pigment. These cells function as *Becherzellen*, secreting a substance physically, but not chemically like mucus. The opinion that the green coloration of the palps and gills is due to a transport of material from the gut by means of the amœbocytes of the blood is completely erroneous. De Bruyne's facts, for instance, deal with pathological conditions. The presence or absence of the green diatom *Navicula* is of little moment in coloration. The green substance, or marennine, is a product of metabolism, and may be formed in a great variety of epithelial cells, though not in the *Becherzellen* and claviform cells. It is an organic substance, of peculiar composition, with iron as one of its principal elements. It is perhaps a nutritive substance, and is carried by amœbocytes from epithelial cells to the liver. One of the results of the author's studies is to show that the amœbocytes are of essential importance in nutritive transport.

Arthropoda.

α. Insecta.

Colour-Variation in the Vanessæ.*—Dr. F. Urech adopts the view, especially emphasised by Eimer, that organisms are to be regarded as very complex material systems, and that therefore any change at one point must be accompanied by compensatory changes at other points. This view he illustrates by a tabular survey of the artificially produced colour-variations in *Vanessa*. His conclusions are—(*a*) that in ontogeny the effect of warmth is to deepen the tint of pigmentary colours by a concentration of the pigment at special points, rather than by an actual increase in amount; and (*b*) that the continued action of heat throughout many generations produces an increase in amount of pigment and a deepening of tint, and of cold, a decrease in amount and a diminution of intensity of tint. The increase in amount may manifest itself either directly or indirectly as an increased complexity of chemical structure. In other words, colour-changes occurring during ontogeny are to be regarded merely as new positions of equilibrium; but an increased temperature acting through many generations may lead to absorption of energy, and so to actual increase of pigment production.

In estimating colour-change Urech emphasises the importance of realising that optical colours usually occur in non-pigmented scales, so that an increase in blue or violet (optical) colours may be due to an actual decrease in the amount of pigment present. If this be kept in mind, he is of opinion that almost all artificially produced colour-changes in the Vanessæ may be explained as correlated or compensatory changes.

The paper contains also some additional arguments in favour of the author's view, that the progression of colours observable during development in the Vanessæ is to be regarded as a case of recapitulation.

Bag-Shelter of Larvæ of Australian Moths.†—Mr. W. W. Froggatt states that, in many parts of the Australian bush, one frequently comes across brown, liver-coloured silken bags, of an irregular funnel shape,

* Zool. Anzeig., xix. (1896) pp. 163–74, 177–85, 201–6.
† Proc. Linn. Soc. New South Wales, xxi. (1896) pp. 258–60 (1 pl.).

spun round a stout twig. They vary in size from 3–8 inches in diameter at the broad end. Upon examination, if freshly constructed, they will be found full of very hairy caterpillars, mixed up with their castings and moulted skins. These curious structures are woven round twigs by the larvæ of several different species of moths belonging to the genus *Teara*. They are constructed for shelter during the day, and are not used for pupating purposes. Hiding in them during the day, the caterpillars issue forth at dusk, feeding all night, and return to cover at daybreak. When moving about they travel in procession.

The author gives a description of *T. contraria*. The larvæ of this species live in communities of one hundred or more. About fifty specimens were collected and placed in a glass jar in the museum, where they remained huddled together in a mass, unless disturbed, when they would all set off in a procession round the walls of their prison. In about a fortnight they began to burrow into the loose sand at the bottom of the jar, constructing soft felted cocoons out of the hairs upon their bodies.

Metamorphoses of Beetles.*—M. le Capitaine Xambeu describes, in a fifth memoir on the subject, the metamorphoses in numerous families of beetles. His twofold object is to aid towards securer classification, and to work out for economic reasons the exact life-history of practically important forms.

Brain of the Bee.†—Dr. F. C. Kenyon has made a study of the brain of the common bee. A thousand or more brains were put into requisition. It appears to be evident that, though there are more difficulties in the way of obtaining good results than with Vertebrates, patient application of the bichromate of silver method will throw as much light upon the organisation of the hexapod nervous system as it has upon that of the higher animals. The minute structure of the so-called mushroom bodies has been brought to light, and it is now almost clear to demonstration that the function of these peculiar bodies is that of enabling the insect to intelligently adapt itself to its surroundings. The cups of these bodies are connected with two pairs of tracts of fibres from the optic lobes, with three from the antennary lobes, and with one from the ventral nervous system. The roots are very probably connected with the inner terminals of motor, or possibly of other efferent fibres, but the exact course of the connection and the number of cellular elements composing it remains to be demonstrated. The central body is plainly shown to be connected with the fibrillar arch and with the fibrillar mass in front and with that below it. Motor cells have been found in a ventral position in the ventro-cerebron, which does not accord with the distinction, based upon physiological experiments, of a dorsal motor and a ventral sensorial area for each ganglion of the ventral cord. The author reconciles the discrepancy by pointing out that it is the fibrillar connections that are destroyed, in the lesions produced dorsally, and the association cells and fibres and the terminals of sensory fibres in ventral lesions.

Wasps.‡—We would recommend all who are interested in these insects to read the short paper by Mr. Jas. Campbell, which breathes

* Ann. Soc. Linn. Lyon, xli. (1894!) pp. 107–56; xlii. (1895) pp. 53–100.
† Journ. Comp. Neurol., vi. (1896) pp. 133–210 (9 pls.).
‡ Trans. Nat. Hist. Soc. Glasgow, iv. (1896) pp. 265–7.

throughout the true spirit of the field naturalist. He points out as an interesting fact, that away from human habitations wasps act differently towards people from those we meet near houses or by the roadside. The author thinks that perhaps the love of the wasp for what we call bad smells determines its best sphere of usefulness. The "wet heap-rubbish, the emptying drain, the oozing cesspool, are evils that cry aloud for redress, and their cries are all the louder till vegetation comes to clothe them. On sewage-laden rivers, the herbage covers much that is unsightly, and lessens the effect of the hurtful odour. If it is better to have such places clothed with a mantle of green, and if we know that the wasp is a willing worker among the flowers that graciously cover places so uninviting, we cannot well fix the limit to the work it is doing, both openly and out of sight."

Remarkable Use of Ants.*—Mr. R. M. Middleton jun. records a remarkable use of ants in Asia Minor. He has made the acquaintance of a Greek gentleman who fell from his horse in Smyrna six years ago, and received a severe but clear cut on the forehead. In accordance with the custom of the country, he went to a Greek barber to have the wound dressed, and the barber employed at least ten living ants to bite the sides together. Pressing together the margins of the cut, which was rather more than an inch long, with the fingers of the left hand, he applied the insect by means of a pair of forceps held in the right hand. The mandibles of the ant were widely opened for self-defence, and as the insect was carefully brought near to the wound, it seized upon the raised surface, penetrated the skin on both sides, and remained tenaciously fixed while the barber severed the head of the ant from the thorax, and so left the mandibles grasping the wound. These were left in position for three days, when the cut was healed and the heads removed. It is not yet certain what the species used is. The author refers to some observations on the subject by Sir John Lubbock in his well-known work on ants, bees, and wasps.

Thoracic Glands in Larvæ of Trichoptera.†—Prof. G. Gilson gives an account of segmentally disposed glands in these insects. He comes to the conclusion that in larval Trichoptera each of the thoracic segments may be provided with more or less complex glandular organs, more nearly representing nephridia than the coxal glands of Annelids and *Peripatus*, and he carries this further by saying that in the Hexapoda remains of segmentally glandular organs, be they coxal or nephridial, are now known for the whole length of the body, from the mandibular to the posterior abdominal segments.

Larval Gills of Odonata.‡—Prof. G. Gilson and M. J. Sadones state the results of their investigations on the larval gills of the Odonata in the following terms:—

(1) The rectal tracheal gills of larval Odonata are prevented from adhering to one another by the presence of three conical pillars.

(2) The main tracheal tubes alone are lodged between the two that form the gill. The terminal loops, i.e. the functional part of the system, run through the protoplasm of the subcuticular layer.

* Journ. Linn. Soc. Lond., xxv. (1896) pp. 405-6.
† Tom. cit., pp. 407-12 (2 figs.).
‡ Journ. Linn. Soc. Lond., xxv. (1896) pp. 413-8 (3 figs.).

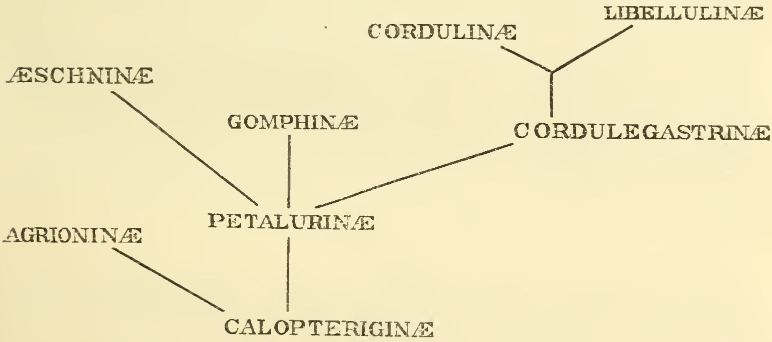
(3) A blood-space communicating with the body-cavity exists in the rectal gills.

(4) The oxygen seems to be absorbed through the tracheal loops by the action of the subcuticular protoplasm only, and to be discharged from this into the general tracheal system.

(5) Carbonic acid, on the contrary, appears not to be carried to the gills by tracheal tubes, but by the blood alone.

(6) In any case the blood would appear to play an important part in the excretion of carbonic acid, and a very unimportant part in the absorption of oxygen.

Gizzards of Odonata.*—Dr. F. Ris has studied the structure of the gizzard in a large number of dragon-flies, both adult and larval. The primitive form, as seen in Calopteryginæ, has sixteen longitudinal areas, eight broad and eight narrow, which bear an armature of irregularly disposed teeth. In the typical Agrioninæ the areas are more complicated, and the spines more regular; in *Pyrrhosoma minium* there is greater elaboration and concentration. In *Lestes* the areas are reduced to eight, which are differentiated into four broad and four narrow, each with peculiar and specialised armature. Among Anisoptera, *Gomphus* and *Æschna* show a reduction or concentration to four similar areas. Finally, *Cordulegaster* and the Libellulidæ differentiate the four areas to two pairs of teeth, so that a primitively radial arrangement has become bilateral. These conditions are clear in the larvæ, but obscured in the imagines, where the organ tends to be reduced. The reduction is least in *Calopteryx*, much more in *Agrion*, most in *Gomphus* and *Æschna*. In *Cordulegaster* and the Libellulidæ there is in the adult but little trace of the larval conditions. On the basis of his researches, the author suggests the following scheme of relationships:—



Parasitic Beetles.†—Dr. G. Brandes notices an account of the beaver of the Elbe by H. Friedrich, to which is appended remarks on *Platypsyllus castoris* Ritsema. The history of this insect dates back to 1868, when it was brought before the Ashmolean Society by Westwood,

* Zool. Jahrb. (Abth. Syst.), ix. (1896) pp. 596–624 (figs. A–N).

† Centralbl. f. Bakteriol. u. Parasitenk., 1[te] Abt., xx. (1896) pp. 297–305.

who called it *Pl. castorinus.* Priority of publication was, however, obtained by Ritsema by a period of 14 days. Both these naturalists located the insect among the Fleas. In 1872 the American coleopterologist Le Conte pointed out that the beaver parasite was a Beetle, and his contention was supported later on (1886) by Riley in a communication entitled 'Systematic Relations of *Platypsyllus* as determined by the Larva.' Thus it seems that the beaver of the Old and New Worlds is infested by parasitic beetles which, according to some, belong to the same species. In the skin of the Alaska beaver another parasitic beetle, *Leptinillus validus* Horn, having only rudimentary eyes, has been found, and in the skin of mice a perfectly blind example of the same family, *Leptinus testaceus* Müll.

Mégnin has described two other beetles parasitic on Rodents, *Amblyopinus Jelskii* and *A. Mniszechi*, but the author holds that their real parasitism is not proved.

Resemblance of an Insect-Larva to a Lichen-Fruit.*— Mr. G. E. Stone points out the remarkable resemblance—which may possibly be mimetic—between the larva of the elm-leaf beetle, *Gossyparia ulmi*, recently imported into the United States from Europe, and the apothece of a lichen, say, *Physcia hypoleuca*; the resemblance extending to size, form, and colour.

Social Wasps of Brazil.†—A short note by Dr. H. von Ihering is of interest, as, with the exception of one note by him, all the facts we know with regard to social wasps have been learnt from the observation of European species, In some genera the societies are not dissolved in winter, but are perennial. Unlike what happens in *Polistes* and *Vespa*, where each society has but one fecundated female, which is much larger than the workers, there are in the societies of *Polybia* a number of fecundated females, and these females do not differ from the workers in size. The presence of a number of fecundated females is an important fact, and represents a condition which is relatively primitive. At first, of course, there were no workers in a colony, but only males and females. Specialisation could not have started with the immediate reduction of the fecundated females to one queen, but there must have been a partial reduction in numbers. These fecundated females became reduced in number, and at the end of the process there was only one. In *Polybia* we see one of these stages—numerous fecundated females with no difference between them and the workers.

Life-History of Larvæ of Œstrus.‡ — Dr. Ruser reports that he found in four oxen, which gave the ordinary external signs of being affected by this fly, transparent larvæ in the loose connective tissue between the œsophagus and the body-wall. It would appear that the larvæ are able to bore through the wall of the œsophagus, and so to make their way to the great vascular trunks in the region of the neck. It would appear, therefore, that the view that the larvæ of this fly enter by the mouth is correct.

* Bull. Torrey Bot. Club, xxiii. (1896) pp. 454–5.
† Bull. Soc. Zool. France, xxi. (1896) pp. 195–62.
‡ See Centralbl. f. Bakteriol. u. Parasitenk, xx. (1896) p. 548.

Nervous System of Mecopodinæ.*—M. L. Bordas has made a study of the stomatogastric nervous system of this tribe of Orthoptera. He has had the advantage of examining a large species—*Platyphyllum giganteum*. The stomatogastric system of this species consists of a frontal ganglion, a subcerebral ganglion, a pair of latero-œsophageal or intestinal ganglia. The large number of centres and the numerous branches which are given off from them, indicate clearly enough that this system must play a large part in the accomplishment of the digestive functions, and especially of those movements which are necessary for the complete trituration of the food. The author gives a sufficiently detailed account of the facts of the anatomy of this species.

β. Myriopoda.

Notes on Lysiopetalidæ.†—Dr. C. Verhoeff describes *Lysiopetalum lendenfeldi*, a new species from Bosnia. Among his many detailed results, we note that the copulatory apparatus of Lysiopetalidæ is formed from a single pair of segmental appendages, that the parts previously called *Vorderarme* are differentiations of the coxal parts, and that the Lysiopetalidæ are, as regards their copulatory organs, far removed from Iulidæ, but near Polydesmidæ.

δ. Arachnida.

Dermatobia noxialis.‡—Dr. R. Blanchard has published some new observations on the larvæ of this creature. *Dermatobia noxialis* is distributed throughout the whole of intertropical America, but may extend north and south beyond the tropics. Notwithstanding the many observations which have been made in the most varied countries and on the most diverse animals, and, notwithstanding the variety of names under which it is known, the cuticolar larvæ of the genus *Dermatobia*, observed until now in man and domestic animals, belong to one species only—*Dermatobia noxialis*; the two larval forms which have such distinctive characters are only two successive stages in the development of one species, and are separated the one from the other by an ecdysis, which takes place in the tumour where the larvæ is developed. Another species of *Dermatobia* is found in South America, and, although apparently widely distributed, its larva is not yet known. It does not appear to attack either man or domestic animals.

ε. Crustacea.

Eyes of Decapods.§—Herr B. Rosenstadt has studied the eyes of numerous Decapods, especially as regards (1) the pigmentation and its displacement, and (2) the relation of the crystalline cones and the optic rods (rhabdoms) to one another and to their matrix cells. Species of *Lucifer*, *Sergestes*, *Virbius*, *Palæmon*, *Astacus*, *Pagurus*, &c. were included in his investigations.

In each ommatidium there are (*a*) four iris-pigment-cells beside the

* Comptes Rendus, cxxiii. (1896) pp. 562–4.
† Zool. Anzeig., xix. (1896) pp. 465–77 (4 figs.).
‡ Bull. Soc. Centr. Med. Vétérinaire, 1896, 14 pp. and 3 figs. (separate copy).
§ Arch. f. Mikr. Anat., xlvii. (1896) pp. 748–70 (2 pls.).

crystalline cones or cells, (*b*) two retinal-pigment-cells (four in *Galathea*), while (*c*) the retinule-cells themselves are more or less pigmented according to illumination. The changes observed according to illumination are described. Except in *Lucifer* and *Sergestes*, a granular, dirty-yellow "tapetum" was observed, associated with two cells in the posterior part of each ommatidium.

Following Exner, the author distinguishes and discusses eyes forming an apposition-image, a superposition-image, or the former in light and the latter in darkness.

The rods are quite independent of the cones, the former arising from a group of retinule-cells, the latter from the epidermic crystalline cells.

Variation in Portunus depurator.*—Mr. E. Warren has made on this crab seven measurements on each individual male, corresponding to those made by Prof. Weldon on the male of *Carcinus mænas*. The total number of crabs measured was 2300, and the measurements were recorded to the tenth of a millimetre. Since the crabs were growing and varied much in size, it was found necessary to reduce the measures to percentages of some standard dimension. The carapace length was selected, and all the measurements are expressed as thousandths of this dimension. On glancing down the mean of the several dimensions it will be seen that a stable equilibrium is in no way reached, except, perhaps, in the case of the total breadth; thus, throughout life, this crab is gradually changing its shape, and it appears to be clear that, when all its organs are in a rapid state of change, the crab can protect itself. Here is an argument, Mr. Warren thinks, against the transmission of acquired characters, for otherwise the earlier brood would tend to have a somewhat different shape to the later, and this is scarcely probable. From the measurements which the author records, he believes himself to have proved that the mutual relationships of the organs measured are almost as closely similar between the two genera *Portunus* and *Carcinus* as one or two more sharply marked off races of a single species. Of course, a considerable number of such comparisons would have to be made before any safe conclusion could be drawn, and the meaning of the differences observed by such comparative treatment of a large series of genera. The larger duration probably indicated real differences in the correlation constant, and are possibly associated with changes in the habit or environment. For example, it is conceivable that a crab which swims might require to be more symmetrical than one that only crawls between tide-marks.

Changes in the Carapace of Carcinus Mænas.†—Mr. H. Thompson has made a study of certain changes observed in the dimensions of parts of the carapace of this common crab. The methods followed were those of Prof. Weldon. On comparing two sets of measurements it appeared that the average size of the "frontal breadth" of the crabs collected in the year 1893 exceeded that of the crabs collected in 1895. The deficiency in frontal breadth in 1895 appeared to be compensated for by the possession of a larger right dentary margin. As the results seemed to indicate that a change in regard to these dimensions was taking place in the species, it was thought desirable to compare similar measurements

* Proc. Roy. Soc. Lond., lx. (1896) pp. 221–44 (6 figs.). † Tom. cit., pp. 195–8.

in the adult. Two hundred and fifty-four specimens of the male of the crab had been collected in 1892–3 and were available for examination, while 496 individuals were collected at Plymouth in January of the present year. The results fully confirmed those arrived at for the young. It is not possible at present, of course, to say whether we have here indications of a permanent change, or whether there is mere oscillation such as, for all we know, may be constantly going on in the relative dimensions of the various parts of the members of all species. It is clear that a similar set of measurements must be taken two or three years hence.

Lucifer Reynaudi.*—Herr B. Rosenstadt has made a study of the organisation and post-embryonic development of this very interesting decapod. After treating of its general form and integument, the author describes in considerable detail the extremities, the musculature of the body, and the nervous system. The intestine and its appended glands are also fully dealt with. The condition of the specimens did not allow him to dissect the blood-vessels. Special attention is called to the complete want of gills in *Lucifer*. With regard to the excretory organs, it is of interest to know that they have some resemblance to the glands described some time since by Mr. E. J. Allen, in the axis of the gills of *Palæmonetes varians*. In conclusion, the structure and development of the reproductive apparatus is dealt with. The author finds that the vasa efferentia are morphologically modified portions of the testis. The two spermatophoral glands may be referred to that portion of the rudiment of the generative apparatus which connects the rudiment of the testis with the ejaculatory duct. The azygous condition of the testis and its site below the intestine are secondary morphological peculiarities which appear in the course of post-embryonic development.

At the end of his paper the author calls attention to a case of complete hermaphroditism.

Peripheral Nervous System.†—Dr. B. Němec describes the peripheral ganglionic strands which occur in certain Isopods. They are especially well seen in *Titanethes*, a blind genus. A thoracic segment shows a central ganglion directly connected by a nerve with the ventral cord, and from the central ganglion branches go to two lateral ganglionic plexuses lying under the hypodermis. Similar structures occur in *Orchestia* among Amphipods.

Visceral Nervous System of some Isopods.‡— Dr. B. Němec finds that Isopods (*Porcellio*, &c.) have an anterior and a posterior visceral system, the former innervating œsophagus, gizzard, and hepatopancreas, the latter supplying mid-gut and hind-gut. The anterior starts from the circumœsophageal commissure, has a ganglion near the upper lip, another in front of the gizzard, and so on. The posterior system arises from the fused post-abdominal ganglia, and is without any ganglionic differentiation.

Development of Asellus.§—Prof. L. Roule adds to his previous embryological studies of Crustacea an account of the development of *Asellus aquaticus*. In spite of the amount of yolk, segmentation is virtually

* Zool. JB. (Abth. Anat.), ix. (1896) pp. 427–76 (6 pls.).
† Anat. Anzeig., xii. (1896) pp. 434–8 (2 figs.).
‡ Zool. Anzeig., xix. (1896) pp. 477–9.
§ Ann. Sci. Nat. Zool., ser. viii., i. (1896) pp. 163–96 (3 pls.).

total; the conical blastomeres surround an undivided core. After the preliminary cleavages, the blastoderm (blastolécithe) becomes distinct from the yolk (deutolécithe); a zone of small cells surrounds a non-nucleated internal vesicle. The blastoderm becomes immediately double, differentiating the two primary layers. This is comparable to the extension of the "cicatricula" in *Porcellio* and its conversion into the blastoderm. The vitelline membrane disappears quickly, and is replaced by a cuticular layer, perhaps corresponding to a cuticle of a nauplius moult.

The body of the embryo diminishes in size as the yolk is absorbed; and splits dorsally in a peculiar fashion, as if bent on itself. At the two ends of the cleft there develop two rigid annexes, transversely elongated. These dorsal organs are adaptations peculiar to the embryo and without significance for the adult. The dorsal cleft and the separation of the two regions which result from it has its homologue in the development of the crayfish, though its precocious appearance there has led to its being misinterpreted as gastrular.

It is evident, the author concludes, that an acquaintance with the development of *Asellus* is necessary to an understanding of the other forms; and a full comparison is promised.

Freshwater Copepoda and Cladocera of Portugal.*— MM. J. De Guerne and J. Richard give a first list of these Crustacea. They enumerate in all 25 species, all of which are known and most of which are common in Europe. This appears to be the first list which has been given of these Crustacea from the fresh waters of Portugal.

Annulata.

Epigamy and Schizogamy.†—M. A. Malaquin discusses these two phenomena in Annelids. In epigamy the whole sexual individual is affected, the eyes increase in size, the notopodia of the median and posterior regions change and acquire natatory setæ. Such changes, first observed in Nereidæ, are also known in Syllidæ and Hesionidæ. In schizogamy, only a part of the animal acquires the characters of sexuality, separating off and swimming freely. The part may acquire a differentiated head with appendages and large eyes, but it has no mouth, and is wholly reproductive. Various aspects of this schizogamy (which must be carefully distinguished from schizogenesis, are illustrated by *Syllis* (*Haplosyllis*) *hamata* Clp., *Trypanosyllis*, *S. prolifera* Krohn, *S. amica* Qtrfs., and *S.* (*Typosyllis*) *hyalina*. What the author particularly insists on is that in *Autolytus longeferiens* St. Joseph and *Exogone gemmifera* Pag. both epigamy and schizogamy are included in one life-cycle.

Combined Nucleoli.‡—M. A. Michel treats particularly of combined nucleoli, as observed in the eggs of the Annelids. These bodies have been found in the tissues of various animals, but the author has confined his researches to the eggs of *Nephthys* and *Spiophanes*. The bodies in question contain one part which is solely granular, and stains with safranin more than the rest of the egg, and another clear refractive

* Bull. Soc. Zool. France, xxi. (1896) pp. 157–9.
† Zool. Anzeig., xix. (1896) pp. 420–3.
‡ Comptes Rendus, cxxiii. (1896) pp. 903–5.

part, almost oily in appearance, which does not stain. The author gives some details as to his observations, and remarks that, as to the origin of these nucleoli, no one has been able to give a definite account of how they became connected.

Lymphatic Glands of Nereids.*—Prof. A. Kowalevsky demonstrated both by sections and by injections of carmine, &c. that a pair of lymphatic or phagocytic glands occur regularly in each segment (of *Nereis cultrifera* and other forms) just above the parapodia. He responds to Mr. E J. Goodrich, who regarded the alleged organs as accidental agglomerations of leucocytes.

Earthworms from Celebes.†—Dr. W. B. Benham remarks that, although a considerable number of species of *Perichæta* have been described from the Malay Archipelago, none seem to have been collected on the island of Celebes or from Jampea, which is due south of it. Mr. H. Everett made a collection of twelve worms, which fall at least into six groups, none of which agree with any species hitherto known. We are glad to add that Dr. Benham has appended to his description of the anatomy of the individual a summary of what he regards as the characteristic features in the form of a diagnosis. He, like others, has much felt the absence of such a brief *résumé* in many instances, while reading through the literature of the genus.

Nematohelminthes.

Filaria nocturna.‡—Mr. F. Henry reports an interesting case of indigenous parasitic chyluria with *Filaria nocturna* in the blood. This is the first case that has been observed in Philadelphia, and was introduced from the south. The patient came under treatment to be delivered of a child, who was born healthy. Before delivery, she had complained of pains in the region of the kidneys. The urine was milky, and contains signs of albumen, but no sugar. On microscopic examination of the blood, the author discovered in it *Filaria sanguinis*. At first about five *Filariæ* could be seen in the preparation, but later on they were more numerous. They were only found in the blood at night. The author made use of several leeches to see whether they would serve as intermediate hosts.

The parasite only lived for three or four days in the leech and then died. In the course of six weeks the blood and the urine were repeatedly examined, and during this time *Filaria nocturna* was always found in the blood, and often in the urine. The parasite was not killed either by treatment with chinin, thymol, or methylen-blue. The use of the last reagent caused colouring of the blood-serum, and of the parasite itself, while the stools and urine of the patient were coloured, as were also the stools of the child whom the patient suckled.

According to the author's observations, *Filaria nocturna* rebelled against all medicines that were tried. The parasite appears also to have a great power of withstanding cold. It lives for ten days in

* CR. Congr. Internat. Zool. Leyde, 1896, pp. 526–30 (1 pl.).
† Ann. Mag. Nat. Hist., xviii. (1896) pp. 429–48 (2 pls.).
‡ Med. News, 2nd May, 1896. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 619–20.

a cold chamber. The author recommends the careful filtration of water, as he thinks it possible the parasite may be introduced by this fluid.

Platyhelminthes.

New Freshwater Nemertean.* — Dr. T. H. Montgomery jun. describes a freshwater Nemertean from Pennsylvania, to which he gives the name of *Stichostemma asensoriatum*. This barbarous specific name is, we are told, given in consequence of absence of the supraoral sense-pit, though we don't think that this is any excuse. A few details are given as to the characters of these worms, which are remarkable for having been found in a stream less than a yard in breadth and at no place more than a foot in depth. Most freshwater Nemerteans, it will be remembered, have been found in larger streams and rivers. Only three other Nemerteans are known from the fresh waters of North America.

Turbellaria of the Michigan State Fish Commission.†—Mr. W. M'M. Woodworth has a short report on the Turbellaria collected by the Michigan State Fish Commission, during the summers of 1893 and 1894. The collections, though few in number, contributed to the Turbellarian fauna of the United States four new species. The author points out that it is a matter of regret that in many cases new species have to be described from alcoholic material, for the action of killing and preserving reagents tends to destroy or bleach the pigments, and alter the shades of the animal, so that descriptions of this kind make subsequent identification difficult. The descriptions of the worms contain no point of any general interest.

Haplodiscus.‡—Herr H. Sabussow has studied some specimens of *Haplodiscus* obtained from Naples, which are not only the first recorded European forms of this pelagic Atlantic genus, but represent a new species, *H. Ussowii*. The body is flat and lens-like, with almost circular outline; the dimensions are ·8 mm. in length, ·86 mm. in breadth, 160 μ in height; the anterior end is quite rounded, the posterior end invaginate; the mouth lies in the second third of the body; pharynx and frontal organ are absent; the brain lies far forward; otocysts occur; the ovaries form two compact ventral strands connected in the middle line; the testis is unpaired and dorsal; there are no vasa deferentia, but there is a seminal vesicle and a tubular penis, covered with small warts. The new species is nearest *H. orbicularis*.

Anatomy and Histology of Amphistomidæ.§—Dr. R. Otto has had the opportunity of investigating seven species of this group belonging to the genera *Gastrodiscus*, *Amphistomum*, and *Gastrothylax*. In the first part of his work the author deals with the anatomy of these forms, while in the second part he treats the organs from the standpoint of comparative histology. He regards the cuticle of these worms, which ordinarily consists of two layers, as an excretory product of the parenchyma. There are no tegumentary glands. The musculature of this group does not differ from that of other Trematodes. Especial attention appears to

* Zool. Anzeig., xix. (1896) pp. 436–8.
† Bull. Mus. Comp. Zool., xxix. (1896) pp. 239–43 (1 pl.).
‡ MT. Zool. Stat. Neapel, xii. (1896) pp. 353–80 (2 pls.).
§ See Zool. Centralbl., iii. (1896) pp. 769–71.

have been paid to the nervous system. Throughout the group the generative apparatus appears to be similarly formed. All species have two testes, the number of lobes of which increases with age.

Aspidogaster conchicola.*—Dr. J. Stafford gives a lengthy memoir on the anatomical structure of this worm which, as he rightly remarks, has already been the subject of frequent observation. Its organs, however, have not been subjected to the methods of modern research. The author does not provide any summary of his conclusions, and it is impossible for us to do more than indicate the details on which he reports.

The parenchyma is the name applied to a mass of cells placed directly under the subcuticular system of muscles hitherto not observed in this genus, though frequently described under various designations in others. It seems to have had, indeed, more than a dozen names already. It appears to be the site of active reproducing cells from which modification takes place in two directions. The elements towards the cuticle remain mostly small and indefinite, while those towards the centre of the animal increase rapidly in size, and are transformed into glands, &c. The anterior end is called a mouth-sucker, although it is recognised that it is a much less specialised organ than the mouth-sucker of nearly all Trematodes. It is likely that its form in the adult has more relation to the needs of nourishment than to those of locomotion. The author describes the difficulty that he had in recognising the presence of slime-glands. The parasites themselves are to some extent bathed in their own secretion, and must carry some of it into their intestines. As may be supposed, the author's account of the excretory system extends over a number of pages. He is not yet able to give an approximately complete description of the nervous system.

New Species of Bilharzia.†—Sigg. C. Parona and V. Ariola report the discovery of a new species of this parasite in the blood of the black-headed gull (*Larus melanocephalus*). They call it *B. kowalevskii.* The male reaches the length of 14 mm.; the surface of the body is smooth, and there are no spines or tubercles. The gynæcophoral canal begins just behind the ventral sucker, and extends as far as the caudal end. The intestine is forked in front of this sucker, and does not unite again into an unpaired canal as in *B. hæmatobia*, but the arms of the intestine run separately to the hinder end, although they cross one another repeatedly.

Distoma Opisthobrias.‡—Herr A. Lutz describes a new species of fluke from a Brazilian Opossum. It belongs to the gronp in which the genital pore lies in the hinder end of the body, but is not terminal. Its close ally is a fluke found in the common European Hedgehog. It is probable that the intermediate host is some land snail.

Distomum felinum.§—Prof. P. Sonsino twice found *Distomum felinum* in dogs, and once in a cat, who had bitten a girl without obvious cause,

* Zool. JB. (Abth. Anat.), ix. (1896) pp. 477–512 (6 pls.).

† Boll. Mus. Zool. Genova, 1896, No. xlv. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) p. 620.

‡ Revista Mus. Paulista, i. (1895) pp. 180–88 (1 pl.). See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) p. 623.

§ Gaz. d. Ospedali e d. Cliniche, xvi. (1895). See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) p. 709.

and had, therefore, been suspected of rabies and killed. Large numbers of *Distoma* were found in the liver. The possibility of human infection is pointed out, and the suggestion made that in cases of *Cirrhosis hepatica* careful search should be made, more especially as Winogradoff has already shown that in Siberia, *D. felinum* occurs in man, and causes *Cirrhosis parasitaria hepatos.* The author also mentions some recent observations on *D. Westermanni.* His chief object appears to be to point out the danger of human infection from the diffusion of these parasites.

Hymenolepis diminuta Rudolphi found in Man.*—Prof. P. S. de Magalhães records a second instance of the occurrence of *Hymenolepis diminuta* Rudolphi (*Tænia flavopunctata* Weinland) in man. The patient was a mulatto, twenty months old, living at Rio de Janeiro. The worm passed was 18 cm. long and $3\frac{1}{2}$ mm. broad. The broadest part was some 18–20 links before the posterior end, the links there being 0·3 mm. long. Altogether, about 1300 links were counted. The head was 0·56–06 mm. broad, and was furnished with four suckers, close to the rostellum. The neck was short and 0·34 mm. broad. The genital pores were on one side. The eggs were round, with a diameter of 59·5 μ, and that of the embryos was about 34 μ. The last eight links of the chain, which were quite empty, were 0·6 mm. long and 1·5 mm. broad. The case is recorded on account of the rarity of this *Tænia* as a human parasite.

Tænia (Hymenolepis) nana v. Siebold and Tænia murina Duj.†—Prof. O. von Linstow is of opinion that *Tænia nana* and *T. murina* are distinct species. He relies on differences of size and anatomy. The number, shape, and size of the hooklets are different in both examples. The cortical layer is more strongly developed in the human tapeworm than in the parasite of the rat. On the other hand, *T. murina* has larger testes than *T. nana*. Other differences occur in the disposition of the receptaculum seminis in the ripe proglottides, and in the structure of the eggs. In *T. nana* the ova are spherical and double shelled, and on the inner investment are two thread-like processes. The ova of *T. murina* are triple shelled and elliptical. The inner coat has a knob-like process at both poles. *Tænia nana* has a universal distribution, while the allied cestode of the rat and mouse has hitherto been found only in Europe. The hosts of both worms are different, and whether the direct development of *T. murina* occurs also in *T. nana* of man, the future can only decide.

Cysticerci of Bothriocephalus latus.‡—Mr. A. E. von Schroeder gives, in Russian, an account of his studies on the broad-worm in Russian fishes. Out of 80 two-year-old perches examined only 28 were infected, and these only in very small quantities. It appears likely that the fish becomes directly, and at various ages, again and again infected with the free-swimming larvæ of this parasite. The spring and summer months appear to be those in which infection most frequently occurs.

* Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 673–4.

† Reference given is 12 pp. and 8 figs. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) p. 708.

‡ Prakt. Medizin, iii. (1896) Beil. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) p. 621.

New Human Tapeworm.*—Mr. H. B. Ward has a preliminary description of a new human *Tænia*, of which two examples have been found. It is proposed to call the new species *T. confusa.* The terminal joints are 27–35 mm. long, and 3·5–5 mm. broad. This length is, of course, considerably greater than that of the joints of the two common tapeworms which infest mankind. The scolex has four suckers and a retractile rostellum, which has six or seven closely set rows of small hooks. It is to be hoped that other practitioners will keep an eye on this parasite, and give us a fuller knowledge of it than we have at present.

Remarkable Pseudhelminth.†—M. A. Bavay gives an account of a remarkable form which was found in the fæces of a patient. The bodies found had the form of brown, jointed ribbons, wider at one end than the other, which became almost transparent. Each ring, or what appeared to be a ring, carried a pair of curved short feet. The only questions that suggested themselves were—are these marine annelids, or are they myriopods? They were, of course, nothing of the kind. By a happy thought the author recalled the relatively large lingual ribbon of the limpet, and this is what they were; the patient had eaten limpets and digested their flesh, but the horny and spiral radulæ had merely become unrolled.

Rotatoria.

Notommata wernecki.‡—Prof. W. Rothert describes this form, which makes galls on *Vaucheria*-filaments, as has been known since the beginning of the century. To Balbiani's careful description (1878) the author has some results to add. The masticatory apparatus is not reduced, and the unci may be seen protruded from the mouth. Entrance into the filament seems to be effected by the growing point. The parasite eats not only the colourless protoplasm, but also fat-drops and chlorophyll grains. The females cannot complete their development outside of the galls. As Balbiani observed, the same female may lay summer and winter ova. The winter ova have a delicate external and a firmer internal envelope, the latter formed some time after laying and alone persisting during the resting period. Only a few winter ova are produced, but over sixty summer ova may be laid by one female. In favourable conditions, not wholly dependent on temperature, summer ova as well as winter ova may be produced in late autumn and winter. In winter ova, segmentation occurs immediately after laying; before it stops the inner envelope is formed; during the resting period the egg contains a fairly well-developed embryo. This is probably true of other winter ova of Rotifers. Prof. Rothert was fortunate enough to find the males. They are remarkable in having a normal masticating apparatus, though the alimentary canal is rudimentary. They thus approach Seisonidæ. Female and male summer ova are laid normally by the same female, the former usually predominating; and the same is probably true of the winter ova. The parthenogenetic development of the male summer ova is quite certain, but it is not likely that all summer ova are unfertilised.

* West. Med. Review, i. (1896) pp. 35–6 (2 figs.).
† Bull. Soc. Zool. France, xxi. (1896) pp. 162–3.
‡ Zool. Jahrb. (Abth. Syst.), ix. (1896) pp. 672–713 (4 figs.).

Incertæ Sedis.

Structure of Actinotrocha.*—Mr. A. T. Masterman has a memoir on the structure of *Actinotrocha*, considered in relation to the suggested chordate affinities of *Phoronis*. He points out the close harmony of structure which is to be found between the larval forms of *Actinotrocha* and *Tornaria*. The chief of these are the following:—A much overhanging preoral lobe and, in some cases, two eye-spots; a preoral ciliated ring; a postoral ring; a circumanal ring of cilia; mesoderm forming five cœlomic pouches, one preoral and two pairs postoral. Mr. Masterman thinks that the study of the structure of *Phoronis* and of its larval form *Actinotrocha* entirely points to the close alliance of the genus to the members of the group of the Hemichordata, and *Balanoglossus* in particular. The present structure of *Phoronis* points to a marked degeneration, due to a sedentary life, for the highest stage of the organs is reached in *Actinotrocha* just before the metamorphosis, which results in the transformation to the adult condition. In the next place, the structure of *Actinotrocha* conforms to the hemichordate type extremely closely, even to minute particulars. As a general result of his work, the author proposes a further arrangement of the Chordata, forming the group Diplochorda for *Phoronis*. He appends the following view:—

Chordata.	A. Trimetamera.		
		1. Diplochorda.	*Phoronis.*
		2. Hemichorda.	*Balanoglossus,* *Cephalodiscus,* *Rhabdopleura.*
	B. Polymetamera.		
		3. Urochorda.	
		4. Cephalochorda.	
		5. Holochorda.	

Echinoderma.

Function of Polian Vesicles in Sea-Urchin.†—Herr J. von Uexküll uses the term "Polian vesicles" in the sense in which Delle Chiaje used it, in reference to the five interradial bladders (*Zahnblasen*) which lie above the lantern. The history of the term and of what has been said and figured in regard to the organs in question is sketched in an instructive, if somewhat humiliating, fashion. The only figure which the author finds to commend is that given by Romanes and Ewart. The radial bladders (*Gabelblasen*) between the interradials (*Zahnblasen*) have suffered similar maltreatment. Both *Gabelblasen* and *Zahnblasen* are diverticula of the membrana limitans lanternæ. Uexküll's investigation concerns their function. After discussing the conditions of pressure within *Sphærechinus*, he shows that the bladders are not to be interpreted as otolithic, nor as locomotor. The "compass" musculature serves solely to regulate the pressure within the bladder system of the membrana limitans; the regulated changes of pressure subserve respiration and the masticating movements. Increase of pressure within the vesicular space serves to protrude the œsophageal papillæ; the changes

* Proc. Roy. Soc. Edinburgh, xxi. (1896) pp. 129–37 (4 figs.).
† MT. Zool. Stat. Neapel, xii. (1896) pp. 463–76 (1 pl.).

of pressure serve to fill and empty the gills. The compass muscles are inspiratory, the *Gabel*-muscles expiratory. Apart from its discussion of the bladder system, the paper includes some interesting physiological observations, e.g. on the sensitiveness of sea-urchins to carbonic acid gas.

Elasipoda of the 'Travailleur' and 'Talisman.'*—M. R. Perrier has a preliminary report on the Elasipoda collected by these two vessels in 1882 and 1883. Among the deep-sea forms the Holothurians were represented by more than 700 individuals. Of these no less than 354 belonged to the Elasipoda. Altogether there were 9 genera, 2 of which are new, and 14 species, 10 of which are new. The new genera are called *Periamma* and *Tutela*, both belonging to the tribe Elpidiinæ. The former has on its dorsal surface a transverse row of four papillæ, while the latter has three small dorsal papillæ in each ray, which are often hardly visible.

Holothurians of the 'Princess Alice.'†—M. E. Hérouard gives an account of Holothurians collected by the Prince of Monaco in the Atlantic. Only 14 species were collected, of which 3 are new.

Cœlentera.

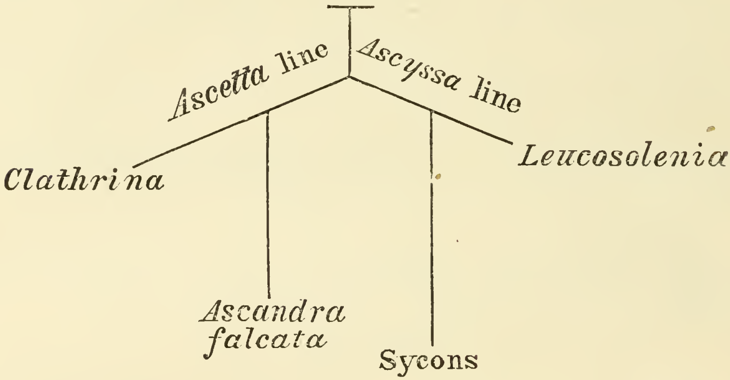
Extra-European Hydroids.‡—Mr. Elof Jäderholm has a report on the extra-European Hydroids contained in the Zoological Museum of the University of Upsala. In addition to some new species, he describes as new genera *Spongocladium* and *Antennellopsis*. The former belongs to the family Solanderiidæ; there are no signs of hydrophores, and the polypes arise directly from the intermediate space of the reticulate skeleton; the skeleton itself is flexible. *S. læve* is a new species from Japan. *Antennellopsis* is a form likewise from Japan, whose exact position is somewhat difficult to define, as it has a distinct resemblance to the Plumulariidæ on the one hand, and the Aglaopheniidæ on the other. The difficulties of determination are increased by the fact that all specimens at present observed are sterile.

Porifera.

Natural Classification of Asconidæ.§—Mr. E. A. Minchin has a preliminary notice on these calcareous sponges, on the study of which he has been engaged for some years past. He begins with a protest against a notion which has been prevalent since Haeckel's writings, and due largely to them, that the form of *Ascon* colony is useless for purposes of generic or specific determination. Indeed, Mr. Minchin thinks that most writers on these sponges have been acquainted only with preserved specimens. It is his experience that almost any species of *Ascon* can be identified at sight when one is acquainted with it, and that the mode of growth of the colony is a character of great generic value. It is true, he adds, that "it is almost hopeless to recognise an *Ascon* by its exterior from the figures given by Haeckel, but that is hardly the fault of the

* Comptes Rendus, cxxiii. (1896) pp. 900–3.
† Bull. Soc. Zool. France, xxi. (1896) pp. 163–8 (2 figs.).
‡ Bih. K. Svenska Vet. Acad. Handlgr., xxi. iv. No. 6 (1896) 20 pp. and 2 pls.
§ Ann. Mag. Nat. Hist., xviii. (1896) pp. 349–62.

Ascons." The author recognises three genera :—*Clathrina* with nine species, *Leucosolenia* with four species, and *Ascandra* with one. There remain many other known species of *Ascons* to which this classification must be fitted if it is to be rendered complete. The relations of the genera are indicated by the genealogical tree which we reproduce below:—



Calcareous Sponges from Ternate.*—Herr L. Breitfuss has a preliminary communication on the calcareous sponges collected at Ternate by Prof. Kükenthal. The material is said to have been well preserved, and the ten examples collected belong to six species and five genera, none of which appear to be new.

New Calcareous Sponge.†—Herr L. Breitfuss has a short preliminary contribution on the new heterocœlous calcareous sponge which he calls *Amphoriscus semoni.* It has the form of a delicate silvery cylindrical tube, attached by means of a thin curved stalk to the shell of *Avicula.* Though found at Amboina, it calls to mind two Adriatic species, from which, however, it is to be distinguished by the character of its spicules.

Protozoa.

Nucleus of Protozoa.‡—Miss M. Greenwood has published the first part of a study on structural changes in the resting nuclei of Protozoa. She now treats of the macronucleus of *Carchesium polypinum.* This creature was selected on account of the size and distinctness of its nuclear constituents, and from the fact that long use has made the author familiar with the structure and habits of the animal. This macronucleus has a strong affinity for stains, and consists in its maturity of four structural elements:—(1) The protomacrosomes, (2) the protomicrosomes, (3) the nucleochyme, and (4) the nuclear membrane. The first of these constituents are complex mobile bodies, especially prominent in the majority of stained specimens. Their complex character and action are suggested by, firstly, their reaction with dyes; for, staining selectively with eosin, they may also colour deeply with methylen blue. In the second place,

* Zool. Anzeig., xix. (1896) pp. 433–5. † Tom. cit., pp. 435–6.
‡ Journ. of Physiol., xx. (1896) pp. 427–54 (1 pl.).

they have a remarkable capacity for vacuolation. The protomicrosomes are less strongly chromatophilous than the macrosomes, but their affinities are distinctively for basic dyes. The structural constituents of the macronucleus are free from inorganic iron, but iron may be unmasked in the nucleus by appropriate treatment with acid. The variation which has been observed in nuclear structure may be correlated in part with the condition of nutrition of *Carchesium*; thus specimens nourished on intermittent bacterial diet have scattered macrosomes of medium size; with abundant artificial nourishment the macrosomes increase in size. The association of nuclear change with varying nutrition is more than coincidental, as may be seen, not only by experimental results repeatedly obtained, but by examination of senile or moribund nuclei on the one hand, and of the macrosomes during reproduction on the other.

Miss Greenwood looks forward to the results of histological work which shall correspond to and complement the suggestive experiments of Verworn—to study of structural change bound up with those demands on nuclear activity which he has associated with the reconstitution of divided cells.

Protozoa of Lake Michigan.*—Mr. C. A. Kofoid has a report upon the Protozoa observed in Lake Michigan and the neighbouring inland lakes during the summer of 1895. The present paper makes no pretensions to completeness, being merely a compilation from the daily record of work; it gives the distribution and relative abundance of such species as were identified during the six weeks the author studied at the laboratory. The list records 81 forms, this number being made up of 76 species and 5 varieties. They were thus distributed among the different groups:—Rhizopoda 22, Heliozoa 5, Mastigophora 20, and Infusoria 34.

Hygienic Importance of Parasitic Vorticellæ.†—Herr G. Lindner makes a new communication relative to *Vorticella ascoidea.* It appears that he has succeeded in transferring stalked to unstalked *Vorticellæ*, and observed their further development. In the unstalked *Vorticellæ* the author sees the direct or indirect cause of disease to animal organisms, and several cases are enumerated. Among these was a malady of typhoid type affecting two labourers, in whose stools *Vorticellæ* were found. The author has found *Vorticellæ* in the blood of dogs which had been fed with *Vorticella.* He is of opinion that Miescher's tubes are *Vorticella* cysts. In eczema of the scalp (from which he suffers himself), the author has found *Vorticellæ.* The cause of muscle poisoning is also assigned to *Vorticellæ*, which convert the albumen into toxalbumen. From sarcoma, carcinoma, and cowpox-lymph the author has bred cercomonads, but failed to reproduce them from their encysted stage.

ew Amœboid Rhizopod.*—Herren E. v. Leyden and F. Schaudinn have found in the ascitic fluid of living men an amœboid Rhizopod,

* Bull. Michigan Fish Comm., No. 6, Appendix ii. pp. 76–84.

† Deutsche Medizinal-Zeitung, 1896, No. 65. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 705–6.

‡ Situngsber. Königl. Preuss. Akad. d. Wiss. zu Berlin, xxxix. (1896) p. 13 (1 pl.). See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 465–6.

Leydenia gemmipara Schaudinn. The organisms are round or polymorphic, with radiating or hair-like processes. They are considerably larger than leucocytes, and contain fat-globules and pigment. Reproduction took place by budding and by fission. The specimens were obtained by centrifuging the exudate, which was examined at 25° and on the hot-stage.

Ætiology of Texas Fever.*—Herren Weisser and A. Maassen examined blood from the kidneys of oxen imported from America to Hamburg. No bacteria were found, but within the red corpuscles peculiar bodies were observed. Transfer and cultivation experiments were negative. The red corpuscles contained spherical bodies—usually single, occasionally in pairs, and rarely more than two. Not infrequently the parasites were found free in the plasma. As a rule, the parasites were spherical, but sometimes elongated and pyriform. They stained readily, but not equally, with anilin dyes. The parasites were also met with in the blood and juices of spleen, liver, heart, and lymphatic glands. Thus the observations of the authors confirm those of Smith and Kilborne, who first described the parasite of Texas fever under the name of *Pyrosoma bigeminum*.

Sarcosporidia in Muscle-Fibres of the Tongue of Cattle and Sheep.†—Prof. Fr. Sanfelice found in sections of tongues of cattle and sheep almost invariably sarcosporidian tubes which, under a power of 15–20, are seen as small white spots. As a rule, fully developed tubes, occupying the half to the whole thickness of the muscle fibres, predominate, the early stages of development being of rare occurrence. The larger tubes are invested in a very delicate structureless membrane and contain sickle-shaped bodies composed of two substances, one of which has an irregular distribution and the other is highly refracting. In stained preparations, uncoloured places are brought out, but no nuclei. The youngest stage of development consists of a protoplasmic mass without structure. Infection continues by bursting of the ripe tubes, the escape of the sickle-shaped bodies, and the invasion of fresh muscle-fibres. Herein they form new tubes, after enlargement and fission. As a further stage of development, the author found protoplasmic masses containing nuclei, which, as they increased in size, became oval, and were finally converted into sickle-shaped bodies.

* Arb. a. d. Kaiserl. Gesundheitsamte, xi. p. 411. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 704–5.

† Zeitschr. f. Hygiene u. Infektionskr., xx. p. 13. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) p. 754.

BOTANY.

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

α. Anatomy.

(1) Cell-Structure and Protoplasm.

Respiratory Function of the Nucleus.*—In further notes on the process of nuclear division, M. C. Degagny lays stress on the fact that (in *Spirogyra* and *Lilium candidum*) during the formation of the nuclear plate, the length of the spindle is reduced by one-half. The energy required for this contraction has its origin in the respiration of the cell, the seat of this respiration being the outer threads of the spindle and the adjacent parts of the cytoplasm. The filaments do not merely contract, but become at the same time rigid and tetanised. They subsequently lose their rigidity, and the phenomena attending these processes are described in great detail. The principal function of the nucleus during division appears to be to prepare a substance destined for respiration; this protoplasmic substance, capable of easy digestion and of contracting while respiring, is furnished by the fine filaments of the spindle. In *Lilium candidum*, owing to the enormous mass of protoplasm which fills the embryo-sac, respiration is greatly reduced in the central part. In *Spirogyra*, on the other hand, where the nucleus is in immediate relation with the external medium, it is much more evident.

Vegetable Cytology.†—In a new work on the morphology and physiology of the nucleus in plants, Prof. A. Zimmermann gives a summary of all the more important recent observations in this subject. The book is divided into three main parts; the first dealing with technique, and with the chemistry and physiology of the nucleus in general; the second, with the structure and behaviour of the nucleus in the different groups of the vegetable kingdom, including its history in fertilisation and embryogeny; while the third part consists of a copious bibliography.

Prof. J. B. Farmer ‡ gives an account of the more important advances recently made in the study of Vegetable Cytology. He lays stress on the fact that the two methods—microchemical and staining—should both be employed. While the staining exhibits more or less completely the structural arrangement of the substances present, the microchemical method not only indicates some at least of the important differences which exist between the different structures revealed by the action of staining, but it teaches us that certain of these same structures are by no means so homogeneous in their nature as one might be led to suppose from the evidence derived from staining alone.

* Bull. Soc. Bot. France, xliii. (1896) pp. 310–4, 332–46. Cf. this Journal, 1896, p. 535.

† 'Die Morph. u. Phys. d. pflanzischen Zell-kernes,' Jena, 1896, 188 pp. See Nature, lv. (1896) p. 147.

‡ Science Progress, v. (1896) pp. 22–37; i. (1897) pp. 141–66.

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

Spectrum of Chlorophyll.*—M. A. Etard describes in detail the spectrum of several different kinds of chlorophyll. He classifies the various kinds of chlorophyll in two groups, to which he gives the formulæ $C_{28}H_{45}NO_4$ and $C_{34}H_{53}NO_{12}$. These are found in different plants, and have different spectra.

Artificial Starch.—Dr. O. Bütschli † claims to have produced artificially sphærocrystals of starch by the very slow evaporation of a mixture of gelatin and an aqueous solution of starch, and maintains his previous view that starch and inulin have both a honeycomb structure.

These researches are subjected to a very unfavourable criticism by Herr A. Meyer.‡

Colouring-Matter of the Aril of Celastrus.§—Dr. Ida A. Keller finds the colouring-matter of the aril of *Celastrus scandens* to be a substance resembling carotin, but differing from it in not being precipitated by alcohol after dissolving in carbon bisulphide.

Reserve Food-Materials.‖—Prof. J. R. Green gives the results of recent investigations on the mode of formation and the function of the various food-materials of plants. With regard to the alkaloids, he arrives at the conclusion that the greater number of them, and probably all, must be regarded not as reserve-materials, but as bye-products or excreta, appearing coincidently with the active metabolic processes of the growing plant.

(3) Structure of Tissues.

Wood of the Oak.¶—Herr P. Metzger states that the duramen and alburnum of the oak contain the same tannin, with the approximate formula $C_{15}H_{16}O_{11}$, that of the bark being different; they are both glucosides. The alburnum, duramen, and bark contain the same oil, belonging to the series of palmitic, stearic, carotic, and oleic acids; no cholesterin or wax was detected. Oxalic, malic, and tartaric acids were found in all three tissues; also glucose and cane-sugar, but starch only in the duramen and alburnum.

Secreting Pockets of the Myoporaceæ.**—In contrast to the statements of previous observers, M. J. Briquet has established that these structures are of schizo-lysigenous origin, a mode of formation of similar bodies which seems to be very widely distributed. Their first origin is schizogenous; but the mode of escape of the oil into the central cavity and the subsequent processes must be termed lysigenous. The site of formation of the oil is always the cell-walls which are in process of gelification; and the nucleus, which is always situated near the walls which bound the central cavity, appears to take part in the process.

* Comptes Rendus, cxxiii. (1896) pp. 824–8 (1 fig.).

† Ber. Versamml. Deutsch. Naturf. u. Aerzte, 1896, Bot. Sect. See Bot. Centralbl., lxviii. (1896) p. 213. ‡ Bot. Ztg., liv. (1896) 2te Abt., pp. 328–35.

§ Proc. Acad. Nat. Sci. Philadelphia, 1896, pp. 212–6 (1 fig.).

‖ Science Progress, v. (1896) pp. 60–76.

¶ 'Beitr. z. chem. Charakt. d. Holzkörpers der Eiche,' Heilbronn, 1896, 34 pp. See Bot. Centralbl., lxviii. (1896) p. 48.

** Comptes Rendus, cxxiii. (1896) pp. 515–7. Cf. this Journal, 1895, p. 190.

Structure of Trigoniaceæ and Chailletiaceæ.*—An examination of a number of species belonging to these two small orders of Thalamifloræ leads M. F. Barth to the conclusion that they are nearly related to one another, and that the Trigoniaceæ should be separated from the Vochysiaceæ. The epiphyllous inflorescence of certain Chailletiaceæ results from the fact that a bud-bundle, instead of detaching itself from the foliar bundle in the stem, is drawn up to a certain height along with the latter.

"Gommose bacillaire" of the Vine.†—In opposition to the view of Prillieux and others, Herr E. Ráthay maintains that this disease is not due directly to the attacks of a bacillus. The gum is formed in the ordinary way for the protection of a part injured by a wound or by unfavourable vital conditions.

(4) Structure of Organs.

Importance of Anatomical Characters in Classification.‡—M. P. Parmentier insists on the importance of using characters derived from the internal anatomy, as well as morphological characters, for determining both the bounds of critical species, and the position of difficult genera. A number of illustrations of both kinds are given. It is shown that, on anatomical grounds, *Trapa* must be placed among the Halorageæ and not among the Œnothereæ, and that the Eupteleæ have no genetic connection with the Magnoliaceæ. The most important anatomical characters are; in the leaf:—the general presence or absence of crystals, especially in the epiderm; the pattern of the cell-walls of the cuticle; a single or multiple epiderm; the presence or absence of hypoderm; the centric, sub-centric, or bifacial structure of the mesophyll; the presence or absence of vesicular reservoirs, of fibres running through the mesophyll, and of sclerified cells; and the mode of increase and localisation of the latter. In the stem:—the general plan of the vascular bundles; the presence or absence of periderm, of mechanical fibres, of sclerified cells, and of crystals, and the localisation of these various elements; the form and orientation of the cells of the conjunctive parenchyme, &c.

Flower of Canna.§—Prof. L. H. Bailey calls attention to the prevailing want of symmetry in the Scitamineæ. The reduction in the number of stamens is carried to excess in the Zingibereæ, where there is only one, and still more in the Canneæ, where the stamen is represented by what is apparently a single loculus, the other loculus being developed into a foliaceous organ, and the remaining five stamens into petaloid staminodes.

Stigma and Pollen of Arisæma.‖—Mr. W. W. Rowlee describes the structure of the stigma and pollen in *Arisæma triphyllum* and *A. Dracunculus* (Araceæ); the principal peculiarity being that the stigmatic papillæ are continued down the inner surface of the open stigmatic tube,

* Bull. Herb. Boissier, iii. (1896) pp. 481–520 (33 figs.).
† JB. K. K. Oenol. u. Pomol. Lehranstalt Klosterneuburg, 1896. See Bot. Centralbl., lxviii. (1896) p. 54. Cf. this Journal, 1896, p. 100.
‡ Ann. Sci. Nat. (Bot.), ii. (1896) pp. 1–36.
§ Bot. Gazette, xxii. (1896) pp. 222–3.
‖ Bull. Torrey Bot. Club, xxiii. (1896) pp. 369–70 (2 pls.).

and form a stigma-like tuft at the summit of the ovary, close to the micropyle of the erect ovule.

Compound Ovaries.*—Prof. C. E. Bessey discusses the origin of the compound ovary, which he considers as differing in different cases. Apocarpous plants he regards as lower than syncarpous. Ovaries may be primitively simple, or may have become simplified from a more complex structure, as in the case of grasses and sedges. The Amentiferæ, notwithstanding their apparently simple floral structure, are not to be regarded as among the lowest of the dicotyledons.

Fruit of Phœnix melanocarpa.†—M. A. Girard describes in detail the composition of the fruit of a very remarkable date-palm, grown near Nice, which ripens its fruit in April, instead of in July, as is the case with the African date-palm. The chief chemical peculiarities are that the saccharose is entirely replaced by levulose, and the complete absence of acids, and of the tannin group of substances.

Symmetry of the Axis.‡—M. A. Chatin lays stress on characters derived from the structure and origin of the roots as indicating the relationship of the primary divisions of the vegetable kingdom. In Dicotyledons there is always a true perennial descending axis originating from the embryo; in Monocotyledons there is a system of primary roots, of temporary duration, succeeded by adventitious roots; in Acotyledons, all the roots are adventitious. The root is fibrovascular in the Dicotyledons, Monocotyledons, and higher Acotyledons; cellular in the lower Acotyledons. The Dicotyledons alone produce from their primary descending axis secondary roots arranged symmetrically, comparable to the arrangement of leaves on the stem.

Stem and Leaf of Phyllantheæ.§—Dr. H. Rothdauscher goes into great detail respecting the structure of the leaf and axis in the various genera belonging to this family of Euphorbiaceæ, excluding the Euphyllantheæ. Among the more general characters may be mentioned the absence of latex-tubes, the absence of glandular hairs, with the exception of peltate hairs in one genus, the occurrence of companion-cells parallel to the fissure of the stomates, the comparative or complete absence of hairs, &c.

Spines of the Aurantiaceæ.‖—Sig. E. Migliorato discusses the anatomical nature of the spines in *Citrus Aurantium* and other species of the order. From the occasional occurrence of subtending bracts and from other characters, he concludes that they are of axial and not of foliar origin.

Position of Leaves.¶—According to Mr. R. N. Day, the position of the leaf is the result of internal physiological, not of external mechanical forces. The predominating force is always the heliotropic tendency.

* Bot. Gazette, xxii. (1896) p. 224.
† Comptes Rendus, cxxiii. (1896) pp. 720–4.
‡ Bull. Soc. Bot. France, xliii. (1896) pp. 267–72.
§ Bot. Centralbl., lxviii. (1896) pp. 65–79, 97–108, 131–6, 161–9, 193–203, 248–53, 280–5, 305–15, 338–46, 385–93.
‖ Nuov. Giorn. Bot. Ital., iii. (1896) pp. 436–8 (7 figs.).
¶ Bot. Gazette, xxii. (1896) p. 222.

Reaction of Leaves to continuous Rainfall.* — From a series of experiments made by Prof. D. T. MacDougal on the influence of a continuous rainfall upon leaves, he concludes that a direct effect on the structure of the leaf is produced, but that the nature of this change differs in different species. In addition to the hitherto recognised characters of adaptation to a heavy rainfall, the author adds an upwardly convex form of the lamina of the leaf.

Petiole of Quercus.†—M. F. Bossebœuf distinguishes two distinct types in the petiole of different species of oak :—(1) At the base of the petiole the numerous isolated vascular bundles are arranged in a circular line, flattened above, or nearly triangular; at the back of each of the bundles is a mass of sclerenchyme proceeding from the pericycle, with very strongly thickened walls. (2) The vascular bundles, also isolated at the base, but less numerous, soon unite to form a complete ring, flattened above, composed of a layer of internal xylem and one of phloem, and surrounded by the strongly thickened pericycle; this arrangement continues through the rest of the petiole and the median vein of the lamina; there is never any internal arc. Varieties of each type are described; and there are also intermediate forms.

β. Physiology.

(1) Reproduction and Embryology.

Embryology of Balanophoraceæ.‡—M. P. van Tieghem describes the structure of the male and female flowers in the different genera of this order. They may be classified under three families, characterised by the structure of the ovary in the female flower. In the first (Sarcophytideæ) there are as many rudimentary and transitory ovules as there are carpels; they are orthotropous, pendant, and basigamous, and the ovary is plurilocular, with axile placentation. In the second (Helosideæ) there are no ovules, but only a placenta, enclosing as many endosperm mother-cells as there are carpels; they are acrogamous, and the ovary is unilocular, with central placentation. In the third (Balanophorideæ) there are neither ovules nor placenta; but the monocarpellary ovary produces, beneath the epiderm of its base, a single acrogamous endosperm mother-cell. The order must be placed in the sub-class of Dicotyledons destitute of ovules, i.e. in the Loranthineæ.

Embryo-Sac of Succulent Plants.§—A detailed study of the reproductive organs of succulent plants—especially the Cactaceæ, Mesembryanthemaceæ, and Crassulaceæ—leads M. E. d'Hubert to the conclusion that there are several features characteristic of this class of plants, though not absolutely confined to it.

In the Cactaceæ the ovules are so arranged as to fill up as completely as possible the cavity of the ovary; they are amphitropous and bitegumented. The funicle is always strongly developed; it is coiled round it, forming a complete envelope (the aril of *Opuntia*), and is loaded with starch; it serves both to protect and to nourish the ovule. The embryo-sac is formed only at a late period, the axile hypodermal cell of the

* Bot. Gazette, xxii. (1896) pp. 232–3.
† Bull. Soc. Bot. France, xliii. (1896) pp. 260–6 (8 figs.).
‡ Tom. cit., pp. 295–310.
§ Ann. Sci. Nat. (Bot.), ii. (1896) pp. 37–128 (3 pls. and 61 figs.).

nucellus giving birth to it directly. Starch is rapidly formed in the embryo-sac, and plays a very important part in the nutrition of the embryo; it is the antipodals that store it up for this purpose. The synergids take no part in this process; the nucleus of one of these goes to meet the pollen-tube; that of the other one drops to the neighbourhood of the oosphere, and remains there until the first bipartition of the nucleus of the oosperm. The synergids supply nutriment to the nucleus of the pollen-tube, and to the oosperm at the moment of its formation. The two polar nuclei, first of all placed at the periphery of the sac, serve for its increase; subsequently they contribute to the nourishment of the oosphere. The ovule of the Mesembryanthemaceæ is also amphitropous and bitegumented, and displays striking resemblances to that of the Cactaceæ. The funicle is again strongly developed, and there is a large formation of starch in the embryo-sac. The principal differences are—the presence of a three-celled cap in the ovary, and the possible fusion of the polar nuclei without the pollen-tube reaching the ovule.

In the Crassulaceæ the ovule is characterised by the hood of the embryo-sac formed by the epiderm of the nucellus, by the regression of the nucellus, and by the presence of an axial conducting system from the chalaza to the embryo-sac. The ovule is anatropous and bitegumented; the nucellus is greatly reduced; the embryo-sac is protected, but is isolated in the micropylar region; it receives the nutrient material only in its enlarged lower portion.

The embryo-sac of other succulent plants—Asclepiadeæ, Euphorbiaceæ, Portulacaceæ, Liliaceæ, Amaryllideæ—likewise contains starch; but this is also the case with some plants that are not succulent.

Significance of Chalazogamy.*—Prof. J. M. Coulter regards chalazogamy as a purely physiological phenomenon, not involving any such change of structure as defines a natural group or indicates a line of descent. It ought not, therefore, to be used as an indication of phylogeny, as suggested by Nawaschin.

Parthenogenesis in Thalictrum.†—Mr. D. F. Day reports the frequent occurrence of parthenogenesis in the diœcious species *Thalictrum Fendleri* from Colorado.

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

Growth of Pines.‡—Prof. R. Hartig has investigated the effect on the growth of pine-stems of various external influences, such as wounds and the attacks of insects and fungi. Pines attacked by the larva of the moth *Psilura monacha* show a smaller yearly growth in all parts of the stem, especially the lowest. Young trees so attacked may regain their strength after a time. A stronger growth on one side of the stem is not the result of a greater development of foliage on that side; the strongest growth is always on the side opposite to the prevalent wind.

Relation of the Growth of Foliage-Leaves and the Chlorophyll Function.§—Prof. D. T. MacDougal gives the results of a series of experiments on this subject, made on a variety of plants, especially in

* Bot. Gazette, xxii. (1896) pp. 227–8. † Tom. cit., p. 241.
‡ Forst. Nat. Zeitschr., 1896, pp. 1–15, 33–45. See Bot. Ztg., liv. (1896) p. 295.
§ Journ. Linn. Soc. (Bot.), xxxi. (1896) pp. 526–46 (1 pl. and 1 fig.).

relation to the deteriorating effect of placing them in an atmosphere devoid of carbon dioxide. The power of developing inactive leaves is not constant in the same species, being dependent on the availability of the reserve-food for this purpose. Material constructed in active chlorophyll areas, and stored in special organs, may be transported to inactive chlorophyll organs in some plants in light and in darkness, and may be used in such a manner as to allow of the perfect development of those organs. It is possible for some plants to form perfect leaves in darkness; some when a portion of the stem only is darkened, and others when the entire plant is darkened. Placing a leaf under such conditions that it cannot construct food-material, sets on foot the specific regulatory mechanism of the organism in such a manner that the plastic material may be withdrawn and the organ cast off. An exaggerated development of the petiole in darkness may be induced by this mechanism.

Recent Literature relating to Leguminosæ Tubercles and the Fixation of Free Oxygen.—Prof. Stutzer * reports on some of the most recent papers on the root-tubercles of the Leguminosæ.

Herren F. Nobbe and L. Hiltner † continue their experiments on the adaptability of root-tubercle bacteria of unlike origin to different genera of Leguminosæ. The experiments showed that an effective inoculation was obtainable with certainty only when inoculations were made from like species. From these experiments two important conclusions are arrived at, namely, that the tubercles have no influence so far as aerial growth is concerned, so long as the plants obtain sufficient nitrogen from the soil, and that, directly the soil-nitrogen begins to fail, those Leguminosæ which are devoid of or possess only imperfect tubercles show their want of oxygen; hence the leaves of the Leguminosæ can hardly be considered as organs for assimilating oxygen.

M. Gonnermann ‡ obtained pure cultures of tubercle-bacteria in a medium composed of 100 grm. of expressed lupin juice, 10 grm. gelatin, and 3 grm. meat pepton.

Salfeld § observed that burnt chalk prevents the formation of tubercles on peas, but B. Tacke,|| who has also investigated the question, finds that Salfeld's results must be due to some other cause, for chalk seems to favour the formation of root-tubercles.

Physiology of the Root-Tubercles of Leguminosæ.¶—From the results of a series of experiments carried on for two years in the S. of France on a number of different species of Leguminosæ, M. C. Naudin doubts the correctness of the prevalent hypothesis that the bacteria of the root-tubercles have the power of absorbing the free nitrogen of the atmosphere, or that they are of advantage to the host-plant. He finds that some species thrive quite as well in sterilised soil, the seeds sometimes germinating earlier, and producing stronger plants, than those sown in ordinary soil. The plants grown in sterilised soil had sometimes a large number of root-tubercles, sometimes only a few, sometimes

* Centralbl. f. Bakteriol. u. Parasitenk, 2te Abt., ii. (1896) pp. 650–3.
† Landwirt. Versuchstat., xlvii. p. 257. ‡ Landw. Jahrb., xxiii. p. 652.
§ Deutsche Landw. Presse, 1894, No. 83.
|| Mitt. d. Vereins. z. Förderung d. Moorkultur, 1895, p. 389.
¶ Comptes Rendus, cxxiii. (1896) pp. 666–71.

none at all. No evidence could be obtained of their increasing the richness of the soil in nitrogen.

Fixation of Atmospheric Nitrogen by Algæ and Bacteria.*—M. R. Bouilhac has experimented on the power of the three algæ *Schizothrix lardacea*, *Ulothrix flaccida*, and *Nostoc punctiforme* to absorb free nitrogen from the atmosphere in pure cultures in the presence of the bacteria of the soil. With the first two species the results were negative; but the cultivation of the *Nostoc* in association with the bacteria resulted in a vigorous development of both species and the fixation of atmospheric nitrogen. The power of this alga to absorb nitrogen may be compared to that of the Leguminosæ.

Influence of Light and Temperature on Turgor.†—According to experiments made by Mr. E. P. Copeland—on mosses and on seedlings of *Vicia Faba*—the turgor is affected by temperature in a variety of different ways, both direct and indirect. Turgor is regulated by rapidity of growth, rather than the converse. With regard to the connection between etiolation and turgor, the turgor of the root is influenced by the amount of light which the aerial parts receive. Turgor is not affected by the removal of carbon dioxide from the atmosphere; it is as high in etiolated as in illuminated parts of the plant.

Absorption and Emission of Water by Seeds.‡—As the result of experiments made on a number of different seeds by M. H. Coupin, it appears that the absorbing power for water of the same species varies greatly, as also does the extent to which the water penetrates the seed. In some saturated seeds there is water which does not belong either to the testa or to the embryo. Dormant seeds absorb, as a rule, as much water as living seeds. The absorbing power of seeds is only slightly influenced by the temperature. Aqueous vapour can be absorbed directly by seeds, especially by the embryo.

The bursting of the testa of seeds cannot be attributed entirely either to the increase in size of the embryo or to the direct force of the germinating radicle; it is probably due to a diastase, which decreases the resistance of the testa by disorganising it.

When seeds are plunged in water dilatation takes place, followed by contraction, if the seed has a thin folded testa; but contraction only if the seed adheres to the embryo. The contraction is due to a chemical combination of the reserve-materials with water; dilatation to rapid imbibition by the testa. When ripening, seeds become desiccated by transpiration, not simply by evaporation.

(3) Irritability.

Rheotropism.§—Mr. F. Newcombe has experimented on the existence of rheotropism in Phanerogams. The experiments were made on the roots of suspended seedlings dipping in water. Out of 17 species of Monocotyledons and Dicotyledons, 8 were found to be positively rheotropic, i.e. they bent the tips of their roots directly or obliquely against

* Comptes Rendus, cxxiii. (1896) pp. 828–30.

† 'Ueb. d. Einfluss v. Licht u. Temperatur a. d. Turgor,' Halle, 1896, 59 pp. See Bot. Centralbl., lxviii. (1896) p. 177.

‡ Ann. Sci. Nat. (Bot.), ii. (1896) pp. 129–222 (34 figs.).

§ Bot. Gazette, xxii. (1896) pp. 242–3.

the stream. Nine species were indifferent; none negatively rheotropic. The curvature appeared to be a response to irritation.

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

Physiology and Biology of Winter-Green Plants.*—Understanding by "winter-green" plants not only evergreen perennials, but also such biennial or annual herbaceous plants as maintain the activity of their leaves in the winter, e.g. *Senecio vulgaris*, *Geranium robertianum*, Dr. B. Lidforss states that they are characterised by the entire absence of starch from the guard-cells of the stomates during the cold season; it has already completely disappeared by December; but its formation is at once induced by a higher temperature. The same is true of the mesophyll-cells of the leaf. These contain, on the other hand, large quantities of a soluble carbohydrate, probably glucose; and the author regards the transformation of starch into glucose as a protection against cold, similar to the formation of oil in many trees. Submerged plants, mosses, and green algæ exhibit similar phenomena.

γ. General.

Divergence of Monocotyledons and Dicotyledons.†—Prof. C. E. Bessey points out that Monocotyledons and Dicotyledons cannot have diverged from one another at what are generally regarded as the lowest members of each group, viz. the Typhaceæ, Pandanaceæ, Naiadaceæ, &c. on the one hand, and the Piperaceæ, Chloranthaceæ, Salicaceæ on the other hand; since these orders show no kind of affinity with one another. He considers, on the other hand, that external anatomy, histology, and embryology point to a genetic relationship between the apocarpous Monocotyledons (Alismaceæ, Naiadaceæ, &c.) on the one hand, and the Thalamifloral Ranales (Ranunculaceæ, Magnoliaceæ, Nymphæaceæ, &c.) on the other hand.

Graft-Hybrid.‡—Prof. N. Wille records a remarkable instance of apparent graft-hybridism of a pear on a whitethorn. The fruits are small, pear-shaped, with the colour of the fruit of *Cratægus*, 5-celled, but usually sterile; the leaves have all the appearance of pear-leaves.

Fossil Plants of the Coal-Measures.§—Parts 2 and 3 of this important work, by the late Prof. W. C. Williamson and Dr. D. H. Scott, comprise the detailed account of their researches on the roots of Calamites and on *Lyginodendron* and *Heterangium*, which appear to belong to a fossil group on the border-land of Ferns and Cycadeæ.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Female Prothallium of the Heterosporous Lycopodiaceæ.‖—From observations on the germination of the megaspores of *Isoetes malinverniana*

* Bot. Centralbl., lxviii. (1896) pp. 33–44.
† Bot. Gazette, xxii. (1896) pp. 229–32.
‡ Mitt. Biol. Gesell. Christiania. See Biol. Centralbl., xvi. (1896) p. 126.
§ Phil. Trans. R. S., clxxxvi. (1896) pp. 683–779 (15 pls.). Cf. this Journal, 1895, pp. 338, 660.
‖ Bot. Ztg., liv. (1896) 1te Abt., pp. 159–68 (1 pl.).

and *Selaginella cuspidata* var. elongata, Herr W. Arnold maintains that the development of the female prothallium presents no essential difference in these two genera. The single nucleus of the spore divides gradually into daughter-nuclei, which are imbedded in the parietal part of the protoplasm, and determine the formation of cells in the prothallium. The mature prothallia closely resemble one another; they are colourless, and bear only unicellular rhizoids; the spores germinate while still in the sporange, falling out, in *Selaginella*, at the time of impregnation; while in *Isoetes* the young plants are produced within the sporange. The process is compared by the author to the development of the endosperm in Phanerogams.

Sporanges on Prothallia.*—Mr. W. H. Lang describes the production of sporanges on prothallia of two ferns, *Lastrea dilatata* var. cristata gracilis, and *Scolopendrium vulgare* var. ramulosissimum. In the case of the former species the midrib of some of the prothallia was elongated into a peculiar cylindrical process containing tracheids. On this process are produced sexual organs of both kinds; also sporanges, either on the process or immediately behind it, and either isolated or collected into groups resembling sori; also single sporanges on the edge of the prothallium. Beneath the sporanges a few tracheids were always found. In the hart's-tongue the prothallium was prolonged into a similar cylindrical process, which bore a large number of sporanges as well as sexual organs. The author adduces reasons for regarding the production of sporanges on the prothallium as a special case of apogamy.

Division of the Prothallium of a Fern.†—Mr. E. J. Lowe records some interesting results from the repeated division of the prothallium of *Scolopendrium vulgare* var. crispum. Some of the fern-plants which sprang from the divided prothallia had a remarkably *Marchantia*-like appearance. These fronds appear to have characters intermediate between the sporophoric and the oophoric. Apospory was also observed, as also the formation of antherids and archegones on an entirely new growth of repeatedly divided prothallia.

Muscineæ.

Mucilaginous Paraphyses in a Moss.‡—In some of the paraphyses of *Diphyscium foliosum*, Herr W. Lorch finds bell-shaped membranes attached to the septa. In their youngest stages, an accumulation of mucilage takes place between the cuticle and this membrane, which distends and finally splits the cuticle, producing the bell-shaped structures.

Algæ.

Sarcomenia.§—Mdme. A. Weber van Bosse describes minutely the structure of *Sarcomenia miniata* (Florideæ) from South Africa. The cells of the central tube are connected by a very strong strand of protoplasm. Secondary pores and smaller strands of protoplasm also connect the pericentral tubes with one another and with the central tube.

* Proc. Roy. Soc., lx. (1896) pp. 250–60.
† Journ. Linn. Soc. (Bot.), xxxii. (1896) pp. 529–39 (2 figs.).
‡ Jahrb. Naturw. Ver. Elberfeld, viii. (1896) p. 86 (1 fig.). See Hedwigia, xxxv. (1896) Rep., p. 121. § Journ. of Bot., xxxiv. (1896) pp. 281–5 (1 pl.).

Antherids occur on the same plant as the cystocarps. The branches are the result of endogenous growth, as in *Rytiphlœa* and other genera.

Fucaceæ.*—Herr E. Gruber describes in detail the structure of a number of species of Fucaceæ, and classifies the genera into six groups, viz. the Durvilleæ, Hormosireæ, Fuceæ, Loriformes, Cystosireæ, and Sargasseæ. The Durvilleæ comprise the genera *Durvillæa* (including *Sarcophycus* and *Ecklonia*) and *Splachnidium* (?); the Hormosireæ, *Hormosira* and *Notheia;* the Fuceæ, *Fucus, Pelvetia, Xiphophora, Ascophyllum, Axillaria, Seirococcus, Scytothalia, Phyllospora,* and *Marginaria;* the Loriformes consist of *Himanthalia* alone; the Cystosireæ are divided into Bilaterales and Radiares; the former including *Halidrys, Bifurcaria, Carpoglossum, Myriodesma* (?), *Platythelia,* and *Platylobium*; the latter *Cystoseira, Cystophyllum, Hormophysa, Coccophora, Scaberia* (?), *Cystophora,* and *Langsburgia*; the Sargasseæ comprise *Anthophycus, Carpophyllum, Contarinia, Pterocaulon, Sargassum,* and *Turbinaria.*

New Genus of Freshwater Phæosporeæ.†—Under the name *Heribaudiella,* M. M. Gomont establishes a new genus of Ralfsiaceæ, with the following diagnosis:—Planta phæosporina, crustacea, e strato initiali arcte appresso et filis erectis inde ortis formata; stratum initiale monostromaticum, ambitu crescens, cellulis connatis secus series dichotomas flabelliformiter arcuatas ordinatis constitutum; fila erecta libera, articulata, monosiphonia, abundanter et plerumque dichotome ramosa, ramis fastigiatis, arcte appressis; sporangia unilocularia in soros haud aggregata, transformatione cellulæ superioris filorum ascendentium orta, poro apicali vacuefacta; sporangia plurilocularia usque adhuc ignota aut nulla. The genus is nearly allied to *Symphyocarpus* and *Lithoderma. H. arvernensis* sp. n. forms a brown coating on mica-schists in running water in Haute Auvergne.

New Cephaleuros.‡—Under the name *Cephaleuros Coffeæ,* Herr F. A. F. C. Went describes a new species of this genus of Chroolepideæ parasitic on leaves of the coffee plant, and follows the various stages of its development. The pigment is blood-red. It causes black spots on the leaves, and the blackening and drying up of the fruit.

Pseudocodium, a new Genus of Siphoneæ.§—Under the name *Pseudocodium De Vriesii* g. et sp. n., Mdme. Weber van Bosse describes a new Siphonean Alga from S. Africa, with the following diagnosis:—Frondes virides, dichotomi; rami cylindrici, omnino consimiles, ex filis tubulosis subparallelis longitudinaliter dispositi, apice iterum atque iterum divisi, contexti, articuli exteriores apice in vesiculos oblongos evoluti, corticem pseudoparenchymaticam formantes; rhizini filiformes cum granulis sabulosis et inter se dense intertextis; propagatio ignota. Notwithstanding its outward resemblance to *Codium,* the authoress considers the genus more nearly related to *Halimeda.*

Rotifer-Galls on Vaucheria.‖—Herr W. Rothert describes in great detail the structure and development of the galls produced on species

* Biblioth. Bot. (Luerssen u. Frank), Heft 38, 34 pp. and 7 pls. Cf. this Journal, 1890, p. 69. † Bull. Soc. Bot. France, xliii. (1896) pp. 388–91 (1 pl.).
‡ Centralbl. f. Bakt., Parasit. u. Infektionskr., 2te Abt., i. pp. 681–7.
§ Journ. Linn. Soc. (Bot.), xxxii. (1896) pp. 209–12 (1 pl.).
‖ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxix. (1896) pp. 525–94 (2 pls.).

of *Vaucheria* by *Notommata Wernecki*. The outgrowths caused by the parasite branch dichotomously or trichotomously, while the normal *Vaucheria*-filaments branch only monopodially. The membrane of the gall differs from that of the ordinary thallus in thickness and stratification, and contains substances peculiar to it. The gall is surrounded by a thin layer of mucilage resulting from the disorganisation of the outer layers. The galls probably arise from lateral branches of the thallus formed in consequence of the destruction of the growing point by the parasite. The protoplasm of *Vaucheria* displays a remarkable resistance to the attacks of the *Notommata*, which is a true parasite, having nothing but an injurious effect on the host.

A new species, *Vaucheria Walzi*, is described.

Fungi.

Distribution of Fungi by Snails.*—According to Herr G. Wagner, the carriage of spores by snails plays an important part in the propagation of Fungi. This was established in the cases of *Plasmopora nivea*, the oidium of *Erysiphe communis*, *Puccinia Caryophyllearum*, &c.

Membranaceous Mycele.†—M. C. van Bambeke describes a mycele which forms extensive white pellicles. The separate hyphæ contain irregular flat swellings, which the author regards as spores, and believes that they perform a function as reservoirs of reserve food-material.

Chytridium simulans sp. n.‡—M. P. A. Dangeard describes this new species of Chytridiaceæ, parasitic on an aquatic fungus, probably a species of *Pythium*. It is nearly allied to *C. subangulosum*, and consists of a zoosporange, with a rudimentary nutrient filament at its base.

New Genera of Fungi.§—Abbé J. Bresadola describes the following new genera from Brazil :—*Hydnochæte* :—Receptaculum resupinatum, suberoso-coriaceum, hymenium aculeato-dentatum, aculeis subulatis fulvis præditum; basidia tetraspora; sporæ hyalinæ. In Hydnaceæ, near to *Asterodon*. *H. badia* on wood. *Mölleria* :—Stroma subcarnosa, verruciforme, parenchymati foliorum innatum; perithecia plus minusve immersa; asci polyspori, sporidia subfusoidea, continua, hyalina. In Hypocreaceæ, near *Polystigma*. *H. sulphurea* on living or dead leaves of trees.

Herr P. Hennings ‖ finds the following new genus of Gasteromycetes among fungi from New Zealand :—*Clavogaster* :—Perithecium subcoriaceum, persistens, e stratis binis discoloribus efformatum, clavatum, stipitatum; capillitium subfasciatum, in cellulas favosas polyedras; sporis levibus, ellipsoideis, coloratis, pedicellatis. Near to *Hippoperdon*.

Behaviour of the Nucleus in the Development of the Fructification of the Ascomycetes.¶—Mr. R. A. Harper has followed out the process of nuclear division in the formation of the ascus, especially in *Sphærotheca Castagnei*, *Erysiphe communis*, and *Ascobolus* sp. The ascogones of these three genera resemble one another in essential points.

* Zeitschr. f. Pflanzenkr., 1896, p. 144. See Hedwigia, xxxv. (1896) Rep., p. 110.
† Bot. Jaarb. Dodonæa, viii. (1896) p. 121 (1 pl.). See Hedwigia, xxxv. (1896) Rep., p. 118.
‡ Le Botaniste (Dangeard), v. (1896) pp. 21–6 (1 fig.).
§ Hedwigia, xxxv. (1896) pp. 287 and 298.
‖ Tom. cit., pp. 303–4 (4 figs.).
¶ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxix. (1896) pp. 655–84 (2 pls.).

The ascogenous cell of *Ascobolus* corresponds to the cell from which most, and probably all, the ascogenous hyphæ of *Erysiphe* spring, and to the ascogenous cell of *Sphærotheca*. In the two latter genera a portion of the nucleus resulting from the division of the fertilised oosphere has a purely vegetative function, and finally disappears, the other portions forming the ascospore; while in *Ascobolus*, the entire contents of the ascogone are used up in the production of the ascospores. The ascogenous hyphæ of *Erysiphe* and *Ascobolus* are undoubtedly of the same morphological value; and the formation of asci from these hyphæ presents essentially the same process in both. In the case of the Erysipheæ at least we may assume that the ascus-fructification is a non-sexual spore-fruit, originating from an impregnated oosphere.

Reproduction of Sphærotheca Castagnei.* — M. P. A. Dangeard confirms the statement of Harper, that a fusion takes place between the two nuclei of the ascus in this fungus; but disputes his assertion that the ascus is itself the result of the conjugation of a nucleus derived from an antherid, and the nucleus of the oogone.

Tuberaceæ.†—Parts 57, 58 of Rabenhorst's Cryptogamic Flora of Germany are mainly occupied by a monograph, by Dr. E. Fischer, of the German Tuberaceæ. The order is divided into three families, viz.:—(1) Eutuberineæ; receptacle with passages either hollow or filled with a weft of hyphæ (less often a single cavity), opening outwards, the walls covered by the ascogenous layer; (2) Balsamieæ; receptacle with hollow closed chambers, not opening outwards, the walls covered by the ascogenous layer; (3) Elaphomycetineæ; asci imbedded in clusters or bands, or regularly distributed through the receptacle. The Eutuberineæ comprise the genera *Genea* (6 spp.), *Hydnotrya* (3), *Stephensia* (1), *Pachyphlœus* (3), and *Tuber* (16). The Balsamieæ are composed of the single genus *Balsamia*, with 3 spp. The Elaphomycetineæ include *Hydnobolites* (3 spp.), *Choiromyces* (1), *Terfezia* (1), *Picoa* (3), *Elaphomyces* (21), and *Onygena* (5 spp.). The small group of Hemiasceæ—*Ascoidea* (1 sp.), *Protomyces* (4), *Monascus* (3) and *Endogone* (4 spp.)—follows. The illustrations are numerous and excellent.

Fructification of Antennaria.‡—In addition to the forms of fructification of *Antennaria scoriadea* already known, Dr. Neger describes a new one, found on several trees in Chile, on which the fungus is parasitic. It resembles a conidial form of *Cladosporium Fumago*, known as coniothece, and consists of small black cushions, resembling peritheces, from the margin of which multicellular bodies become detached, and these develope, in certain conditions, into a mycele.

Parasitic Fungi.—M. E. Prillieux § traces a destructive disease of the chicory to *Phoma albicans*, the pycnid generation, of which *Pleospora albicans* is the perithecial form.

Herr G. Wagner ‖ confirms the observation of Magnus of the identity

* Le Botaniste (Dangeard), v. (1896) pp. 27–31. Cf. this Journal, 1896, p. 339.

† 'Kryptogamen-Flora v. Deutschland u.s.w.' (Rabenhorst), 1er Bd., 5te Abt., Lief. 57, 58, Leipzig, 1896, 131 pp. and many figs.

‡ Centralbl. f. Bakteriol. u. Parasitenk., 2te Abt., ii. pp. 613–5.

§ Bull. Soc. Mycol. France, 1896, p. 82 (1 fig.). See Bot. Centralbl., lxvii. (1896) p. 215.

‖ Ber. Deutsch. Bot. Gesell., xiv. (1896) pp. 212–5.

of *Puccinia sylvatica* and *P. sessilis*. A number of other "species sorores" are also included in the same cycle of development.

Herr P. Magnus * describes a new species of *Cintractia*, *C. Seymouriana*, parasitic on *Panicum crus-galli* in N. America.

Prof. M. Shirai † describes four new species of *Exobasidium* from Japan, viz.:—*E. Camelliæ*, parasitic on *Thea japonica*, *E. japonicum* on *Rhododendron indicum*, *E. hemisphæricum* on *R. Metternichii*, and *E. pentasporium* on *R. indicum*.

A common disease of the Lombardy poplar is attributed by M. P. A. Dangeard ‡ to a different cause from that assigned to it by MM. Vuillemin and Prillieux. He finds on the living branches a species of *Calicium*, *C. populneum*, belonging to a genus usually placed among the Lichens, but here wanting its algal constituent, and therefore carrying on a parasitic existence on the living tissues. On the young roots he found also an undescribed species of Chytridiaceæ, which he names *Rhizophagus populinus*.

Herr K. Starbäck § describes the development of *Sphærulina halophila*, belonging to the Pyrenomycetes, parasitic on the leaves of *Helianthus peploides*.

Saccharomyces guttulatus Rob.‖—Dr. L. Buscalioni describes the structure and life-history of this species, found in the intestinal canal of rabbits and other herbivora. He finds it to be a true Saccharomycete, capable of multiplication by spores and by gemmation. It is furnished with a nucleus which divides during the processes both of gemmation and sporulation. The mode of nuclear division is very different from that observed in other fungi, and appears to resemble more or less that which takes place in certain Algæ (*Valonia*, *Codium*). The process is probably one of karyokinesis, greatly reduced during sporulation, and of fragmentation during gemmation. The mode of life of *Saccharomyces guttulatus* is parasitic, or at least endophytic.

Fertilisation of the Uredineæ.¶—M. Sappin-Trouffy repeats his observations on this process, and points out that the reduction in the number of the chromosomes and in the chromatic substance is a phenomenon of impregnation both in flowering plants and in the Uredineæ; but that in the latter it takes place after, instead of before, fecundation. The result is the same. The "egg" (oosperm) in both cases preserves the properties of the species, and transmits them in their integrity to the descendants with the same number of chromatic elements.

Development of Æcidia.**—Mr. H. M. Richards has studied the development of the æcidia of the Uredineæ, especially that of *Uromyces Caladii*. He states that the hymenium is formed by budding from several fertile primary filaments. The basids are produced especially on the

* Tom. cit., pp. 216–21 (1 pl.).

† Bot. Mag. (Tokyo), x. (1896) pt. ii. pp. 51–4 (1 pl.).

‡ Le Botaniste (Dangeard), v. (1896) pp. 38–43. Cf. this Journal, 1889, p. 681.

§ Bih. K. Svensk. Vet. Ak. Handl., Afd. iii. 1896 (1 pl.). See Hedwigia, xxxv. (1896) Rep., p. 115.

‖ Malpighia, x. (1896) pp. 281–327 (1 pl.).

¶ Le Botaniste (Dangeard), v. (1896) pp. 32–7 (1 fig.). Cf. this Journal, 1896, p. 342.

** Proc. Amer. Acad. Arts and Sci., xxxi. (1896) pp. 255–70 (1 pl.). See Bot. Centralbl., lxviii. (1896) p. 87.

periphery of the hymenium; but in certain cases young basids also appear in the more central region between the older ones. The formation of the peridium commences by the differentiation of the apical cells of the older chains of spores, advancing from the centre towards the periphery. The author found two nuclei, not only in the spores, but also in all the other parts of the æcidia, in the hyphæ, the peridia, and the pseudo-parenchyme of the early stage; in the spores three nuclei were sometimes observed.

Parasites of the Uredineæ.*—M. Sappin-Trouffy describes two species of fungus-parasites found on the Uredineæ :—*Tubercularia persicina*, on the æcidia of a number of different species; and *Darluca filum*, on uredospores and teleutospores of species of *Puccinia*.

Puccinia graminis.†— Pursuing his investigations on the various forms of this parasite, Herr J. Eriksson finds that their æcidium-stages on *Berberis* and *Mahonia* are distinct, as well as their teleuto- and uredo-stages. Although the *Berberis* may bear a number of different æcidium-forms, each one can, as a rule, give rise only to its special teleuto- or uredo-form, and can therefore infect only those species of grass on which it grows. The forms previously described as ff. *Airæ*, *Poæ*, and *Agrostidis* appear to be quite innocuous to corn-crops.

Auricularia auriculæ-Judæ.‡—M. Sappin-Trouffy describes the structure and development of this fungus (popularly known as Jew's-ear or Judas's-ear), which he regards as forming a link between the Uredineæ and the Protobasidiomycetes. The basids are septated transversely, the probasid being homologous to the teleutospore of a *Coleosporium*; the promycele is formed within it.

Ringworm Fungi.§—Drs. T. C. Fox and F. R. Blaxall have made a conjoint inquiry into the plurality of fungi causing ringworm in human beings, as met with in London. The authors' work was carried out on lines similar to those of Sabouraud, of whose observations the present researches are both a confirmation and a criticism. Sabouraud divided ringworms into microsporous and macrosporous. The latter were further subdivided into *Trichophyton megalosporon endothrix* and *Tr. meg. ectothrix*, or rather *endo-ectothrix*. The *ectothrix* ringworms were stated to be of animal origin. In London, from 80–90 per cent. of ringworms were found to be due to *microsporon*; those due to *endothrix* were about 4 per cent. (14 in all) and the remainder to *ectothrix*. The chief points in which the authors differ from Sabouraud are that circinate lesions of the glabrous skin accompany the invasion of the hairy scalp by *microspora* much more frequently than Sabouraud allows. They do not agree with Sabouraud as to the arrangement of the mycele in hairs invaded by *microspora*. They find his descriptions to be incomplete in many respects, and that he is too dogmatic on many points. In the *Ectothrix Trichophyta* they find that the hairs themselves are very often implicated.

* Le Botaniste (Dangeard), v. (1896) pp. 44–52 (2 figs.).
† Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxix. (1896) pp. 499–524. Cf. this Journal, 1895, p. 209.
‡ Le Botaniste (Dangeard), v. (1896) pp. 53–8 (4 figs.).
§ Brit. Journ. Dermatol., viii. (1896) pp. 241–55, 291–308, 337–59, 377–84 (11 pls.).

Similar results to those described by Sabouraud were only attainable by using exactly the same media; hence it would seem that ringworm fungi are very sensitive to their environment. The authors found that the duration of life on potato was longer than three weeks, and might be maintained for at least a year. They differ as to the mycology of ringworm, finding in *Microspora* spore-bearing hyphæ and spores exactly similar to those seen in the *Endothrix* and *Ectothrix Trichophyta*. The characteristic pectinations were observed, but only on the submerged hyphæ. In all the groups the aërial hyphæ show the same fructification. In *Microspora* chlamydospores were always present, generally in *Ectothrix*, and never in *Endothrix Trichophyta*.

Myxomycetes.

Sappinia, a new Genus of Acrasieæ.*—Under the name *Sappinia pedata* g. et sp. n., M. P. A. Dangeard describes a new type of this family of Myxomycetes, found on old cultures of horsedung. The separate Myxamœbæ may become encysted, or they become fixed at the end of stalks; resting cysts are also formed. Some of the Myxamœbæ enclose spherical endogenous germs, composed of a large number of small rounded corpuscles; they are apparently produced by a parasitic Micrococcus.

Cribraria and Physarum.†—On the ground of the structure of the sporange, Dr. C. Schilbersky proposes to detach *Cribraria mirabilis* from that genus, and to place it under *Dictydium*. He also describes a new species, *Physarum mucoroides*, parasitic on the stem and leaves of *Sedum carneum*.

Protophyta.

α. Schizophyceæ.

Growth of Diatoms.‡—Further experiments by Mr. G. C. Whipple show that abundant food-supply is not the only condition for the rapid increase of diatoms; temperature, amount of light, and other factors also influencing their growth. In common with all other chlorophyllaceous plants, they will not grow in the dark; while, on the other hand, bright sunlight kills them. The intensity of the light below the surface being affected by the colour of the water, diatoms are found most abundantly in light-coloured waters. Different genera, however, differ in this respect; *Melosira* does not require so much light as *Synedra*. Weather has a marked influence on their growth. They increase most rapidly during those seasons of the year when water is in circulation throughout the vertical; during these periods not only is food more abundant, but the vertical currents keep the diatoms near the surface, where there is light enough to stimulate their growth, and where there is abundance of air. Some species display very strong positive heliotropism.

Formation of Auxospores in the Diatomaceæ.§—Herr H. Klebahn gives a *resumé* of all the cases hitherto described of the formation of auxospores in diatoms, which he classifies under five heads, viz.:—(1) Re-

* Le Botaniste, v. (1896) pp. 1–20 (4 figs.).

† Bot. Centralbl., lxvi. (1896) pp. 81–6 (1 pl.).

‡ Technology Quarterly (Boston), ix. (1896) pp. 145–68. Cf. this Journal, 1895, p. 345.

§ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxix. (1896) pp. 595–654 (1 pl.).

juvenescence of a single cell, accompanied by an increase in size; the simplest and a common type. (2) Two daughter-cells are produced from the protoplasm of a mother-cell, and from these arise two auxospores (*Achnanthes longipes*, *Rhabdonema arcuatum*). (3) Two cells, lying side by side, cast off their old valves, and each grows into an auxospore, without any previous fusion or any visible interchange of contents; much the most common type. (4) A true conjugation takes place; the protoplasts of the two cells fuse together into one, and this grows into an auxospore; also common. (5) Before conjugation the protoplasm of each of the two cells divides beforehand into two daughter-cells, and two auxospores are formed by the fusion of a daughter-cell from each mother-cell with the daughter-cell of the other one lying opposite to it (*Amphora ovalis*, *Epithemia Argus*, *Rhopalodia gibba*, &c.).

The process is then described in detail of the formation of two auxospores in *Rhopalodia* (*Epithemia*) *gibba*, which was found abundantly imbedded in the gelatinous envelope of *Schizochlamys gelatinosa* at Plön. The fixing of the cells during conjugation is assisted by peculiar gelatinous caps at their apices. Since the two nuclei which unite to form the nucleus of the auxospore are derived from two cells which have no near relationship to one another, the author regards the conjugation which results in its production as a true sexual process.

Sporulation of Diatoms.*—Comte Abbé F. Castracane proposes to collect together all the recorded instances of the multiplication of diatoms by means of internal spores, and to found, on the variations in this mode of propagation, a new and more natural system of classification. He would classify e.g. the species of the present genus *Synedra* under two distinct genera, one terrestrial, the other marine, differing from one another in exhibiting an entirely different mode of sporulation.

New Genera of Cyanophyceæ.†—Floating on the surface of a dark well, M. E. Roze found a gelatinous mucus, with very pale yellow spots, caused by an organism for which he constitutes a new genus of Chroococcaceæ *Aplococcus*, nearly allied to *Aphanocapsa*, and forming the lowest member of the family, with the following diagnosis:—Cellulæ sphæricæ, liberæ, absque integumentis, in thallis mucosis homogeneis amorphis v. formæ definitæ nidulantes; cellularum divisio in unam solam directionem. The cells of *A. natans* sp. n. have a diameter of about 0·5 μ. They are largely attacked by a *Micrococcus*, probably undescribed, which appears to live on the gelatinous thallus of the Nostocaceæ.

From an adjacent well was obtained a filamentous organism, which becomes the type of another new genus of Cyanophyceæ, *Clonothrix*, alied to *Cladothrix*. *C. fusca* sp. n. is characterised by remarkable flask-shaped swellings of the branches. The diagnosis of the genus is as follows:—Trichomata elongata, articulata, simplicia v. pseudoramosa, plus minusve distincte vaginata; propagatio cellulis articulorum disjunctis v. e medio fractarum vaginarum emergentibus; generatio dubia, ampullis exiguis, apice evanescentibus, in quibus plasma fere hyalinum primo vacuolas deinde granulos paucos continet.

* Atti Accad. Pont. Nuovi Lincei, xlix. (1896) pp. 107–13.
† Journ. de Bot. (Morot), x. (1896) pp. 319–23, 325–30 (14 figs.).

Nostocaceæ.*—Herr P. Richter prefers the division of the Nostocaceæ into Psilonemeæ and Trichophoreæ, adopted by Thuret and Bornet, rather than that proposed by Hansgirg, Bornet, and Flahault, into Heterocysteæ and Homocysteæ; the presence or absence of heterocysts not being of a sufficiently constant character to use for a primary classification. He gives reasons for identifying *Aphanizomenon incurvum* specifically with *A. flos-aquæ*, and for regarding *Oscillatoria Agardhii* as a sterile form of the same species. A new species, *Aphanizomenon holsaticum*, is described.

Hassallia and Tolypothrix.†—M. M. Gomont proposes the following new diagnosis for distinguishing these two genera:—

Hassallia. Fila fragilia; articuli diametro trichomatis semper breviores. *Tolypothrix.* Fila flexilia; articuli diametro longiores, vel sub-quadrati.

β. Schizomycetes.

Action of Glycerin on the Growth of Bacteria.‡—Drs. S. M. Copeman and F. R. Blaxall give a preliminary account as to experiments on the action of glycerin on the growth of bacteria. The experiments had special reference to the bacteriology of small-pox and vaccinia, and to the purification and preservation of vaccine lymph. The method pursued was to add known quantities of glycerin to tubes of beef-pepton-broth, and subsequently to inoculate these with equal quantities of pure cultivation, and incubate at blood-heat and at room-temperature. Control inoculations in ordinary beef-broth were invariably made. Inoculations were afterwards made from the broth-tubes to solid media at varying intervals of time, in order to see whether the particular microbe was still capable of growth or not. The micro-organisms used were *St. py. aureus*, *St. py. albus*, *Str. pyogenes*, *B. pyocyaneus*, *B. subtilis*, *B. coli communis*, *B. diphtheriæ*, and *B. tuberculosis*. Small-pox and vaccine material in the form of "crusts" and lymph were also used. The results were that no visible development took place when more than 30 per cent. of glycerin was used. All micro-organisms were killed in it in less than a month with 30–40 per cent. of glycerin, except *B. coli com.* and *B. subtilis*, when kept in the cold. *B. coli com.*, unlike *B. typhosus*, resists the action of 50 per cent. glycerin in the cold for a considerable period, a fact which might be used for differentiating these microbes. Small-pox and vaccine material are completely sterilised, so far as extraneous microbes are concerned, in a week by the presence of 40 per cent. of glycerin in the broth-tubes.

Associated Action of Bacteria.§—Herren Pesina and Honl think that secondary infection and mixed infection should be sharply demarcated. By secondary infection they understand a process wherein a second pathogenic organism, usually a coccus and most frequently streptococcus, is associated with the first, and, without aiding in the development of the primary process, excites quite independently a second new septic condition. Of mixed or multiple generalised infection, some cases

* Hedwigia, xxxv. (1896) pp. 263–75.

† Bull. Soc. Bot. France, xliii. (1896) p. 382.

‡ Proc. Brit. Assoc., 1896.

§ Intern. Klin. Rundschau, 1894, Nos. 49 and 50. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 689–90.

are mentioned where two quite different microbes combine to produce a definite pathological process; the combined action is far more serious than that of either alone. Thus, in a case of meningitis from otitis-media, Friedländer's bacillus and *B. pyocyaneus* were isolated. Alone, it is quite rare for either of these to excite meningitis. Two or several microbes do not invade the body simultaneously; a definite pathological condition has already declared itself at the time of the invasion of the second. The latter immediately excites its own peculiar action, and does this, not by superadding a different pathological condition, but by intensifying the action of the first. As an example is quoted the case of simultaneous bacillar meningitis and croupous pneumonia. All at once the symptoms indicated a vertical meningitis as well. The autopsy revealed the presence of tubercle bacilli at the base of the brain, and pneumonia cocci over the vertex.

Influence of the Induced Current on Bacteria.*—Dr. H. Friedenthal reports on some experiments he has made by exposing suspensions of *M. prodigiosus* (5) and of beer yeast (2) to the action of the induced current. The electric current had little or no effect. The exposure was for about one hour and a half, and the strength varied from 14 to 20 ampères. The current was passed along a spiral round the tubes filled with the fluid containing the bacteria, a low temperature being maintained by a stream of cold water.

Relation of Immunising Substances to Specific Microbes.†—Dr. E. Klein finds that when suspensions of virulent diphtheria bacilli in bouillon are injected into the peritoneal sac of guinea-pigs, most of the animals remain healthy, the minority dying on the third or fourth day. The survivors are eventually able to tolerate a large dose, and their blood serum is so strong that 0·25 ccm. is able to neutralise a fatal dose administered subcutaneously. It was further found that the subcutaneous injection of antitoxin had the same effect, and that no morbid action occurred from the subcutaneous injection of a fatal dose of a gelatin culture previously mixed with 0·1 ccm. of antitoxin. This resistance would therefore seem to be due to germicidal substances arising directly or indirectly out of the bacteria themselves.

Gases produced by certain Bacteria.‡—Mr. L. H. Pammel and Miss E. Pammel, after discussing the work of previous observers, narrate the method of their own procedure, aud give the results of their experiments with certain gas-forming bacteria.

Bacillus aromaticus, obtained from rotting cabbage, coagulated milk in 48 hours, and produced on potato a yellowish-white growth. Grown in pepton-bouillon-glucose and saccharose, there was copious development of gas; with lactose none.

Bacillus gasoformans, obtained from water, coagulated milk with alkaline reaction, the growth on potato being copious, granular, and wrinkled. This bacillus, like the preceding, developed gas copiously on pepton-bouillon containing glucose and saccharose, but none with lactose.

Bacillus mesentericus vulgatus coagulates milk with acid reaction,

* Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 505–8.
† Tom. cit., pp. 417–20. ‡ Op. cit., 2te Abt., ii. (1896) pp. 633–50 (1 pl.).

and forms on potato a shining white growth. There is no gas formed with glucose, but copious development with lactose and saccharose.

Bacillus coli communis developed gas in all three media. Negative results were obtained from a micrococcus.

All the four bacilli were mobile, and all produced an acid reaction of the medium. The gases produced were carbon dioxide and hydrogen.

Abilities of certain pathogenic Microbes to maintain their existence in Water.*—From the observations of Dr. E. Klein it seems that cholera bacteria can live in Thames water for at least 42 days, and that they are demonstrable therein for a longer period than the typhoid fever bacilli, which could not be found after 36 days. The foregoing results were obtained with natural Thames water; but when the water was filtered and sterilised these bacteria survived for a longer period.

Bacteriological Examination of Water for Coli Bacteria.†—Dr. E. von Freudenreich has made experiments for the purpose of ascertaining whether coli bacteria multiply with great rapidity in water. The specimens were cultivated in milk-sugar-bouillon, and then inoculated in sterilised and unsterilised water. The sources of both kinds of water were various. In series A (sterilised water) there was increase six out of seven times. In series B (unsterilised water) there was increase in ten, and decrease or absence in four cases. No definite conclusion appears to be possible from the as yet too few experiments, though they are sufficient to suggest that when water is to be examined for coli bacteria (by Parietti's, the milk-sugar-bouillon, or any other method), the examination should be made at once.

Pathogenic Bacteria in Buried Bodies.‡—Prof. W. Lösener has made some experiments with pathogenic bacteria relative to the time these organisms retain their vitality in buried corpses, and the dangers supposed to be incurred by contamination of the soil and the soil-water by these microbes. The method adopted was to insert the virus into pigs, which were wrapped up in linen cloths, placed in wooden coffins, and buried in a soil partly sandy, partly clayey.

The bodies were infected by injecting into the axillary artery dilute cultures, or by inserting into the thoracic or abdominal cavity cotton-wool saturated with cultures, and even by inserting infectious viscera, such as tuberculous lungs or typhoid spleen. The bodies were buried at a depth of 1½–2 metres; they were only dug up once, and measures were taken for obtaining samples of the soil-water and the soil in their immediate vicinity after varying intervals of time. The microbes used were those of enteric fever, cholera, tuberculosis, tetanus, suppuration, and anthrax. It would seem that the typhoid germ may retain its vitality under the conditions mentioned for at least 96 days. The cholera vibrio was demonstrable up to the 28th day, but only in the fluid taken from the abdominal cavity wherein a cotton-wool plug had been inserted. The observations on tuberculosis were carried on for two years. In only two

* Ann. Rep. Loc. Gov. Board, 1894–5. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 688–9.

† Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 522–7; also Ann. de Microgr., viii. (1896) pp. 415–23.

‡ Arb. a. d. Kaiserl. Gesundheitsamte, xii. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 454–8.

cases (dug up at 60 and 95 days) were tubercle bacilli found, and then only in remains of introduced viscera. Tetanus microbes were not found after the 234th day. Staphylococci and Streptococci were regularly found during the first six months. *M. tetragenus*, *pyocyaneus*, and *B. Friedlaender* soon succumbed.

The experiments with anthrax were intended to ascertain if there was any dissemination of the germs owing to the rise and fall of the soil-water, for the resistance of anthrax spores to putrefaction was settled long ago. One experiment gave positive results, and that was probably more or less accidental.

The main result of the author's work seems to be that, provided the soil around a corpse have good filtering properties, though the layer be not thick, there is practically no chance of dissemination of a virus, whether there be permanent or variable saturation of the soil.

Epidemic among Pigeons caused by Bacillus coli communis.*—Prof. F. Sanfelice records an epidemic among pigeons caused by *Bacillus coli communis*. There were peritonitis, enlargement of the spleen, and suppurative inflammation of the mucosa of the oviducts. *B. coli communis* was found in the spleen, liver, and heart-blood.

Pigmentary Functions of Bacillus pyocyaneus.†—Dr. M. Nicolle and Dr. Zia Bey record observations, made from four different samples of *Bacillus pyocyaneus*, relative to the pigmentary functions of this organism. The general characters of the four samples were as follows:—Mobile; not staining by Gram's method; liquefying; presenting the classical aspect on potato; exhaling the characteristic odour; *in vacuo* growing with difficulty and without pigment. All were pathogenic to rabbits. All four samples produced more pyocyanin than the typical bacillus, and on one medium, the composition of which is not given, the pigment was greenish and non-fluorescent, on the other four media green and fluorescent. The authors also found that the presence of phosphates in the media, while extremely favourable to the formation of fluorescent pigment, is not an indispensable condition thereof.

While the pyocyanin, the greenish pigment, and the rusty-brown pigment (resulting from the oxidation of the fluorescent green) pass readily through the Chamberland filter, the fluorescent green pigment is entirely held back.

Agglutinative Action of Typhoid-Serum.—The agglutinative action of the blood-serum of persons suffering from enteric fever on cultures of the typhoid bacillus, has been largely made use of for the diagnosis of this disease since it was introduced by Widal.‡ The method of Widal is simple, rapid, and effective. It merely consists in adding a drop of serum or of blood to ten drops of a young bouillon culture of *Bacillus typhosus*. If there be "clumping" and immobilisation of the micro-organism the diagnosis of enteric fever is confirmed.

Prof. S. Delépine and Dr. E. J. Sidebotham § record the results of their investigation by this method on twenty-five cases of undoubted

* Zeitschr. f. Hygiene u. Infektionskr., xx. p. 23. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) p. 753.
† Ann. Inst. Pasteur, x. (1896) pp. 669–71.
‡ Lancet, 1896, ii. p. 1371. § Tom. cit., pp. 1587 and 1665.

typhoid fever, on ten cases of other febrile diseases, and on normal blood. Positive results were obtained with the typhoid fever cases only. The reaction is usually obtained from the fourth day to long after the fifth week. After the ninth day the reaction is usually instantaneous. Though the action can be obtained with dry serum, its immobilising and agglutinative properties are sooner lost than those of fluid serum.

According to Dr. H. E. Durham,* the reaction is not always obtainable, for in a series of ten cases no reaction occurred in four, and he concludes that an absolute diagnosis cannot always be made by this method. The best procedure for obtaining serum is to prick the lobule of the ear and allow 0·2–0·3 ccm. of blood to trickle into a test-tube held horizontally. After the blood has clotted, the serum can be removed, or the blood may be slowly centrifuged.

Dr. A. S. Grünbaum,† who made experiments on the agglutinative action, states that it is only in cases of enteric fever that the serum shows a distinct agglutinative action within 30 minutes, when diluted sixteen (or more) times. The method recommended is to take blood from the ear, and centrifugalise it in a U-shaped capillary tube. The serum is afterwards blown on to a slide and then mixed with bouillon. An emulsion of typhoid bacilli in bouillon is then made, and the mixture examined to make certain there are no clumps therein. A small drop of the diluted serum and a similar drop of the emulsion are mixed on a cover-glass and examined as a "hanging drop." If the bacilli aggregate in clumps with impaired or lost mobility within 30 minutes, the reaction indicates enteric fever. The reason for diluting the serum is that if undiluted the serum of enteric fever patients may exhibit a stronger reaction with the cholera vibrio or *Bac. coli com.* than with *B. typhosus.*

The time limit is necessary, because almost every human serum, even when diluted, will eventually produce an agglutinative action.

Diphtheria or Diphtheroid Bacilli in Empyema Pus.‡ — Dr. J. Trumpp records a case of empyema from which was isolated, among other microbes, a bacillus having the morphological characters of *Bacillus diphtheriæ* Loeffler. Even grape-sugar bouillon became acid in 24 hours, and showed a flocculent deposit. Experiments on animals showed, however, that the cultures were devoid of virulence. This absence of virulence raised the question whether the bacillus was that of true diphtheria, pseudodiphtheria, or a diphtheroid organism. The question was answered by injecting a guinea-pig with 0·35 ccm. of diphtheria toxin as well as the cultivation. In this way virulence was regained, and by the third remove the animal died in 12 hours. This method of restoring the virulence is apparently new, and is certainly simple.

* Tom. cit., p. 1746. † Tom. cit., pp. 806 and 1747.
‡ Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 721-5.

MICROSCOPY.

Text-Books of Histology.*—Both the books mentioned below are excellent examples of the progress of modern histology, and of the fact that enthusiasm for details and the minutiæ of methods has not thrown out of perspective a comprehensive and even philosophical treatment of a great subject. As a science, histology is dependent wholly on manipulative details; but it is a notable fact that, in these two latest books which deal with it, its relations to biology as a whole are steadily, and with philosophical acumen, kept in view.

The entire ground is covered by each of these books, and both present much more of the earnestness of the teacher and the enthusiast than is to be found in the majority of even good text-books.

In Mr. Clarkson's treatise the practical side of histology is well and carefully presented. His treatment of "General Methods," involving the examination of tissues, and including dissociating, softening, hardening, imbedding, freezing, cutting, staining, and mounting, is concise but sufficient, while his treatment of "Simple Tissues" we may commend with supreme confidence to the student. It however includes "The Animal Cell," and as this involves its nature, its nucleus, and the whole subject of karyokinesis, we might have desired a more expansive treatment; but we are bound to remember that, relatively large as the book is, nothing was easier than to lose perspective in dealing with the descriptive and practical aspects of such a wide subject, which, as the author himself tells us, "cannot aspire to be of the nature of an exhaustive treatise on any part of it." But even this part has the advantage of great clearness, and shares with the entire book the quality of not being merely descriptive, but, at least to the limits required by the student, thoroughly practical. Moreover, the illustrations, from their accuracy and excellence, must prove of great value to those for whom the book was written. Considering the professed object of the work, the whole subject of Histology is dealt with in successive chapters, which we venture to think represent honest and sincere work. Everywhere the least has been said consistently with intelligibility, so that on the whole subject the most might be said; and we believe that the student who will as conscientiously work through the pages of this book as its author has conscientiously prepared it, will at least have a general mastery of his subject, and if such be his object, he will have laid a good foundation for future original research.

Prof. Duval's "Précis d'Histologie" has a larger and higher aim than Mr. Clarkson's manual; it is, indeed, one of the most comprehensive and philosophical treatises of the general subject with which we are acquainted. It contains more than twice as much matter as the

* 'A Text-Book of Histology, Descriptive and Practical. For the Use of Students. By Arthur Clarkson, M.B., C.M. Edin., with 174 original coloured illustrations. Bristol, Wright & Co.; London, Simpkin & Co., 1896,' xx. and 554 pp.

'Précis d'Histologie. Par Mathias Duval, Professeur à la Faculté de Médecine de Paris, Membre de l'Académie de Médecine. Ouvrage accompagné de 408 figures. Paris, Masson et Cie., Éditeurs-Libraires de l'Académie de Médecine, 120 Boulevard Saint-Germain, 1897,' xxxi. and 956 pp.

English work, and is yet not complete. It is the purpose of Prof. Duval to publish a further portion so that the combined work shall be what would appear to us to be much more than a Handbook on Histology and "Microscopic Anatomy." The whole will represent a course of lectures given by him as Professor of the Faculty of Medicine of Paris, and they represent a deep and exhaustive knowledge of the subject.

Our object is not to compare the two books that are here briefly considered, but to those who desire to see the difference of treatment which like subjects receive, we would call attention to chapters iii., iv. and v. "La cellule en général," including "Morphologie et constitution de la cellule" and "Production des cellules," and "Les divers types de cellules" with chapter iii. in Mr. Clarkson's book, and no better evidence of the character and the distinctive qualities of each treatise could be presented. Prof. Duval's Précis (especially when its second part shall have appeared) might well be read after Mr. Clarkson's treatise had been worked through from cover to cover; and this is further seen in the really admirable chapters on "Le système nerveux," the subtleties and refinements of which it would be impossible to epitomise, but to which—as indeed to the whole volume—we would advise those who desire a thorough, practical, and well-digested knowledge of the subject to go.

α. Instruments, Accessories, &c.*

(2) Eye-pieces and Objectives.

New Objective by Queen & Co.†—Dr. A. C. Stokes gives the result of his examination of one of the new 1/12 objectives made by Queen & Co. The lens is a homogeneous-immersion, non-adjustable, and with N.A. 1·35.

With oblique illumination from the achromatic condenser it resolves *Surirella* in styrax into black dots. With central light, under rather less than a one-third illuminating cone, *Isthmia nervosa* exhibits its secondary structure with good resolution of the postage-stamp fracture. The lens has a remarkably flat field and ample working distance, as it is intended as "a rapid working lens for the practising physician."

(4) Photomicrography.

Use of Colour-Screens for Photomicrography.‡—Prof. G. B. Todd has recently been using with considerable success screens made of coloured gelatin. Three reproductions of photographs of a transverse section of the rhizome of the common bracken are given, the first showing a photograph taken without a screen, the second taken with an orange screen, and the third with a red screen. The last gave by far the best result, the orange screen being intermediate between the first and third. The screens were made by laying a thin film of coloured gelatin over the aperture of the stage, fixing the slide with the object immediately above it, and then focusing and photographing.

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

† Micr. Bull., xiii. (1896) p. 40.

‡ Journ. Anat. and Physiol. Norm. Path. Human and Comp., xxxi. (1896) pp. 114–5 (3 figs.).

(5) Microscopical Optics and Manipulation.

Microscopic Vision.*—Dr. G. J. Stoney considers that in the recent paper by Lord Rayleigh, an abstract of which appeared in this Journal (1896, p. 681), the generality of Abbe's method of studying the images formed by Microscopes is not sufficiently appreciated. In the present memoir, therefore, his object is to offer a fuller account of this generality than he has given elsewhere.†

The author begins by contrasting two of the many possible methods of resolving the disturbance of the æther in front of and close to the object. The most obvious resolution into spherical waves is the foundation of Airy's method of studying the images formed by telescopes, while the mode of resolution into plane waves is the foundation of Abbe's method of studying the images formed by Microscopes (the Diffraction Theory).

As fundamental principles, seven propositions are then discussed, with the help of which, and the more familiar laws of optics, it is claimed that nearly everything in microscopic vision may be explained.

Proposition 1.

However complex the contents of the objective field, and whether it or parts of it be self-luminous or illuminated in any way, however special, the light which emanates from it may be resolved into undulations, each of which consists of uniform plane waves.

This is practically an extension of Fourier's theorem. By *the objective field* is to be understood the whole of the object and its surroundings, of which an image is formed by an instrument, or in the eye of the observer. To prove this proposition the author conceives a plane through the object, perpendicular to the line of sight (the Objective Plane), to be divided up into squares, one containing the projection of the objective field, and the others replicas. The proof then follows from the fact that a point in the objective field with the corresponding points in the replicas forms a system which by the theory of diffraction gratings will produce a disturbance of the æther resolvable into plane waves.

Proposition 2.

The standard image may be regarded as resulting from the superposition and mutual interference of uniform luminous rulings of equidistant parallel bright lines, extending over the whole field of view; each ruling being produced by the convergence upon it, after the reversal, of two or more of the undulations of uniform plane waves, into which the light emitted by the object may be resolved.

By the standard image is meant the image formed by imagining the undulations to travel backwards to the positions that had been occupied by the original object. The image thus formed will therefore be the most perfect which the light from the object is capable of forming, and may be used as a standard of perfection which cannot be exceeded by the images formed by any optical contrivance. In the microscopic image, owing to the fact that the angular aperture of the objective is less than 180°, the amount of detail falls short of that in the standard image. With the best immersion lenses with aperture 120°

* Phil. Mag., xlii. (1896) pp. 332–49, 423-42, 499–528.

† See 'On the Foundation of the Diffraction Theory,' English Mech., December 13, 1895, p. 380.

or 130°, little more than half the light would be caught by the objective, and the light excluded is that which brings out the finest details in the standard image. This leads to—

Propositions 3 and 4.

When, of the light emitted by the object, only part is employed to form the microscopic image, then features may intrude themselves into the microscopic image which are not present in the standard image, and which do not represent anything upon the object ; and *the partition of the light between the portions received by and excluded from the objective, will in general be different for different wave-lengths ; and when the difference is marked, a colourless object will appear to be coloured in the Microscope.*

In connection with the use of the condenser we have—

Proposition 5.

The standard image is the outcome, partly of the features upon the object, and partly of the state of the light by which the object is illuminated. It may be improved by increasing the degree in which the first of those factors, and by decreasing the degree in which the second, contributes to produce, to modify, or to efface detail in the image.

Proposition 6.

Mounting the object in a medium of extra high refractive index will, cæteris paribus, increase the conspicuousness of the finer detail to be seen upon it.

Proposition 7.

If a microscopic object, mounted dry, is so close to the cover-glass that the chink of air between it and the cover-glass is less than the thickness of the Stokes's layer, then light from it can pass up through the cover-glass and the oil above it at angles both within and beyond the critical angle.

The peculiar optical properties of a thin layer (Stokes's layer) of a rare medium in contact with a denser were investigated by Sir George Stokes.*

In the application of the above principles to the Microscope the author starts with the consideration of the illuminating apparatus. The source of light and the condenser are so far good as they enable the whole of the light of each wave-length which is brought to bear upon a point of the object to reach that point at each instant in the same phase. Efforts to attain this end should not be confined to the improvement of the condenser and to the cutting of thin sections. A further advance may be made by attending to the source of light, which ought to be confined to a thickness small compared with a wave-length. The appearance presented under the Microscope by the diatom *Pinnularia nobilis* is brought forward as an illustration of the confusion into which the light is thrown by traversing the substance of the object. Matters would be improved by mounting the diatom between two media, of which the under one has the same refractive index as silex, and the upper one a refractive index as much as possible exceeding this.

The successive stages of the transformation from the object to the image delineated on the retina (see fig. 2) are then carefully traced out. These stages are as follows :—

A. Object A, the actual microscopic object, to which corresponds the

* Stokes's 'Collected Papers,' ii. p. 56.

ideal image A, reproducing all possible detail, which only light of infinitesimal wave-length would be competent to produce.

B. Image B, *the standard image.*

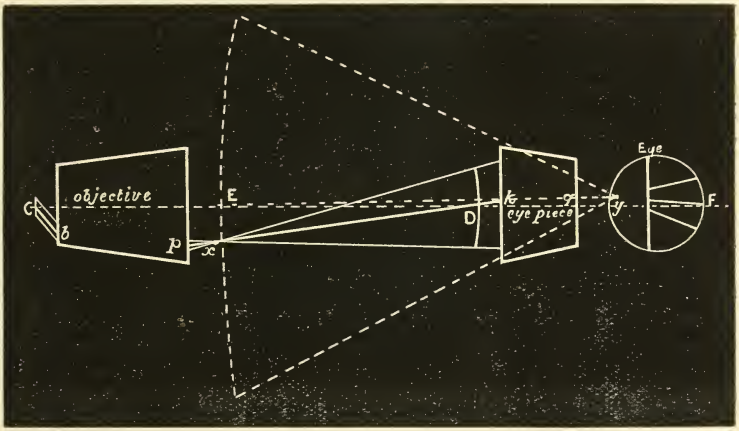
C. Image C, *standard image* No. 2, is the image which the light taken in by the objective would, if reversed, produce.

D. Image D, the *focal image* formed by the objective, is an enlargement with distortion of image C.

E. Image E, *the visual image*, is the virtual image formed by the eye-piece, an enlargement with slight distortion of image D.

F. Finally, image F is the image actually produced on the retina of the observer.

FIG. 2.



The consideration of the transition from A to B leads to the conclusion that any speck in the image, when best seen, will have an apparent diameter of $\lambda/4$; consequently the corresponding portion of the object (viz. a globe with diameter $\lambda/4$) contains an enormous amount of detail, all of which is massed together in the standard image as one speck. The investigation of the other transitions (from B to C and so on) shows that it is upon image C, the standard image No. 2, that we must fall back to determine what is the detail in the image E and its true nature; and that the adjustments of the Microscope must be made with a view to the improvement of this image C.

The course of an individual beam from this standard image C (fig. 2) is then traced. The dark line in the figure represents the axial ray. The beam is brought to a focus at x, then diverges and helps to form the image D, and after passing through the eye-piece is brought to a second focus at y, where the eye-piece can form an image of x. The light of the beam advancing in the direction $q\,y$ will enter the eye as if it had come direct from the whole extent of the image at E. After passing y, the beam again diverges, but is bent by the action of the front half of the eye so as to again intersect the optic axis of the Microscope where that axis pierces the retina of the observer; and there it assists in the formation of the image F. At x is formed the image which can be seen on removing the eye-piece.

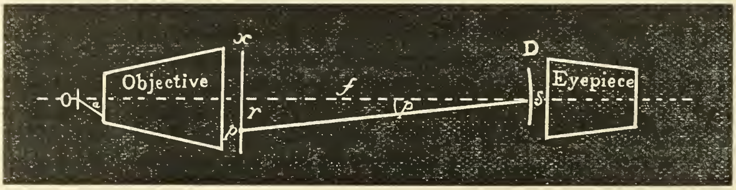
As regards the illumination of the object, the light from the iris-diaphragm and stops should be such as would be emitted in the reverse direction downwards from *a perfectly featureless self-luminous plane* occupying the position of the objective field. The ideal position for the iris-diaphragm and stops would be a position z (corresponding to x and y) where beams of uniform plane waves emitted downwards from the supposed luminous plane would be brought to a focus by the condenser. This position is very close to the condenser, and the author suggests that it would be a marked improvement in Microscopes if the iris-diaphragm and stops were brought nearer to this ideal position than is usually the case.

A consideration of the composition and resolution of undulations leads to the following modification of Proposition 1:—*The whole of the light emitted from the objective field may be resolved into beams of uniform plane waves; these beams may be divided into smaller groups, each an elementary sheaf of beams, and each elementary sheaf of beams may have a single beam substituted for it.*

According to the author, the great advantage of this Abbe method of resolution into plane waves is that it substitutes uniformity for that want of uniformity which exists in all other methods of resolution in just those places where we are unable to assign the law of this want of uniformity.

Part III. of the memoir commences with a discussion of the Numerical Aperture, or, as the author prefers to call it, Grasp. Let c denote the medium between the cover-glass and the objective. Everything below the objective, except medium c which is to be extended downwards, may be supposed to be removed and replaced by image C (i.e. standard image No. 2, formed in medium c by two reversals of the light.) The

Fig. 3.



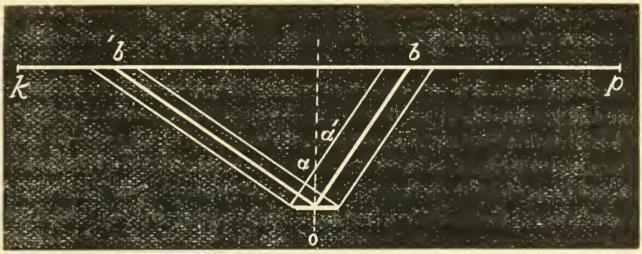
light from C is resolvable into beams of uniform plane waves, each with its axial ray. If α and β (see fig. 3) are the angles which one of these rays makes with the optic axis at o and s, then by Lagrange's theorem

$$n \sin \alpha = \mathrm{M} \sin \beta,$$

where M denotes the magnification, and $n \sin \alpha$ is the aperture or *grasp* of the beam. The author represents the grasp by G (instead of the usual N.A.) in the case of the most inclined beam, whose axial ray can be caught by the objective, and by g in the case of any less inclined beam.

In fig. 4 let $o\,b$ and $o\,b'$ be the axial rays of two beams lying in the same meridian plane, $k\,q$ the front of the objective, and o the middle

FIG. 4.



of image C. These beams, if reversed, will produce a ruling in image C, the spacing of which is given by the formula

$$\lambda' = \sigma\,(\sin\alpha + \sin\alpha'),$$

where λ' is the wave-length in c,

$$\therefore\ n\,\lambda' = \lambda \text{ (the wave-length in air)} = \sigma\,(g + g').$$

For two beams equally inclined on opposite sides of the vertical

$$\sigma = \frac{\lambda}{2\,g},$$

and for the most inclined rays

$$\Sigma = \frac{\lambda}{2\,G}$$

where Σ is the spacing of the *finest* ruling which can be seen by the objective for light of wave-length λ.

The information which is supplied by the image x (seen by looking down the Microscope after removal of the eye-piece) is next considered.

Taking the case of the beam represented in fig. 3, let r be the radius from the axis of the Microscope to the point p where the beam is focused in the image x, and let f be the distance from image x to the focal image D.

Then $r/f = \tan\beta = \sin\beta$ for small values of β.

$\therefore$ by Lagrange's theorem

$$g = M\sin\beta = \frac{M}{f}\,r,$$

and

$$G = \frac{M}{f}\,R;$$

where R is the radius to the border of the disc of light seen on looking down the tube.

$$\therefore\ g = \frac{G}{R}\,r,$$

or, in words—g is proportional to r, on the same scale on which G is represented, by R. For two beams in the same meridian which are focused in the image x at the points p and p' we have (see *ante*)

$$\sigma = \frac{\lambda}{g + g'} = \frac{\lambda}{\frac{G}{R}(r + r')} = \frac{\lambda}{\frac{G}{R}d}$$

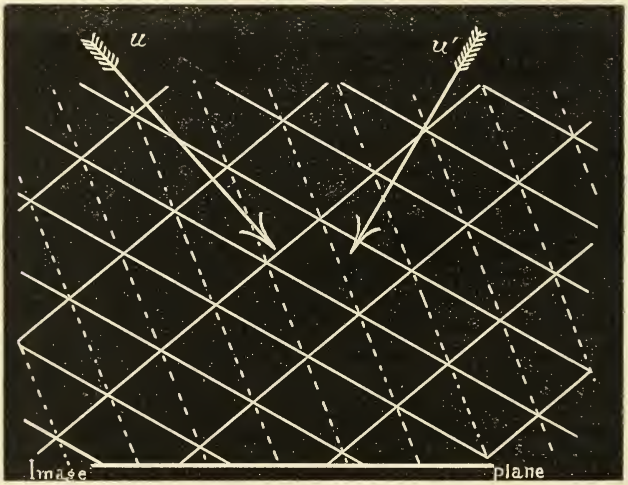
where d is the distance between p and p'. The equation $\sigma = \lambda / \frac{G}{R} d$ is proved to be equally true for two beams which are not in the same meridian.

If a radius of the image x be divided into a scale (the X scale) of equal parts, with zero at the centre, and on which the number G is at the outer end, then G becomes = R, and we have $\sigma = \lambda / d$. Hence *σ is equal to λ divided by the number represented by d on the* X *scale;* and, further, it can be proved that *the ruling of which σ is the spacing has its luminous bars perpendicular to the line d.*

This is a very important proposition in the interpretation of microscopical phenomena. As an illustration of the use of the above formulæ and of the assistance which the Abbe theory affords in microscopical work, the successive steps in the arrangement of the microscopic apparatus for the resolution of such a difficult "test-object" as *Amphipleura pellucida* are minutely described.

The author gives the following explanation of the bright specks becoming dark on change of focus, and of detail appearing to shift upon an object.

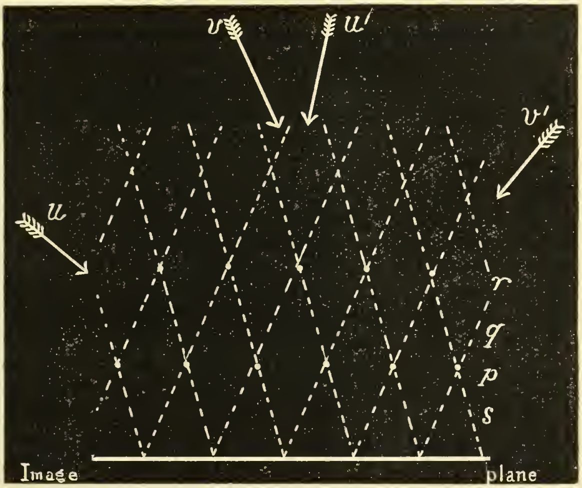
Fig. 5.



The finer detail in image C is formed by the interlacing of beams inclined at a wide angle. Let u and u' be two such beams, and let the unbroken lines of fig. 5 represent wave-surfaces which at the instant

t are in phase θ. Then the two undulations reach every point of the dotted planes in the same phase. Hence markings seen by the ruling produced by those beams co-operating with rulings produced by other pairs of beams little sloped to u and u', will appear to shift sidewards if we put the object a little out of focus. A case more frequently met with is represented in fig. 6. Here two pairs of undulations, u u' and v v', co-operate to produce one of the rulings by which the markings are seen. In the figure, the dotted lines sloping up to the left repre-

Fig. 6.



sent the planes over which u and u' are in the same phase; and the dotted lines sloping up to the right, the same for v and v'. Hence if the objective be focused upon the horizontal plane through s, everything is in confusion, whereas on focusing a little farther out to p the ruling reappears, but now dark lines occur where bright ones were before.

Thence follows:—

Proposition 8.

When the image of minute detail is produced by a triplet of beams, or by two pairs of beams, in each meridian, then the conditions are usually such, especially when the detail presents the appearance of round specks, that it will suddenly change from bright to dark, or vice versâ, upon a slight change of focus; and under special circumstances which are occasionally met with, more than one of these alternations may occur.

And Proposition 9.

The conditions are likely to be such, unless special precautions have been taken, that on a slight change of focus the minute detail upon the object will appear to shift its position relatively to the general position and broader features of the object.

Experiments with *Navicula lyra* are described in illustration of the above points.

The phenomenon of illusory coloration is strikingly exhibited by the diatom *Actinocyclus Ralfsii.* Experiments with this diatom are described.

In illustration of intercostal markings, experiments are described with *Peristephania Eutycha.* In this connection it is stated that the light which does not contribute to delineate anything upon the object is apt to intrude in three forms:—either (*a*) concentrated into patterns which are superposed upon the microscopic image; or (*b*) scattered in patches over part of it; or (*c*) spread in the form of a luminous haze over everything.

The phenomenon produced by Stokes's layer ("Optical Contact") is then illustrated by experiments with *Pleurosigma angulatum.*

Lastly, the author describes how, by putting a disc with pinholes in it over the back of the mounting of the objective, it is possible to actually see one of the rulings which go to build up the ordinary microscopic image.

β. Technique.*

(1) Collecting Objects, including Culture Processes.

Simple Method for Excluding Air from Liquid Media used for Anaerobic Cultures.†—Dr. Th. Kasparek uses a simple contrivance for cultivating anaerobes. It consists in having a side-tube (about 1 cm. wide) ending in a bulb fixed to the neck of a flask. After the flask has been filled up to the neck with bouillon, about 3 ccm. of fluid paraffin are poured in. The flask is then placed in a steriliser, when, in consequence of the heat, the bouillon rises up the neck and drives most of the paraffin into the side-tube. When the flask cools, a thin layer of paraffin covers the bouillon. The bouillon is next inoculated and then the side bulb heated to remelt the paraffin. By inclining the flask the melted paraffin runs out and forms a thick layer over the surface of the bouillon. In this way a perfectly air-tight stopper is obtained. Of course the paraffin is removed by merely warming the neck of the flask and running the paraffin into the side neck.

Egg-yelk as an Adjunct to Nutritive Media.‡—Dr. A. Capaldi recommends egg-yelk as an addendum to cultivation media, partly on account of its intrinsic chemical properties and partly from the results obtained. The yelks of fresh eggs are also said to have the additional virtue of being free from germs, for if bacteria be present in the egg they reside in the white. The author's procedure is to crack a fresh egg and having removed the white, to place the yelk in a sterilised Petri's capsule. The yelk-sac is then cauterised with a hot glass rod at some point. The burnt part having been removed with a platinum wire, 3–4 loopfuls of yelk are removed and mixed with the intended medium, e.g. agar, which is already prepared. Plates or tubes are then made. The medium is yellowish and rather cloudy, but the results obtained are quite as good as those from blood-serum, while the preparation is quicker and more convenient.

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

† Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 536–7 (2 figs.).

‡ Tom. cit., pp. 800–3.

Growing-Cell.*—Dr. A. M. Edwards describes the growing-cell which he has used in the examination of Bacillariaceæ. In a piece of plate glass, a quarter of an inch thick and three inches square, a hole about two inches in diameter is cut. The piece of glass thus bored through forms the box of the growing-cell. A bottom is formed of ordinary plate glass soldered on. The cover is also of ordinary plate glass, loose on the cell. It has a minute hole drilled in it to form a communication for the water in the body of the cell to the cover of the object. This is an ordinary round cover placed upon the plate glass.

Lately, in the observation of the actions on Bacillariaceæ of the change of water from fresh to salt, the author has used a simpler contrivance, viz. a small bottle with flat sides cemented to an ordinary slide. The bottle is closed by a cork, but has a small hole drilled in it to let the water communicate with the interior and the Bacillariaceæ.

Cultivation Medium for Ringworm Fungi.†—Dr. T. C. Fox and Dr. F. R. Blaxall recommend the following medium for cultivating ringworm fungi, as it gives consistent and reliable results. It is called maltose-potato-agar. It is made by preparing a decoction of potatoes, 1/2 a kilogram of powdered potato to a litre of water, steaming this well till of a light brown colour, then straining through a fine cloth. To the filtrate is added 1·5 per cent. agar, and 3 per cent. pure maltose. The medium has a slightly acid reaction. On it development is quick, the fungi giving a visible growth from the third to the fifth day.

Cultivating Pathogenic Schizomycetes on Media containing Supra-renal Extract.‡—Dr. N. Wróblewski records three series of experiments made with cultivation media containing juice from supra-renal bodies for the purpose of ascertaining the effect on certain bacteria. A fresh bullock's supra-renal body was minced and pulped and then boiled for 2 hours with water and alkalinised with soda. The extract thus obtained was mixed with an equal bulk of agar (2·5 grm. agar, 6 grm. glycerin, 1 grm. common salt, to 100 of water), sterilised, filtered two or three times to get rid of any precipitate, and finally sterilised again. After that it was kept at 36° for a couple of days. Extract made as before, mixed with an equal quantity of 20 per cent. gelatin, formed the medium for series 2, while series 3 was made with supra-renal bouillon. The proportions used were the same as in ordinary beef broth (0·5 kgrm. meat, 15 grm. pepton, 5 grm. common salt, 3 grm. of soda to 1 litre of water), but supra-renal body was substituted for the meat.

These experiments showed that media containing supra-renal extract were favourable to some bacteria, and decidedly unfavourable to others, and also indicated that they might be used to distinguish between closely allied species such as *B. coli com.* and *B. typhosus*, when grown on supra-renal agar, or by difference of colour arising in course of cultivation, as with *V. choleræ asiat.*

* Amer. Micr. Journ., xvii. (1896) pp. 346–9.
† Brit. Journ. Dermatol., viii. (1896) p. 308.
‡ Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. 1896, pp. 528–35.

Changes affecting Soil from Sterilisation.*—Herr L. Richter has found that soil used for cultivating plants undergoes certain changes from sterilisation. The sterilisation was discontinuous, at the temperature of boiling water for 6 hours on several consecutive days. A comparison of the results showed three principal changes: the power of the soil to absorb water was very variable if the earth were moistened previously; while the total amount of nitrogenous matter remained unaltered, a certain part became very soluble; the organic matter of the soil became highly soluble.

New Stopper for Fermentation Flasks.†—Herr J. Wortmann describes two kinds of stoppers for fermentation flasks. The first, which has been used for years, consists of a U-shaped tube, one leg of which dips into fluid contained in another tube of larger size, and having a lateral outlet tube directed upward. Either air can pass in or carbonic acid pass out, but only through the fluid in the larger tube. The second is an improvement of recent date, and is more convenient for weighing. In this, the outer end of the tube from the flask is surrounded by an inverted cup or glass sac, which is fixed to the tube by its lip in such a way that two holes are left. This cup is, in its turn, surrounded by another open at the top and covered with a small glass cap to exclude the dust. Hence the cups form a receptacle for holding fluid, and this receptacle is on the one hand in communication with the outer air, and on the other, through the two holes or gaps left at the lip, with the fermentation flask. The character and construction of the apparatus is easily made out from the illustration (fig. 7).

FIG. 7.

Airol, a new Antiseptic.‡—Airol is one of the numerous antiseptics so easily made by the manufacturing chemist. It is intended to be a substitute for iodoform, and its virtue is derived from its easily parting with iodine. It is a greenish-grey bulky powder, and is a compound of iodine, bismuth, and gallic acid. It is odourless, tasteless, and parts easily with iodine. It is poisonous if absorbed, and, therefore, while useful as an external application, is not suitable for internal administration. The experiments made with airol are stated to have given more satisfactory results than those made with iodoform.

(2) Preparing Objects.

Study of the Brain of the Bee.§—Dr. F. C. Kenyon, in studying the brain of the common honey-bee, treated a thousand or more by

* Landwirthschaft. Versuchstat., xlvii. (1896) pp. 269–74. See Centralbl. f. Bakteriol. u. Parasitenk., 2te Abt., ii. (1896) pp. 623–4.

† Bot. Ztg., liv. (1896) pp. 321–5 (2 figs.).

‡ S.A. aus Beiträge z. Klin. Chirurgie, xv. pt. 1. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 714–5.

§ Journ. Comp. Neurol., vi. (1896) pp. 137–41.

several of the bichromate of silver methods. Of this number, scarcely more than 15 or 20 per cent. were found to be satisfactorily impregnated. One of the best of the methods was the use of sulphate of copper and hæmatoxylin with brains hardened in from 10 to 20 per cent. formol for a day or more; 40 parts of 10 per cent. potassium bichromate, 40 parts of 5 per cent. sulphate of copper, and 20 parts of formol, gave also good results. As the author not unnaturally remarks, the bichromate of potash was quite unnecessary. The hæmatoxylin mixture that gave the best results was one that contained phosphomolybdic acid. Of this, 1 ccm. 10 per cent. solution was added to 1 grm. of hæmatoxylin crystals, 6–10 grm. chlorate hydrate, and 100 ccm. of water. For impregnation with bichromate of silver, the rapid method of Cajal was at first employed, but was set aside, as it was discovered that one in which the osmic acid is replaced by formol gives a much more transparent background for the darkened fibres and cells. On the whole, the author's preparations were comparatively free from precipitates and crystals. The nitrate of silver was employed in strengths ranging from 5 per cent. to 2 per cent. A solution of 1 per cent. was adopted for leaving the specimens in over-night, or until Dr. Kenyon was ready to make sections of them.

Method for Demonstrating Blastomycetes in Neoplasms.*—Dr. E. Aievole fixes the tissue in absolute alcohol, and then saturates small pieces with xylol. After imbedding in paraffin, sections are made, and these stuck on slides by means of albumen. The paraffin is then extracted with xylol and the latter with absolute alcohol. The sections are then immersed in Ehrlich's solution for 10–20 minutes. After having been washed with distilled water, they are treated with 0·5 per cent. oxalic acid, and again washed in distilled water. Thereupon they are decolorised in absolute alcohol, and next immersed in 1 per cent. aqueous safranin for 2–3 minutes. After washing again in distilled water, they are dehydrated in absolute alcohol, cleared up in xylol, and mounted in xylol-balsam. By this method the parasites are stained blue or violet, and the nuclei of the cells red.

New Method for Examination of Blood.†—Dr. J. Arnold describes a method which possesses many advantages for examining blood. Sterilised thin disks of elder-pith are soaked in a drop of the blood to be examined, and so placed in the hollow of a ground-out slide that the moistened side of the disk (*sic*) adheres to the cover-glass. The advantages claimed are that the blood is protected from pressure and evaporation, and the effect of chemical and colouring reagents can be tested on the dried disks. Besides this, the disks may be imbedded and sectioned, and treated in various ways suitable for microscopical investigation. The method is also recommended for the study of fibrin-formation.

Connections of Neurones.‡—Herr Semi Meyer recommends the following method:—A newly-born guinea-pig is subcutaneously injected,

* Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 745-9 (1 pl.).
† Centralbl. f. Allgem. Pathol. u. Pathol. Anat., vii. p. 17. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) p. 825.
‡ Arch. f. Mikr. Anat., xlvii. (1896) pp. 734-48 (1 pl.).

at intervals of $\frac{1}{4}$–$\frac{1}{2}$ hour, with a 2 ccm. aqueous solution of methylen-blue (BX). After several injections (3–6), the animal is dead, and the brain, in 2–3 parts, is placed in 10 gr. ammonium molybdate + 100 ccm. water + 10 drops hydrochloric acid. This fluid must first be cooled to zero, and the pieces are left in it at zero till next day. After being washed for two hours in running water, they are treated, still in the cold, with gradations of alcohol. The neurones and their connections are thus readily investigated.

(3) Cutting, including Imbedding and Microtomes.

Gelatin Method for Imbedding Objects for Exhibition.*—For keeping perishable fruits, such as apples, grapes, &c., intended for lecture purposes, exhibitions, &c., Herr J. Wortmann recommends the use of gelatin to which 1 per cent. of carbolic acid has been added. The medium is clear and transparent as water. The specimens to be exhibited—suspended in the desired position—are immersed in the phenol-gelatin while the medium is hot and liquid. Fixed in this way, preparations of healthy and diseased grapes, pears, apples, plums, &c., make not only excellent objects for demonstration, but are not damaged in transport. The method is much more effective and less troublesome than preservation in spirit.

(4) Staining and Injecting.

Methylen-Blue.†—Mr. A. D. Morrill calls attention to a few points observed in the use of the methylen-blue method by the investigators at Woods' Holl, which he thinks may be of general interest. The method has been successfully applied during the past summer to the study of the nervous system of a great variety of forms. The method of application and strength of the solution were determined by experiment for each animal and tissue. During the action of the stain the animal or tissue was kept as nearly as possible in its normal condition. Everything seems to depend on keeping the tissue alive, and in bringing the stain into contact with it in a solution of a strength suitable for obtaining the best results. In some cases the abundant supply of oxygen was of great importance, whilst in others it seemed to make little difference. It was found that animals which live in the dark stain better in the dark than in the light. Recently caught and perfectly normal animals stained more satisfactorily than those which had been kept in confinement for some time. For obtaining satisfactory serial sections, the tissues must be placed in Bethe's fluid; but a difference must be made between Vertebrates and Invertebrates, for the latter require less oxygen. Dr. Huber's plan of placing the tissue directly in cold absolute alcohol on removing it from water, and changing several times for a period of two hours, gave good results.

Methylen-Blue Methods.‡—Dr. A. Bethe discusses the various ways of fixing Ehrlich's methylen-blue for nerve-staining. The method he has previously employed is probably the best, but it requires cooling with ice. He sought for a readily soluble combination of methylen-blue

* Bot. Ztg., liv. (1896) pp. 337–40. † Amer. Natural., xxx. (1896) pp. 857–9.
‡ Anat. Anzeig., xii. (1896) pp. 438–46.

which would work effectively without ice-cooling, and be conveniently transformable into a combination not readily soluble. This was found in the ammonium-picrate combination recommended by Smirnow and Dogiel, which is almost insoluble in water, but readily soluble in alcohol. By subsequent treatment with ammonium molybdate or the like, the pigment becomes a molybdate salt. To attain this transformation six different methods, each with its particular merits and demerits, are suggested.

Differentiating Nucleolar Structures.*—Dr. Th. List distinguishes the main nucleolus, the accessory nucleolus, and the nucleolus pure and simple. The first is probably composed of nuclein, the other two are modifications of paranuclein. To produce in the section a Berlin blue staining of the accessory nucleoli, a reaction is effected between hydrochloric acid and potassium ferro-cyanide. Or, if the sections be left half an hour in weak iron chloride solution acidified with hydrochloric (50 ccm. distilled water, 10 drops ·5 per cent. iron chloride, 5–15 drops 1 per cent. hydrochloric), the Berlin blue reaction is effected; nuclein and the related substances remain colourless, the paranuclein of the accessory nucleolus becomes blue. The same method is also useful for mucin-glands.

Nerve-endings of Duck's Bill.†—Dr. L. Szymonowicz fixed duck-embryos with osmic acid or with a mixture of conc. aqueous solution of picric acid (250 ccm.), conc. sublimate solution (250 ccm.), distilled water (500 ccm.), and glacial acetic acid (12 ccm.). For adult specimens he tried many fixatives, e.g. 12 parts conc. sublimate solution, and 2 parts of 2 per cent. osmic acid, Flemming's and Hermann's fluid, &c. He stained with Heidenhain's iron-alum hæmatoxylin and Weigert's fibrin-colouring method. For differentiating the nerves he got best results with Ranvier's gold-method (8 parts 1 per cent. gold chloride solution + 2 parts formic acid after heating). For the embryos he used the methylen-blue method.

Weigert's Neuroglia Method.‡—Dr. B. Pollack calls attention to the importance of Weigert's painstaking work § on the human neuroglia and on the methods therein expounded. Golgi's method is applicable to animals almost exclusively, and especially to embryos; Weigert's method is applicable to man. Golgi's method colours only some cells; Weigert's colours all nuclei and fibres. Golgi's method yields a silhouette; Weigert's shows the natural form and size. Golgi's method distinguishes only cells with processes; Weigert's method shows cell-body or nucleus differentiated from the processes. Golgi's method colours besides the neuroglia the nervous tissue; Weigert's method differentiates the neuroglia—a fact which in part explains how Golgi, Cajal, and most anatomists hold the neuroglia to be nervous, which Weigert, like Ranvier, vigorously denies.

* MT. z. Stat. Neapel, xii. (1896) pp. 477–93 (1 pl.).
† Arch. f. Mikr. Anat., xlviii. (1896) pp. 329–58 (1 pl.).
‡ Tom. cit., pp. 274–80.
§ 'Beiträge zur Kenntniss der normalen Menschlichen Neuroglia,' Frankfurt a. M., 1895.

Staining Gonococcus by Gram's Method.*—Dr. A. Hijmans van den Bergh states that, contrary to the general and received opinion, gonococcus can be perfectly well stained by Gram's method, provided the anilin-oil-gentian-violet be strong (5–10 per cent. of a saturated alcoholic solution of gentian-violet), and the absolute alcohol be not allowed to act for more than 30 seconds.

Gram's Method.†—Prof. P. Ernst directs attention to the great value of Gram's method in the study of horny structures, or rather of structures which are in process of becoming horny. He has studied a great variety of these, and shows that Gram's method—almost unapplied hitherto in this direction—is invaluable in differentiating the elements which introduce cornification.

Method for Contrast Staining in Bacteriological Work.‡—Herr Knaak stains the preparations with dilute aqueous methylen-blue solution, and then, after washing in water, dries them. The contrast staining is made by treating the preparation with aqueous solution (0·1) for a minute to a minute and a half. The tissue is pale red, the nuclei darker, and the bacteria blue.

Staining Anthrax Cells in Blood.§—Herr Marpmann prepares the blood-film on cover-glasses in the usual way, and after drying and fixing stains it by Gram's method. The preparation is then washed with a solution of 0·5 grm. eosin in 100 ccm. of absolute alcohol. It is at once mopped up on blotting-paper and dried.

Sterilising of Syringes by Boiling.‖—Herr J. Hofmeister observed that common leather which had been immersed for 24 hours in 2–4 per cent. formalin solution could be boiled in water without impairment of any of its qualities, and devised therefrom a method for sterilising syringes. Only such syringes as are made of glass, metal, and leather are suitable for this procedure, the parts being screwed on and not connected with cement or the like. The piston and washer are to be removed and freed from fat by means of ether or petroleum-ether, after which they are to be immersed in 2–4 per cent. formalin for 24–48 hours. The formalin must then be carefully removed by prolonged washing with water. The parts of the syringe having been connected, the instrument is then ready for boiling; but before this is done, the air must be removed entirely by driving it out with water.

The formalin treatment should be repeated from time to time.

(6) Miscellaneous.

Adhesive Material for Labels on Glass.¶—Labels stuck on glass often strip off, says Herr Marpmann. This inconvenience may be avoided by means of the following adhesive:—120 grm. of gum arabic are to be dissolved in a quarter of a litre of water, and 30 grm. of powdered gum

* Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 785–92.

† Arch. f. Mikr. Anat., xlvii. (1896) pp. 669–706 (2 pls.).

‡ Deutsche Med. Wochenschr., 1896, No. 34. See Centralbl. f. Bakteriol. u. Parasitenk., 2te Abt., ii. (1896) p. 622.

§ Zeitschr. f. ang. Mikr., ii. (1896) pp. 193–6.

‖ Centralbl. f. Chirurgie, 1896, No. 27. See Centralbl. f. Bakteriol. u. Parasit., 1te Abt., xx. (1896) pp. 779–80.

¶ Zeitschr. f. ang. Mikr., ii. (1896) p. 151.

tragacanth in a similar quantity. After a few hours the tragacanth solution is shaken until it froths, and then mixed with the gum arabic solution. The mixture is strained through linen, and 150 grm. of glycerin (previously mixed with $2\frac{1}{2}$ grm. of oil of thyme) added to it.

Cement for Porcelain.*—The Chinese cement for porcelain (schio-liao), glass, and such like articles, is composed of finely powdered calcined lime 54 parts, alum 6 parts, fresh blood 40 parts. These ingredients are worked up into a homogeneous mass. Pasteboard or paper articles saturated with a dilute form of this cement, made by thinning it down with water, become as hard as wood. Diluted, it may be used to give a protective coat to walls of rooms, or to the inside of vessels used for keeping oil and fats.

Stain for Laboratory Tables.†—Herr J. Wortmann recommends the following stain for microscopical and laboratory tables. Two solutions are rubbed into the wood alternately. The first solution is composed of copper sulphate 100 grm., chlorate of potash 50 grm., water 615 grm.; the second, of anilin hydrochlorate 100 grm., chloride of ammonium 40 grm., water 615 grm. Each of these solutions is to be rubbed in alternately, and the object allowed to dry before using the next. The procedure is to be repeated three times. If the surface do not turn out black all over, but is smeary, it should be washed with lukewarm water, and, after having been allowed to dry, treated to a repetition of the process.

Two other solutions for the same purpose are also given. Solution 1 is made of 67 grm. of sodium chlorate, 67 grm. of copper chloride, 1 litre of water. Solution 2 is composed of 150 grm. of hydrochlorate of anilin and 1 litre of water. The solutions are used in the same way as the first.

* Pharm. Era. See Zeitschr. f. ang. Mikr., ii. (1896) p. 153.
† Bot. Ztg., liv. (1896) pp. 325–7.

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on the 16th of December, 1896, at 20 Hanover Square, W., the President (A. D. Michael, Esq., F.L.S.) in the Chair.

In the unavoidable absence of the Senior Secretary, the minutes of the meeting of 18th November last were read by Mr. J. J. Vezey, and having been duly confirmed, were signed by the President.

The President said that it would be seen that their Assistant Secretary, Mr. Brown, was not with them as usual that evening. Probably they might have noticed that there had been a serious breakdown in his health lately in consequence of several attacks of influenza, and that one result had been that matters had of late not been going on as well as could be wished. Things, however, seemed to have come to a crisis, and Mr. Brown had suddenly absented himself from the office and also from his home, and was missing for several days. He had, however, now returned home, but was laid up in a state of "brain fever." Under these circumstances there was some considerable confusion in the office, and the affairs of the Society had naturally suffered from the want of attention given to them of late. The Council had held a somewhat protracted sitting that evening to determine what was best to be done in the interests of the Society, and it became his duty to inform the Fellows that Mr. Brown was no longer in the service of the Society. In the temporary difficulty in which they had found themselves placed, their friend Mr. F. A. Parsons had come to their assistance, and had undertaken the duties of Assistant Secretary in Mr. Brown's place. They of course, greatly regretted the necessity which had arisen for parting with Mr. Brown, but under the circumstances it was, they feared, unavoidable.

Mr. C. L. Curties exhibited and described a new microtome, the chief features of which were that the knife was advanced towards the material after every cut, instead of the material being moved towards the knife. The bed on which the substance was fixed could also be rotated so as to meet the cutter at any angle. Perfectly flat sections could be cut with it of any thickness from 1/80 in. to 1/400 in. It was constructed so as to run very easily and smoothly.

The President said he had, through the kindness of Mr. Curties, been afforded an opportunity of examining this microtome, and it was certainly in his opinion not only very pretty, but also very efficient. It had one very great advantage over the old Cambridge rocker, in that it cut an absolutely flat section; for although in the case of small sections cut by the Cambridge the curvature was so small as to be practically of not very much importance, yet if the sections were those of large objects of considerable surface, the curvature might be a matter of great consequence. He thought also that this form would possess a still further advantage in the case where a series of sections were required to be cut from a soft tissue surrounding one that was softer, in which case the back motion of the Cambridge cutter was too slow, and in making the cut they would, he thought, find it of great service to be able to get more suddenness and weight of blow brought to bear on the material than was given by the spring of the Cambridge form. In any case, however, there could be no difference of opinion as to the excellence of the construction and finish of this machine, which he felt sure was likely to be very useful.

The thanks of the Meeting were voted to Mr. Curties for bringing the instrument for exhibition.

Mr. C. F. Rousselet read a paper 'On the Male of *Rhinops vitrea*,' the subject being illustrated by drawings and the exhibition of a specimen under the Microscope. Mr. Rousselet mentioned that he had appended to his paper for publication a list of all the Rotifers whose males were already known.

The President regretted that most of their Fellows who took a special interest in Rotifers were absent, as the paper was one of great value as an addition to their knowledge of these organisms, this being the first time that a male rotifer has been observed to have any other organs except reproductive organs. In many low class creatures it was a fact that the male had practically become the reproductive organs only, and this was especially noticed among the Crustacea, where in some cases the male was actually parasitic upon the female. It would also be noticed that wherever the male of an organism was in a rudimentary condition they would find that the group to which it belonged was an eminently variable one, and that where there was debasement from a well recognised type, there they might expect to find the most marked instances of variety, so that where they met with a creature possessed only of organs for special purposes, they would be almost sure to find another cropping up close by which was very much more highly developed. Whatever the cause of this might be, it was a fact that debased creatures did vary enormously. He did not know that he had heard of a better instance than the one which had been brought under their notice that evening.

The thanks of the meeting were unanimously voted to Mr. Rousselet for his paper.

Mr. E. M. Nelson exhibited and described a new calculating instrument for optical purposes, which had been sent to him by Messrs. Watson and Son, who had made it from a design by Mr. Tamblyn-Watts. The instrument consisted of a right-angled triangle made of laths, the right angle being bisected by another lath. The laths which contained the right angle were each divided into 100, and the lath which bisected it into 50 equal divisions. Mr. Nelson explained the principle on which the instrument was constructed, and its use by diagrams on the black-board.

The President said this was a subject which he would not attempt to deal with. They had all seen Mr. Nelson's demonstration, and he was sure they would accord him a very hearty vote of thanks for his communication.

The thanks of the meeting were then unanimously voted to Mr. Nelson.

The President said that as their next meeting would be their Anniversary it was necessary to nominate those Fellows who were recommended by the Council for election as the Officers and Council of the Society for the ensuing year. The list was then read as follows:—

President—Mr. E. M. Nelson.

Vice-Presidents—Dr. Braithwaite, Rev. E. Carr, Mr. Frank Crisp, and Mr. A. D. Michael.

Treasurer—Mr. W. T. Suffolk.

Hon. Secretaries—Prof. F. Jeffrey Bell and Dr. Dallinger.

Council—Messrs. Aiken, Beck, Bennett, Dadswell, Hebb, Karop, Prof. Ray Lankester, Sir Ford North, and Messrs. Powell, Rousselet, Vezey, and T. Charters White.

The President said that it was necessary at that meeting to appoint two Auditors of the accounts of the Society to be presented to the ensuing Annual Meeting. On behalf of the Council he appointed Mr. Dadswell as one Auditor, and requested the Fellows present to elect the other.

Mr. J. Mason Allen was then proposed by Mr. J. M. Offord, seconded by Mr. Ingpen, and duly elected Auditor on behalf of the Fellows of the Society.

Mr. Vezey read an application for the assistance of the Fellows of the Society at a series of Converzationi to be held at the Borough Polytechnic on the evenings of December 28th to January 2nd inclusive.

The President intimated that the Society's Library would be closed from December 24th until January 4th.

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

Mr. C. L. Curties—A new Microtome, by C. Baker.

Mr. C. F. Rousselet—Mounted specimen of Male of *Rhinops vitrea*.

Mr. E. M. Nelson—A new Optical Calculating Instrument.

New Fellows.—The following gentlemen were elected *Ordinary* Fellows:—Messrs. Alfred W. Griffin, John Fredk. Hammond, Joseph Richd. Large, and Chas. Ranken.

ANNIVERSARY MEETING

HELD ON THE 20TH OF JANUARY, 1897, AT 20 HANOVER SQUARE, W., A. D. MICHAEL, ESQ., F.L.S., PRESIDENT, IN THE CHAIR.

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

The List of Donations to the Society since the last meeting was read, and the thanks of the meeting were given to the donors.

	From
An old Microscope	*Mr. Jas. More, jun.*
L. Félix Henneguy, Leçons sur la Cellule. (8vo, Paris, 1896)	*Messrs. Williams & Norgate.*
N. Iwanzoff, Das Schwanzorgan von Raja. (4to, Moscow, 1895)	*The Author.*
—— Ueber den Bau, die Wirkungsweise und die Entwickelung der Nesselkapseln der Cœlenteraten. (4to, Moscow, 1896)	*The Author.*
R. Braithwaite, The British Moss Flora. Pt. xvii. pp. 1–36, 6 pls. (8vo, London, 1896)	*The Author.*

Mr. Jas. More, jun., stated in the letter which accompanied the old Microscope presented by him that he had met with it at a dealer's in Edinburgh, and thinking it might be of interest, he had forwarded it for the acceptance of the Society if they found it to be so.

Mr. E. M. Nelson thought this little instrument was of great interest, as it contained a record that it had been originally purchased in 1775. In this Microscope a combination of three types could be found, viz. the Wilson screw-barrel (1702), the Culpeper stand (1738), and the John Marshall focusing screw (1704). Perhaps the chief interest lay in the oval mirror, of which this was the earliest known example. In conclusion, he congratulated the Society on the valuable addition their collection of old instruments had received through the generosity of one of their Fellows, Mr. More.

The President called attention to the name of Dr. Czapski as being amongst those proposed for election as Fellows of the Society, and congratulated them upon the prospect of being able to include in their number one who was undoubtedly the most eminent optician in Europe at the present time.

Mr. E. M. Nelson exhibited a small lamp for the Microscope, which had been designed by Mr. Goodwin. It was, of course, not intended for serious microscopical work, but as a portable lamp it was a very nice little thing, well made and nickel plated, and having a metal chimney provided with tinted glass screens. A novel feature was that the wick was made of blotting-paper, which appeared to answer the purpose admirably. He had this lamp alight for several hours on the previous evening, and found it to burn most satisfactorily.

The President thought this was a very pretty little lamp, and the use of blotting-paper for the wick seemed to be a very good idea, as it was said to last longer than cotton, and not to require any trimming. In his experience, however, most of the so-called indestructible wicks did wear out in the course of a short time. He had lately been using a carbon burner for his lamp, and found it remarkably clean, and not to require trimming; but it did wear out. The makers gave the life of a wick of this kind as about three months, but he found that it did not last more than from one month to six weeks.

The thanks of the meeting were voted to Mr. Nelson for bringing this lamp under their notice.

The Annual Report of the Council was then read by Prof. Bell.

REPORT OF THE COUNCIL FOR 1896.

FELLOWS.

Ordinary.—During the year 1896, 14 new Fellows were elected, whilst 5 have died, 9 have resigned, and 18 have been removed from the list for non-payment of subscriptions, and other causes.

Honorary.—No Honorary Fellow is known to have died during the past year. The vacancy caused by the death of M. Pasteur remains to be filled.

The list of Fellows now contains the names of 560 Ordinary, 1 Corresponding, 49 Honorary, and 84 ex-Officio Fellows, being a total of 694.

FINANCES.

Subscriptions.—As will be seen by the Treasurer's balance sheet, the diminution of income from this source amounts to more than 150*l.*; this fall is to some extent explained by the fact that the arrears under this head have been greater than in any previous years. The Council desire to again urge on the Fellows the punctual payment of their subscriptions.

Journal.—The state of the Society's finances at the end of the year has caused the Council to seriously consider the possibility of continuing the Journal on the lines which have led to its universal reception as one of the most useful aids to biological investigation now published. It will be the duty of the Council elected to night to take into prompt consideration the immediate future of the Journal.

If the Journal is to be continued as heretofore in future years, it is clear that the Council must have confidence in the financial stability of the Society.

Owing to Messrs. Williams and Norgate's cheque for the first six months of 1896 not having been received till 5th January, 1897, a sum of 138*l.* 19*s.* 4*d.* has to be further credited to the Journal [as also a sum of 21*l.* 3*s.* 5*d.* from Messrs. Dulau, received 23rd January, 1897], but cannot be entered on the balance sheet.

Advertisements.—The amount received under this head is a good deal larger than last year.

ROOMS.

The attendance on Wednesday evenings other than the meeting nights has been so rare and scanty that it is not proposed to burden the Assistant Secretary who is shortly to be appointed with this duty.

The pressure on our wall space has been partly relieved by the offer of our landlords to give us storage room in the basement, which we have gratefully accepted.

INSTRUMENTS AND APPARATUS.

An old Microscope by Cary has been bought for 1*l.*

New Standard Sizing Gauges for Microscopic Object-Glasses.—The Society during the past year has issued fresh gauges for the standard screw-thread of Microscope object-glasses. The so-called Universal screw has hitherto been but an imperfect standard, and the Society has now placed the matter on a satisfactory basis. The original standard screw has been adhered to, but minute changes in the diameter have been made, and gauges issued for both the external and internal threads which, while not interfering with the interchangeability of previous object-glasses and Microscope nose-pieces which have been *correctly* made to the original standard, allows a slightly larger margin for error in individual lenses. The new gauges, if adopted by all manufacturers and regularly used, will produce entire interchangeability for the future, and incorrect screws already in use may be standardised by being passed through the new gauges. It is satisfactory to note that already the most prominent English manufacturers have adopted the gauges, and the Society is in correspondence with foreign firms on the matter.

LIBRARY.

Under this heading, the Council may refer to the painful circumstances which marked the close of last year. Mr. W. H. Brown, who was appointed Librarian and Assistant Secretary in 1891, gained the confidence of the Officers and the general approval of the Fellows. In 1895, and again in 1896, he was certainly the victim of the mysterious affection which is called influenza. During his convalescence he was shown the utmost kindness and forbearance; his holiday was prolonged, and, by the kindness of a member of the Council, he was sent to a convalescent home, whence he reported himself as never better in his life. On December 4th he telegraphed to say he was too ill to come to his work, and from information received by the senior Secretary on the 5th, it became clear that he had no intention of returning to his duties. On the next occasion of the Council meeting his place was declared vacant, and Mr. F. A. Parsons was appointed to his duties for the next three months.

The Rev. Canon Carr moved that the Report of the Council be received and adopted. He thought it was not necessary for him to make any remark in support of this motion, and he would merely express a hope that Fellows who had not yet paid their subscriptions would lose no time in doing so, as it was most important to the Society at the present time that this should be done.

Mr. Hembrey had great pleasure in seconding this motion, and thought the Society was very fortunate in having obtained the services of Mr. Parsons as Assistant Secretary at the present time.

The President having put this motion to the meeting, declared it to be unanimously carried.

The Treasurer's Report and Balance Sheet for the year 1896 was then read by Mr. Suffolk, together with a list of the invested funds of the Society, the balance sheet having been duly audited and certified by Messrs. Allen and Dadswell.

The adoption of the Treasurer's Report having been moved by Mr. T. Charters White, and seconded by Mr. Hembrey, was put to the meeting by the President and unanimously carried.

The President having asked for the appointment of two Fellows to act as Scrutineers of the Ballot, Mr. J. M. Allen and Mr. J. E. Ingpen were proposed by Mr. Rousselet, seconded by Mr. Beck, and unanimously elected.

The President then read his Annual Address, the latter portion of which was illustrated by drawings shown upon the screen by the lantern.

At the close of the Address the Scrutineers handed in their report as to the result of the ballot, and the President declared the following to be duly elected as Officers and Council for the ensuing year.

President—*Edward Milles Nelson, Esq.

Vice-Presidents—*Robert Braithwaite, Esq., M.D., M.R.C.S., F.L.S.; Rev. Edmund Carr, M.A., F.R.Met.S.; Frank Crisp, Esq., LL.B., B.A., V.P. and Treas. L.S.; *A. D. Michael, Esq., F.L.S.

* Those with an asterisk (*) had not held during the preceding year the office for which they were nominated.

THE TREASURER'S ACCOUNT FOR 1896.

Dr.

1896.				£	s.	d.
To Balance 31st December, 1895				120	19	2
,, Admission Fees				23	2	0
,, Annual Subscriptions—						
1892	£6	6	0			
1893	11	8	0			
1894	28	7	0			
1895	40	1	0			
1896	429	11	4			
1897	14	14	0			
				530	7	4
,, Interest on Investments				53	4	3
,, Sale of Journal				159	19	2
,, Advertisements				48	1	2
,, Catalogues sold				0	2	0
,, List of Fellows sold				0	1	0
,, Screw Tools sold				8	5	0
,, Bequest J. Wright				225	0	0
,, W. T. S., Amount due Petty Cash				2	1	5
				£1171	2	6

Cr.

1896.	£	s.	d.
By Rent, Coals, and Attendance	101	4	0
,, Salaries, Reporting, and Commission	141	16	11
,, Books and Binding	75	13	7
,, Expenses of Journal	689	5	3
,, Refreshments at Evening Meetings	11	2	0
,, Stationery	7	6	11
,, Fire Insurance	0	10	0
,, Petty Cash	32	1	5
,, Solicitor's Charges for recovering Subscriptions in Arrear	8	2	0
,, Balance in hand	104	0	5
	£1171	2	6

Investments, 31*st December*, 1896.

380*l*. 17*s*. 3*d*. India Three per Cents.
315*l*. 11*s*. 1*d*. New South Wales Three per Cents.
400*l*. Nottingham Corporation Three 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 and Documents in the possession of the Society, and find the same correct.

Edward Dadswell
J. Mason Allen } *Auditors*.

Treasurer—William Thomas Suffolk, Esq.

Secretaries—Prof. F. Jeffrey Bell, M.A.; Rev. W. H. Dallinger, LL.D., F.R.S.

Twelve other Members of Council—*C. Edmund Aikin, Esq., B.A., M.R.C.S.; Conrad Beck, Esq.; Alfred W. Bennett, Esq., M.A., B.Sc., F.L.S.; Edward Dadswell, Esq.; *R. G. Hebb, Esq., M.A., M.D., F.R.C.P.; George C. Karop, Esq., M.R.C.S.; *Prof. E. Ray Lankester, M.A., LL.D., F.R.S.; the Hon. Sir Ford North; Thomas H. Powell, Esq.; Charles F. Rousselet, Esq.; John Jewell Vezey, Esq.; Thomas Charters White, Esq., M.R.C.S., L.D.S.

The President said he had one other matter of business only remaining to be performed, and that was the very pleasurable duty of inducting the newly elected President, their old friend Mr. E. M. Nelson, and in so doing he felt that he was installing one who would fill the chair with great ability, and with great credit to the Society.

Mr. E. M. Nelson, who was cordially received on taking the chair, said he sincerely thanked the Fellows for the honour they had done him in electing him their President, to occupy the chair that had been so ably filled by Mr. Michael during the past four years. It was usual at this point for the new President to adjourn the meeting until the next month; but he proposed to depart from that custom, and to ask their kind attention to a few remarks on the present condition of the Society; and begged their indulgence if he seemed to be too plain-spoken. He had no wish to pose as a pessimist; nevertheless, he regarded the present time as a very critical one in the history of the Society. There were difficulties ahead that would require very careful and skilful handling; and it was because he firmly believed they might all be overcome, if the Fellows, when made acquainted with them, would only resolve to work together and support the Council, that he was addressing them in that way.

The Balance Sheet which they had just heard read, though it gave a true statement of cash receipts and payments for the past year, did not really place them in a position to realise the present financial position of the Society. When he told them that, on the 31st of December last, there was owing to the Society a sum of nearly 500*l.* for arrears of subscriptions, he felt sure they would agree with him that this was a most improper state of things. It was not in accordance with the dignity of the Society that this should be the case, neither was it fair to the Council, who were quite unable to meet their obligations (which amounted to a larger sum) without trespassing on investments which have been prudently put by in former years. A reference to the Balance Sheet would also show that a legacy left to the Society during the past year, which it would have been right to have treated as capital, had been absorbed in the year's expenditure. Before proceeding further, he therefore appealed earnestly to the Fellows of the Society to remove the present anxieties of the Treasurer and Council by promptly paying their subscriptions, both due and overdue.

* Those with an asterisk (*) had not held during the preceding year the office for which they were nominated.

It must next be pointed out that there were only fourteen Fellows elected last year—a number far below that of the resignations and deaths for the same period. It was therefore incumbent on them all to do their best to increase the present roll of Fellowship.

He must also draw attention to the expenditure of the Society. The largest item, as they were well aware, was for the publication of the Journal. He believed it was considered that the Society's Journal was unique among those of the other learned Societies; for not only did it deal with Microscopical work proper, but it gave an abstract index of current Zoological and Botanical Literature. This entailed an enormous amount of work and expense, and he thought it was but right that the Fellows should know that the outlay on the Journal exceeded 900*l.* per annum.

One of the first and most pressing duties of the new Council would be to deal with that question; and he thought it would materially assist them in their deliberations if the Fellows would express their views as to the value to them, as Microscopists, of the Journal in its present form; that, however, he was asking on his own responsibility.

He should like to state that his policy as President would be to endeavour, at all costs, to keep the Society's expenditure well within its income; and he felt sure he might confidently ask the Fellows to give their hearty support to the Council and Officers to carry out that course. On the other hand, he wished it clearly to be understood that, if the Fellows disapproved of the views he had expressed, and were not prepared to render their loyal support to such plans as the Council might decide upon to extricate the Society from its present somewhat difficult position, he trusted they would inform him, and allow him to vacate that chair at once, in favour of some one who would better represent them.

He had only one more duty to perform, and that was to ask them to accord a very hearty vote of thanks to their old friend Mr. Michael, for the very able address with which he had favoured them that evening. In it he had touched upon both branches with which the Society was accustomed to interest itself, and it would therefore, no doubt, be read with great interest by all. He was very glad to hear Mr. Michael say that he was going still to be with them, because it was too often the fact that when a Fellow ceased to be President, they saw very little of him afterwards; but, although Mr. Michael had made some allusion to his work as to some extent affecting his attendance, it was (he thought) very seldom that he had been absent from their meetings.

Mr. Vezey said he should like to second the vote of thanks to Mr. Michael, whom he was afraid he must now call the ex-President; and in doing so he would point out that the duties devolving on the President were not simply those of presiding at the meetings held in that room, but he was ex-officio Chairman of the Council, and in this respect Mr. Michael's duties had been anything but light in the past year, and his wise counsel and guidance had been invaluable. Although, therefore, it was quite true that they cordially welcomed the new President, it was equally true that they parted from the late President with great regret.

Mr. Michael felt he need not say more than that he thanked the Fellows present very heartily for the way in which his Address had been received—as, indeed, they had always received everything he had done for the Society during his period of office.

The meeting was then adjourned.

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

Mr. E. M. Nelson—An old Microscope, presented to the Society by Mr. James More, jun.; a small Lamp for the Microscope, designed by Mr. Goodwin.

Mr. Rousselet—*Stephanoceros Eichhorni*, with fertilised resting eggs.

New Fellows.—The following were elected *Ordinary* Fellows:—Mr. Sydney T. Klein, Rev. Fredk. Joseph Laverack, and Mr. James H. C. Steward.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

APRIL 1897.

TRANSACTIONS OF THE SOCIETY.

IV.—*Presidential Address:*

Suggestions as to Points connected with the Microscope and its Accessories still needing Improvement.

Résumé of the Anatomy of Bdella.

By A. D. Michael, F.L.S., &c.

(*Read 20th January*, 1897.)

When, a year ago, your Council did me the entirely unexpected honour of asking me to be your President for a fourth year, I explained to them that, not having in any way anticipated such a request, I had undertaken about as much scientific work as I could manage to get through during the then coming twelve months; and that therefore I was only able to accept the honour upon condition that they, and the Society, would be very indulgent to me in the matter of the Annual Address, for it would be impossible for me to devote as much time to its preparation as I had done in former years. Work of this class is apt to turn out more, not less, than we anticipate; I fear, therefore, that what little I have to offer you to-night may be somewhat disjointed and less carefully worked up than the addresses of earlier years. Another reason for its being rather disconnected is, that this is the last occasion on which I shall occupy this chair as your President, and there are a few things which I should like to say to you before I leave it. The first of these is to thank you all for the unvarying kindness and courtesy which I have received from Council, Officers, and Fellows alike, from the first day of my presidency to the last. I shall always look back to the past four years with the greatest pleasure, and with gratitude to my fellow Members of this Society who have combined to render it pleasant.

Next, I wish to make a few observations, which I hope may be of some little practical service, as to the Microscope itself and one or two of the articles which are frequently used in connection with it. These remarks will be directed entirely from the point of view of a constant worker with the instrument who feels the want of certain things, not from that of the optician. All matters of scientific optics will doubtless be dealt with by my successor, who is far more competent to do so than I am. The optical construction of a Microscope has made vast strides during the last few years, and although I am not one of those who believe that perfection has been reached, or even approached, or that there is not any field left for improvements in the future, yet it must be admitted by all impartial minds which have been occupied with the subject that such field has been substantially diminished; and it is also indisputable that the perfecting—or rather, improving, for nothing is perfect—of the optical combinations of a Microscope is by far the most important part of its construction, and has rightly claimed the greatest share of attention. But I am not sure that, while eagerly pursuing this subject of paramount importance, and while rejoicing in such brilliant discoveries as homogeneous immersion and apochromatic lenses, we have not somewhat neglected other parts of the instrument, which might very well receive attention in the lull after these great optical successes. It must be remembered that the finest gem is half wasted if badly set, and it must also be borne in mind that the perfecting of these lenses is only a means to an end; that end is not only the examination of test objects and of objects requiring the highest powers of the instrument, nor of show objects; these are all matters of great value and of the highest interest; but behind them is the supreme necessity of enabling the thousands of scientific workers who now use the Microscope as their everyday instrument of research to do their work in the best, the most convenient, and the quickest manner possible. Another element for consideration is that a large number of these investigators are not men of large means, who can afford to be continually purchasing new and expensive apparatus; if they make an effort to buy it, it must wear well. Now I think that in the race for optical excellence and for low initial cost, the importance of some of these points has not been kept as rigidly before the eyes of makers and designers of Microscopes as it might advantageously have been. The first instance which I will refer to is the coarse-adjustment. This is of the highest importance, for it is used by the average of workers far more than the fine, and it is manifest that the most perfect optical arrangements are wasted if the coarse-adjustment of the instrument which supports them will not hold its focus. When our Microscopes come home from the makers' hands they usually do hold their focus, and the coarse-adjustment works admirably; but do they continue to do so? My experience is that, as a rule, they do not. I am the possessor of several Microscopes, and my instruments are not put away in a glass case to be looked at or preserved; they are pretty constantly used; there is only one of them with which I have not had trouble over the coarse-adjustment, and that one is the oldest of them all, and has had quite equal work with the others during the shorter period they have been used in. I will not mention instruments nor makers' names, but possibly some of my hearers will not be slow to guess what it is. The others have all ceased to hold the focus after a time, and although the tightening of the screws intended to remedy this will cure matters temporarily, it soon ceases to do so. Then the instrument goes back to the makers, and returns better, but not as good as it was at first, and the period for which it will retain its improvement gets shorter and shorter. Why is this? It will be said, "from the natural tendency of all things to wear out." This is quite true; but the oldest instrument does not wear out, or, at all events, only very little; therefore I may repeat the question, Why is this? Am I entirely wide of the mark in suggesting that possibly better workmanship and harder metal may have something to do with it? It appears to me that in the struggle to reduce cost we forget the great importance of having the working parts made of the most enduring, and consequently, as a rule, the hardest, metal possible. The balance wheel of a watch has a pivot of the hardest steel procurable, and it rests upon something equally hard; but have we followed this excellent example? I fear not; cost has come in the way, and although the pinion of our coarse-adjustment is usually, I imagine, made of steel, yet the rack is made of something, not only softer, but often very considerably softer. The harder metal naturally wears away the softer to some extent, and after a period of use the teeth or screw of the pinion which fell sweetly into the rack at first do not quite do so any longer; then comes increased wear, and the evil goes on even faster than before; moreover, it seems to me that diagonal racks wear as fast as straight ones. It is true that the rack may usually be replaced at some considerable expense and trouble, but it is desirable to avoid this if possible, and a good deal of inconvenience is usually put up with before deciding to change the rack. It is not the rack alone that wears; the shaft that carries it wears away also, and the softer it is the faster it wears. Fine instruments are made commonly with the parts near the angles slightly projecting, the central part being planed away. This is doubtless the best construction, but it does not wholly cure the evil unless the metal be very hard and highly finished; the projecting part wears, and what is worse, it wears unequally. At least nine-tenths of each man's work is usually upon a small part of the rack, according to the objectives he most frequently uses, and the parts which receive the pressure when the Microscope is in this position wear most. There must always be a portion of the shaft and rack which is above the collar of the stand when the instrument is in use, and therefore does not wear at all; thus the projecting angles, although they project equally all the way along at first, gradually cease to do so; this is a much worse evil than the rack, for it produces an uneven motion and a difficulty in holding the focus; and these angles are usually of the same piece of metal as the shaft itself, and cannot be replaced. It seems to me that where these projecting angles exist, as it is desirable that they should do, they might be removable like the rack and be replaced when worn. I am aware that there are certain difficulties of fitting, but with care and good workmanship these may be overcome. It will be said that the collar through which the shaft passes may be, and usually is, sprung; that is doubtless an advantage, but my experience is that it is not entirely a remedy. Again, it will be said that every Microscope has tightening screws to meet this very difficulty; so it has, and very admirably they act the first time they are used; but afterwards something wears away; if the screw be of harder metal than the shaft, or whatever it presses on, it gradually cuts a little channel, and that channel is cut in the place where it touches when the Microscope is at the elevation at which it is most frequently used; so that the instrument will hold its focus beautifully in every position except the one in which its owner requires to use it. I suggest that these screws should be of much softer metal than what they press upon, so that *they* may wear away instead of wearing it, and that a few duplicate screws should be supplied with each Microscope, which could be substituted when the original ones are worn out; and they might well have some mark on the outside to show when they have been inserted to the extent of their capacity, and are no longer useful. The moral of all this is that the coarse-adjustment is as important as it ever was; and that hard metal and good workmanship are not less valuable to-day than they were years ago, and are worth paying something to obtain. There is, however, another aspect to this matter; and I venture to ask a question which I fear many of my hearers will consider rather a wild one; namely, Is it absolutely necessary that the whole weight of the movable part of the instrument should be borne by the coarse-adjustment and the tightening screws? Is it beyond the power of human ingenuity to find some satisfactory method of supporting that weight without having recourse to pressure on the faces of the shaft? Cannot we hope for the time when all the coarse-adjustment will have to do will be gently and evenly to move parts the weight of which is supported or balanced by other means? I do not see that it is impossible, and it seems to me to be well worthy of the careful consideration of constructors; the Wale stand was an ingenious step in this direction, but failed for want of rigidity, &c. If we could attain this end we might then indeed have an absolutely efficient coarse-adjustment which practically would not wear out.

The next point which I wish to mention is the working distance afforded by the objective. I fear that in the struggle for definition this is a good deal lost sight of; it is quite true that with high-power objectives, by which, for this purpose, I mean everything above a quarter of an inch, if one has distance enough for the object and the medium, if any, which it is immersed in, and the cover-glass, that is all that is requisite; unless indeed we could obtain sufficient distance to use reflected light with high powers, of which there does not appear any immediate prospect; but the requirements of modern anatomy and research are daily becoming greater, and notwithstanding the immense assistance obtained from section-cutting it continually becomes more and more important to work upon very minute objects under a Microscope. To meet these requirements there should be objectives of half-inch focus, under which a knife or other instrument can be freely used; but how few there are, and they are rather diminishing than increasing; it is true that they would not probably give the definition which is obtained by objectives which have less working-distance, but there is ample field for both; and a serious effort should in my opinion be made to produce half-inch objectives with more working distance than is possessed by most of those at present supplied, combined with the best possible definition which can be obtained at that distance. The effort should not cease here; human skill persistently directed to a desired object does many things, and I trust that the time may come when we may be able to dissect under higher powers than a half-inch. It is true that apochromatic lenses and compensating eye-pieces have done a good deal for us in this connection; for they have enabled us to use deeper eye-pieces, and consequently lower objectives, to obtain the same amplification; but these eye-pieces, excellent as they are, have some disadvantages, among which is not being very suitable for the Stephenson binocular, which is, in my opinion, still *facile princeps* among dissecting instruments.

The next point is one which I have mentioned before from this chair; namely that in these days when section-cutting is one of the greatest, if not absolutely the greatest, means of biological research, and when we are anxious as far as possible to mount a whole series of sections on one slide, it is most desirable to have a good mechanical stage that has a motion of 3 in. by 1 in., or very close to that measurement. Only those who themselves use serial sections to discover what was previously unknown can thoroughly grasp the importance of this; serial sections are not a book which everyone who runs may read; in minute and complicated anatomy the information is there, but it is written in a language which it requires the closest attention to understand; the eye and the mind have to follow the individual organ which is being traced from section to section, often through a great number of sections, and preserve clearly in the mental vision the result of the combination of these numerous and varying pictures. The continual shifting from row to row of sections, or worse still from slide to slide, distracts the attention, and interferes seriously with the powers of realising the results; therefore the longest mechanical movement of the stage is of substantial importance; and it is equally important that whatever movement there is shall be capable of being exerted without bringing any part of the apparatus up against the substage condenser and upsetting that. Since I called attention to this subject before, two very ingenious arrangements have been brought forward with a view to remedy the defect—one by Messrs. Swift, the other by Messrs. Zeiss; but although these are great improvements they do not quite overcome the difficulty, and I urge upon those gentlemen and other makers and designers not to relax their efforts before complete success is obtained. Until that success arrives the inconveniences may be somewhat modified by a very simple contrivance, which, however, is rarely met with on our Microscopes. It is so simple that one hardly likes to mention it here, and yet it is very helpful. The slide should (and usually does) rest upon a sliding bar at the proximal side of the stage; for the old plan of resting it on two pegs, so that when the end of the slide has passed one peg the slide tumbles off the stage, is now, I hope, happily superseded. At the left end of this sliding bar is a stop, which is most useful—indeed, almost essential—for measuring, finding, drawing, &c.; but this stop prevents the slide being pushed on with the fingers when the movement of the mechanical stage is exhausted, before the end of the line of sections is reached. If this stop be hinged, and capable of being turned downward through an angle of 90 degrees, so that instead of being at right angles to the bar it forms an extension of it, the slide can be pushed along this extension, and the remainder of the row of sections seen. Of course, it is far inferior to a mechanical stage which will travel the whole distance, but it is a good deal better than nothing. The stop should have a little spring to cause it to stand firmly in these two positions and not between them. Anyone who has worked with this simple contrivance will appreciate the comfort of it as stages now exist.

Another matter that I think does not receive as much attention as it might do in our Microscope-stands is the revolving stage. It is known how convenient it is for it to revolve right round; but this is very often neglected, or sacrificed to other things, and great inconvenience is caused thereby. It does not usually matter very much while we are simply examining an object; but when we come to draw it, we frequently find that we cannot turn the stage far enough to get it into the right position. Then the slide must be taken off the stage and reversed, the object re-found, and the instrument re-focused (not without some danger of injury if the object be unmounted); and, after all, we perhaps find that we are not any better off, because the right position is just that small piece of the circle which the stage will not pass, whichever side it be turned from.

Another thing which, it seems to me, is too frequently neglected, is allowing sufficient space between the substage and the table for the mirror to be turned at any requisite angle when the Microscope is upright. And it is desirable that we should be able to turn it without (if we are using the flat mirror) reflecting the image of the milled heads of the apparatus which focuses the substage condenser, and throwing it on to the object. It is true that we can get rid of the image by turning the mirror; but that limits the power of searching the sky for a good light when working by daylight. The zenith is often blue, and the best light is often found not very far from the lowest part of the sky visible ; but it is exactly in this position that we get the image. It would be convenient if the milled heads could revolve out of the way, and I think it might be done.

Now a few words about some articles which, although not part of a Microscope, are often used with it. We are extremely careful to achromatise our substage condensers: why should we not do a little in the same direction for our stand-condensers? The two cases are not altogether similar, and the latter is far less important ; but I fancy that something might advantageously be done more frequently than it is. Then there is the question of knives. No knives are manufactured for microscopical work; the ordinary scalpels sold are utterly unsuited for microscopical purposes. The finest knives that one can buy are those made for oculists ; but even these are much too coarse for delicate microscopical work. It might be worth while for the makers of Microscopes to see if they cannot get some knives made fit to use with them. Then knives want sharpening. Good dissecting—and, to an even greater degree, good section-cutting—depends greatly upon the sharpness of the knife and the smoothness of its edge. Probably the best thing we have for sharpening is an Arkansas stone ; and something may be done by using soap instead of oil; but might we not possibly manufacture something of even finer grain? Of course, I am not alluding to finishing-strops. Finally there are lamps. These have received a good deal of attention, but still I fancy there is much room for improvement. A lamp otherwise well manufactured, frequently—perhaps I might say usually—has a badly made and flimsy burner ; and it is desirable to be able to get the image of the flame without the image of the metalwork overlapping it when the lamp is some distance above the mirror. Sufficient care is not always taken to prevent the paraffin from sucking up by capillary attraction and spreading all over the outside of the reservoir, &c. ; and in lamps with metal chimneys, there should be some simple means of taking the chimney off while the lamp is alight without burning one's fingers. The chimney should be left off until the lamp is relighted, which greatly diminishes the unpleasant smell otherwise arising upon lighting it.

I propose to occupy what little time remains to me in giving you a very brief *résumé* of some portions of the microscopical work which has occupied most of my time during the last three years. The results were laid before the Linnean Society in April last, and have just appeared in their Transactions; but, as the greater number of our Fellows here do not belong to the Linnean, and had not the opportunity of hearing them there, they may take some little interest in doing so now; particularly as, when last year I addressed you on the anatomy of the Acarina, I was obliged, in justice to the Linnean Society, to be wholly silent respecting that of the Bdellinæ, which was the subject of the paper to be laid before them, and in which (as it had been very little investigated before) I was able to make a few discoveries, I hope of rather more than passing interest.

The first point which I will mention is the construction of the pharynx, which is the great sucking organ in such Acari as live by suction; and the principal interest in what I am about to mention lies, I think, in showing how small a variation will sometimes profoundly affect the action of the parts. In order that you may understand this variation in *Bdella*, I will shortly remind you of what the pharynx usually is in allied families, such as the Hydrachnidæ. Imagine two chitinous half-tubes, like the gutter-pipes round roofs, fitting one inside the other, and soldered at the edges, the lower one fixed, the upper slightly flexible, so that it can be raised by perpendicular muscles. When the roof of the pharynx is so raised, a partial vacuum is left between it and the floor; the food rushes in from the mouth; a valve closes the entrance of the pharynx; then some transverse muscles, which run from one upper edge of the half-tubes to the other, contract, driving the upper half-tube down on the lower, and consequently (as the opening to the mouth is closed) driving the food on into the ventriculus. In *Bdella* the variation is that the roof of the pharynx is not chitinised; consequently the muscles would not raise the whole roof, but each muscle would raise only the piece it was attached to. Therefore a new arrangement is made: the muscles, instead of acting together, act successively, and the food is carried back by the undulation produced, much as in a cat's lapping. Then the transverse muscles, if attached to the upper edges as in other cases, would not force the upper half-tube down, they would simply crumple it; therefore they have the ends attached below the pharynx, and pass in an arch over it, so that when they straighten, also successively, they compress the whole pharynx, and restore it to its original condition. The pharynx passes into the œsophagus, which in all known Acarina, except *Bdella*, is a mere straight tube. In *Bdella* alone, I have discovered that at the œsophageal end of the pharynx there is a ring-constrictor muscle, and immediately behind this ring the œsophagus bifurcates; one branch is the ordinary tube to the ventriculus, the other leads into a large blind sac at the end of the tubular stalk, and this sac is a reservoir in which food is stored before passing into the stomach. The interest of this, to my mind, lies not in the arrangement itself, but in the fact that it is unknown amongst other Acari, and even, as far as I remember, amongst other Arachnida, while it is well known in a totally different class of the Arthropoda, namely the Insecta, where it is common amongst Diptera, Lepidoptera, Hymenoptera, &c. How are we to account for the sudden reappearance of this organ in one solitary genus so widely removed from those groups where it is typical? Are we to suppose that a common want has produced a similar development in both cases? But if so, how is it that none of the other sucking Acari have it, and that it is not found in Spiders or Phalangiidæ? Or are we to go back to some common ancestor, which we suppose to have had the organ, which has lain dormant in all the numerous stages over vast periods of time, until *Bdella* was reached, and then suddenly reappeared in full vigour? Or are we to suppose the Acarina to be derived from the Insecta? If so, where is any trace of the organ in the intermediate stages, and why does it die out suddenly after *Bdella* without there being a trace of it in the most nearly allied creatures?

A very pretty little piece of apparatus which is peculiar to *Bdella*, although structures serving a similar purpose are known elsewhere, is the epipharynx. This is an organ which is somehow much neglected by anatomists, both in Insects and Arachnida, and yet it is of considerable interest, and of some importance. Oddly enough, it is frequently called the "lingua," although the two organs often co-exist in the same creature, and although a true lingua arises from the floor of the mouth below the pharynx, while the epipharynx, as its name implies, is above the opening of the pharynx, and in the Acarina usually springs from the anterior upper edge of the pharyngeal tube, and projects freely into the mouth-cavity, forming a kind of pent-house overhanging the entrance to the alimentary canal, and probably guiding the food into the opening. It is usually a stiff, more or less elongated, lanceolate or triangular blade; the latter is the shape in *Bdella*, but from its sides in that creature a broad membranous border hangs down like a curtain at the side of the food-stream. It must be remembered that *Bdella* is a predatory creature living by suction, and is a member of that group of Acari where no certain connection has been found between the ventriculus and the hindgut. It does not appear to pass solid dejecta, and therefore it is important that none should enter the canal. This is effected in the Acari of this genus which I have dissected by the epipharynx in the following manner. The lancet-shaped piece with its membranous edge is not the whole of the apparatus; some little way below it is a thin horizontal semilunar membrane with its convex edge forward; its upper surface and its curved edge bear regular series of teeth like those of a saw. The membrane is very transparent, and quite flexible, so that in its ordinary position it falls downward, making the upper surface the anterior, and of course, presenting the teeth towards the mouth. The largest teeth are at the edge; they fall in front of the opening of the pharynx, and their points fall between a set of minute wart-like elevations on the floor of the mouth; thus a grating is formed which effectually strains all solid particles out of the fluids which are sucked into the pharynx.

The brain in *Bdella* has a peculiar interest for the following reason. When last year I showed you a picture of the almost globular brain of one of the Hydrachnidæ, with the nerves springing from it, and the small round hole in the centre affording a passage for the œsophagus right through it; and when I told you at the same time that that nearly spherical mass had been derived from distinct supra- and subœsophageal ganglia, you might well be excused if you felt somewhat incredulous. My mouth was then closed as to the anatomy of *Bdella*, a creature of a closely allied sub-family; now I am able to show you a drawing of it carefully made from actual dissections. You will see here that the large sub-œsophageal ganglion is a flattened, almost oblong, sheet of nervous matter, with the actual nerves penetrating far into it in plainly discernible courses; while the small, almost cubical, supra-œsophageal ganglion is perched on the anterior end of the lower ganglion, and is sharply demarcated from it. Both are slightly excavated for the passage of the œsophagus between the two.

We should be inclined to say from this that *Bdella* was a primitive form amongst Acari, and one of the nearest to other groups such as the Insecta, from a phylogenetic point of view, but the result of further inquiries into the anatomy of the creature shows how difficult such tracings of phylogeny really are, and how complicated are the questions that arise during the inquiry; and we may also learn how easy it is to draw up phylogenetic trees if we confine our attention to the particular organs which we are thinking of at the time, and how delusive those trees may be when so drawn up; for in spite of the somewhat primitive character of the brain in *Bdella*, as compared with that in most other Acari, some other systems of organs in this animal are far more specialised and complicated than the corresponding parts in any other known Acarine; I think I might say, than those in any other known Arachnid. These highly specialised portions of the anatomy are the male genital organs and the salivary glands. The great size, variety, and peculiarity of the latter are very remarkable, while the complication of the former, and the variety, size, and unexpected and special characters of the numerous accessory glands and other organs included in them are really quite startling. I wish I had time to describe to you even a few of the many interesting features of those organs, but it would be hopeless to attempt to do so to-night; anyone interested in them will find them described in the Transactions of the Linnean Society.

And now I have only to thank you once more for the unfailing courtesy and kindness which I have received at your hands during my long occupation of this chair, and to bid you farewell as your President, although I hope to remain for many years one of those connected with your Society in a humbler capacity.

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.†

Germinal Selection.‡—Prof. A. Weismann in this important essay seeks to remove "the patent contradiction of the assumption that the general fitness of organisms, or the adaptations *necessary* to their existence, are produced by *accidental* variations—a contradiction which formed a serious stumbling-block to the theory of selection." "Though still assuming that the *primary* variations are '*accidental*,' I yet hope," he says, "to have demonstrated that an interior mechanism exists which compels them to go on increasing in a definite direction the moment selection intervenes." In this sense definitely directed variation exists.

The interior mechanism referred to is germinal selection, i.e. the selection of vital units *within* the germ-cells; and the central idea of the essay is that "the variations presented to personal [better individual or organismal?] selection must themselves have been produced by the principle of the survival of the fit." This is effected by profound processes of selection in the interior of the germ-plasm.

In short, Weismann has extended to the determinants in the germ the conceptions of struggle, elimination, and survival. With his usual adherence to logic he has extended Roux's "struggle of parts" and histonal selection to the furthest possible point. A few quotations will make his position clear.

* 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.

‡ 'On Germinal Selection,' Chicago, 1896, 8vo, xii. and 61 pp.; C. R. Congr. Internat. Zool., 1896, pp. 35–70.

"A part is not only nourished but also actively nourishes itself, and the more vigorously, the more powerful and capable of assimilation it is. Hence powerful determinants in the germ will absorb nutriment more rapidly than weaker determinants. The latter, accordingly, will grow more slowly, and will produce weaker descendants than the former."

"Minus variations repose on the weaker determinants of the germ, that is, on such as absorb nutriment less powerfully than the rest. And since every determinant battles stoutly with its neighbours for food, that is, takes to itself as much of it as it can, consonantly with its power of assimilation and proportionately to the nutrient supply, therefore the unimpoverished neighbours of this minus determinant will deprive it of its nutriment more rapidly than was the case with its more robust ancestors; hence it will be unable to obtain the full quantum of food corresponding even to its weakened capacity of assimilation, and the result will be that its descendants [" ancestors " in the translation] will be weakened still more.

"As soon as personal [individual] selection favours the more powerful variations of a determinant, the moment that these come to predominate in the germ-plasm of the species, at once the tendency must arise for them to vary *still more strongly* in the plus direction, not solely because the zero-point has been pushed further upwards, but because they themselves now oppose a relatively more powerful front to their neighbours, that is, actively absorb more nutriment, and upon the whole increase in vigour and produce more robust descendants. From the relative vigour or dynamic status of the particles of the germ-plasm, thus, will issue spontaneously an ascending line of variation, precisely as the facts of evolution require."

"Thus, I think, may be explained how personal selection imparts the initial impulse to processes in the germ-plasm, which, when they are once set agoing, persist of themselves in the same direction, and are therefore in no need of the continued supplementary help of personal selection, as directed exclusively to a definite part."

There is much else in the essay which deserves careful attention,—the general vindication of the selection-principle, the modification of his theory of panmixia, the apology for hypotheses, and so on, but in our limited space we have thought it better to give prominence to the main idea.

Evolution on Definite Lines.*—Prof. G. H. Th. Eimer delivered a lecture on this subject at the International Congress in Leyden, which may be fitly noticed in connection with Weismann's. Two more antithetic utterances it is difficult to conceive.

Orthogenesis, or progressive variation in definite direction, is a fact: and a fact destructive to Darwinism.

The causes of orthogenesis are to be found in the action of environment upon the constitution of the organism. Evolution is a larger aspect of growth.

The facts of orthogenesis lead us to recognise certain laws of evolution, of which Eimer states ten, as in his book.

The origin of species depends not on selection, but (1) on stoppage (Genepistasis) at given stages in the evolution-process, (2) on saltatory

* CR. Internat. Congr., 1896, pp. 145–69.

evolution or halmatogenesis, (3) on reproductive isolation (Kyeamechanie), as Eimer pointed out in 1874.

Prof. Eimer gives concrete illustrations of his position, and criticises Weismann's. We cannot, however, enter into the discussion, interesting as it is; the antithesis, roughly stated, is that to Eimer almost everything depends upon growth, to Weismann almost everything depends upon selection; but it is perhaps more accurate to say that there is no antithesis, only a difficulty in appreciating the relative values of the two.

Problems of Vertebrate Embryology.*—Dr. J. Beard has followed up his more concrete and technical papers with a general essay on some problems of Vertebrate embryology. The thread uniting its different parts is the idea of a substitution of organisms in Vertebrate ontogeny.

He begins by stating the characters of "the critical stage" in Elasmobranch fishes. The embryo is beginning to show definite adult characters, and at this stage it annexes (into the gut) the external yolk-sac. In other Ichthyopsida, the critical stage is also found—nay more, all through up to Mammals. Thus the author points out most suggestively the correspondence of the critical stage in *Scyllium* with the birth-period in *Didelphys*, when, as before, a new mode of nutrition is initiated, and with the 15th day stage in the rabbit's development, when the change to an allantoic placenta is realised. Valuable tables at the end of the essay make it easy to compare a variety of types at their critical stage.

The author states von Baer's laws, so often misstated, and would replace them by the following:—"There is a stage [the critical stage] in the development of every Vertebrate embryo, during which, and only then, it resembles the embryo of any other Vertebrate in a corresponding stage in certain general features. But, while it thus agrees exactly with any other embryo in this stage in characters which are common to all Vertebrate animals, it differs from the embryo of any other class in certain special class-features, and also from any other embryo of the same class but of a different order in other and ordinal characters. Immediately before this stage is reached, it begins to put on generic and specific characters, and thus it then begins to differ from all other embryos in these."

"The whole of this has its explanation in an antithetic alternation of generations as underlying the development; for it is the stage at which the embryo first has acquired such an independence as will enable it to set about the task of suppressing the larval or asexual foundation, the phorozoon."

The Recapitulation Doctrine.†—Prof. F. Houssay has been prompted by Dr. Beard's results and theories to discuss some aspects of ontogenetic recapitulation. While very appreciative of Beard's work, he has some criticisms to make. The most important propositions are the following:—(1) The idea of "a substitution of organisms" (Beard) does not exclude a modified belief in ontogenetic recapitulation of phylogenetic stages; (2) Beard has tended to confuse (in part, deliberately) the conception of alternation of generations on the one hand and of metamorphosis on the

* 'On Certain Problems of Vertebrate Embryology,' 8vo, Jena, 1896, vi. and 77 pp.
† Anat. Anzeig., xiii. (1897) pp. 33–9.

other; (3) alternation of generations is "a fragmentation of the individual," a division of the specific individuality into two stages; (4) metamorphosis or metabole is the result of a diminished vitality in ontogeny, of a period of local asphyxia, and is associated with phenomena of necrobiosis; (5) what Beard regards as an alternation of generations in Vertebrata seems to Houssay rather a metabole. It may be noted that this paper does not take account of Beard's paper summarised above.

Development of Teeth in Perameles.*—Prof. J. T. Wilson and Mr. J. P. Hill base on their observations on the development of the teeth of this Marsupial a simpler view of the dentition of these animals than that now in vogue.

They regard the permanent teeth of Marsupials as the homologues of the permanent or replacing teeth of other Mammals. They find the deciduous premolar to be a true milk-tooth, while the so-called prelacteal teeth are in reality milk-teeth which have undergone reduction. The lingually situated downgrowths of the dental lamina by the sides of the developing teeth are not rudimentary enamel-germs. They are merely portions of a quite indifferent "residual dental lamina"; the swelling of the distal portion exhibits no differentiation which is really characteristic of actual enamel-organs.

Experiments on Growth of Blastoderm of Chick.†—Mr. R. Assheton set himself to test by actual experiment Duval's theory of the formation of the primitive streak, and to try and determine experimentally whether the whole or only part of the actual embryo is developed by the activity of the primitive streak.

The result of the first set of experiments seemed to be that the primitive streak is not formed from the posterior edge of the blastoderm, as Duval maintains.

It further seems clear that all the parts of the chick in front of the first pair of mesoblastic somites (that is, the heart, brain, olfactory, optic, and auditory organs and foregut) are developed from that portion of the blastoderm which lies anterior to its centre, while all the rest of the embryo is formed by the activity of the primitive streak area.

Proportions of Yolk, Albumen, and Shell.‡—Dr. R. W. Bauer continues his painstaking estimation of the proportionate weights of yolk, albumen, and shell in birds' eggs. In *Columba romana*, the yolk weighed 4·967 gr., the albumen 15·648 gr., the shell 3·355 gr.; or, in percentages, 20·72, 65·29, and 13·99 respectively.

Blastopore of Chelonia.§—Prof. K. Mitsukuri, in this part of his contributions to the embryology of Reptiles, treats of the "fate of the blastopore, the relations of the primitive streak, and the formation of the posterior end of the embryo in Chelonia, together with remarks on the nature of mesoblastic ova in Vertebrates."

The author has made a study of the surface changes and of what may be seen in sections of *Chelonia caouana*, *Clemmys japonica*, and *Trionyx japonicus*. He is led by his investigations to suggest a reclassification of the eggs of Vertebrates:—

* Quart. Journ. Micr. Sci., xxxix. (1897) pp. 427–588 (8 pls.).
† Proc. Roy. Soc. Lond., lxi. (1896) pp. 349–56 (5 figs.).
‡ Biol. Centralbl., xvi. (1896) p. 848.
§ Journ. Coll. Sci. Imp. Univ. Japan, x. (1896) pp. 1–118 (11 pls.).

I. Primary Type.

Archi-holobastic—*Amphioxus.*

Proto-holoblastic—Eggs that have never acquired a large yolk-mass, and hence have retained the primary condition nearest to *Amphioxus*—Cyclostomi.

Proto-mesoblastic.

(*a*) Eggs that have acquired a large primary yolk-mass—Elasmobranchii.

(*b*) Eggs that, having lost the large primary yolk-mass, have retained the mesoblastic mode of segmentation—Teleostei.

Meso-holoblastic.—Eggs that had a large yolk-mass, but have returned to the holoblastic condition—Amphibia (?).

II. Secondary Type.

Meta-mesoblastic.—Eggs that, having had a large primary yolk-mass, have lost it and now reacquired it—Reptilia, Aves.

Meta-holoblastic.—Eggs that have passed through the preceding stage, but again lost the yolk-mass, and returned to the holoblastic mode of segmentation—Mammalia.

Reproduction and Development of the Common Eel.*—Prof. G. B. Grassi has made a series of most interesting observations on the life-history of *Anguillula vulgaris.* Four years of continuous research have enabled him to dispel the great mystery which has hitherto surrounded the reproduction and development of this common fish. That which has hitherto been known as *Leptocephalus brevirostris* is the larva of the eel.

The eel spawns in the sea, and the eggs float; maturity is reached in the depths of the sea.

Herr K. Knauthe † remarks that light is beginning to dawn on the "eel-question," and that it might soon be clear if the zoologist would make friends with the fisherman. In 1894, Herr A. Feddersen declared that the broad-nosed eel was resident and capable of reproduction in Swedish lakes. Herr Knauthe maintains that the same may be said for Brandenburg and elsewhere. He regards the land journeys of May and June as certainly reproductive in aim, and cites some cases which it seems difficult to interpret, except on the theory that reproduction may occur in fresh water.

Life-Histories of British Fishes.‡—Prof. W. C. M'Intosh treats of the spawning of the lesser sand-eel, the eggs and young of the Pollack, the life-history of the Lumpsucker, the eggs and young of the bimaculated Sucker, and the life-history of *Cottus scorpio.* A number of useful details are given, but there are no generalisations of any kind. Essentially the same results are reported on elsewhere.§

β. Histology.

The Cell in Development and Inheritance.‖—We cannot do more than call attention to this work by Prof. E. B. Wilson. The author

* Quart. Journ. Micr. Sci., xxxix. (1896) pp. 371–85 (4 figs.).

† Biol. Centralbl., xvi. (1896) pp. 847–8.

‡ Ann. and Mag. Nat. Hist., xix. (1897) pp. 241–61.

§ 14th Annual Rep. Fishery Board for Scotland, pt. iii. pp. 171–85 (1 pl.).

‖ New York and London, 1896, 8vo, xvi. and 371 pp., 142 figs. in text.

acknowledges his indebtedness to Prof. Oscar Hertwig's "invaluable book," but the rapid advance of discovery has made it seem desirable to amplify the original plan of the work. It does not profess to be an exhaustive account of the cell, but to consider those features that seem more important and suggestive to the student of development. The author fears that the botanists will complain of gaps.

Prof. Wilson concludes with a glossary, which will not only be useful to those who have forgotten their Greek, but to the student of the history of the subject, as in nearly all cases the name of the author of the term and the date of its invention are added.

Blood of Lamprey.*—Dr. E. Giglio-Tos finds that the red blood-corpuscles of the lamprey are unusually simple, like young stages, in fact. They are spherical vesicles, filled with hæmoglobin in sparse cytoplasm. They are derived from erythroblasts, within which hæmoglobin-forming granules—of nuclear origin—appear as usual. The erythroblasts in circulation show no indirect division, but in rare cases may divide directly. The erythrocytes do not divide.

Leucocytes with simple nucleus and leucocytes with polymorphic nucleus arise from similar leucoblasts, which multiply by direct division. The fine "neutrophilous" granulations of the leucocytes with polymorphic nuclei are probably of nuclear origin. The amitotic nuclear division of these adult leucocytes is not followed by cell-division.

New Nerve-Sheath.†—Dr. A. Ruffini describes in the terminal tract of peripheral nerve-fibres a new sheath—the subsidiary sheath—which occurs between Henle's sheath and Schwann's.

Centrosomes and Attraction-Spheres in Leucocytes of Newt.‡—Dr. R. Marchesini finds that the centrosome and its attractive sphere have a quite definite form and occurrence. Even in the resting cell they have a direct relation with the nucleus, and may perhaps be regarded as a differentiation of the same. He believes that they not only preside over division, but have to do with plasmic movements and the nutrition of the cell. By using a mixture of malachite and saffranin greens he was able to differentiate the centrosome and its sphere instantaneously while the cell was still living.

Minute Structure of Ganoid Scales.§—Dr. H. Scupin has studied the scales of a large number of fossil Ganoids. His chief results are the following:—The enamel is no necessary component of the Ganoid-scale, and may be absent in otherwise typical Ganoids. The interpretation of the "lepidine tubes" of Williamson as traces of connective tissue fibrils is confirmed. In the various families of Ganoids the minute structure of the scales is usually characteristic. The degeneration of the enamel in the Rhynchodontidæ makes it necessary to separate this family from the others included in the sub-order of Lepidosteidei; the nearest relations are rather with the Saurodontidæ.

* Mem. R. Accad. Sci. Torino, xlvi. (1896) pp. 219-52 (1 pl.).
† Anat. Anzeig., xii. (1896) pp. 467-70 (1 fig.).
‡ Boll. Soc. Rom. Stud. Zool., v. (1896) pp. 89-96 (1 pl.).
§ Arch. f. Naturges., lxii. (1896) pp. 145-86 (2 pls.).

γ. General.

Natural Selection and Separation.*—Mr. A. E. Ortmann attempts to show that only separation can effect differentiation of species. He thinks we should distinguish four factors—(1) all organic beings vary; (2) these variations may be transmitted to descendants; (3) upon the material produced by variation and inheritance there acts Natural Selection. But (4) Natural Selection does not form species; it only preserves or transforms already existing species. "Different species are formed by bionomic separation; separation does not always imply differentiation of the conditions of life, and accordingly does not always form new species; but if there is a differentiation into species it is always due to separation under different bionomic conditions."

Specific Characters.†—Prof. R. Meldola, in his annual address to the Entomological Society of London, took occasion to discuss the utility of specific characters and physiological correlation; dealing, that is, with a question which was the subject of lively discussion during the year 1896.

Prof. Meldola's object was to suggest that physiological correlation may profitably form the subject of experimental investigation. He very justly remarks that, at present, discussions as to which out of a group of correlated characters is to be regarded as the cause of the survival of a living being are likely to prove barren. His hope is that his remarks may bring about a closer *rapprochement* between systematists and physiologists.

Nocturnal Protective Coloration.‡—Prof. A. E. Verrill points out that very little attention has been paid to the colours of animals, as seen by twilight, moonlight, and starlight. Yet many animals only move by night, and those that roost in trees, bushes, or reeds need to be protected against their foes. When looked for, it is expected that instances of nocturnal protective coloration will be found to be numerous. The author cites a few examples, and concludes that the colours have been acquired by natural selection in consequence of the protection that they afford.

Explorations in the Moluccas and in Borneo.§—Prof. W. Kükenthal has much to record concerning his visit to the Malayan region in 1893–94. The detailed description of the collections made will be given in special monographs; the first part is a general *Reisebericht.*

The plankton of the Indian Ocean was studied during the voyage. Careful observations were made of the flying-fishes, and led to the conclusion that they do move their pectoral fins a little, but only so as to alter their course.

In the littoral region of Ternate, three zones were well marked:—(1) The region of coral reef and sea-grass, very rich in species, but less thickly peopled than the arctic littoral region; (2) the almost lifeless

* Proc. Amer. Phil. Soc., xxxv. (1896) pp. 175–92.

† Trans. Entomol. Soc. Lond., 1896 (1897) pp. lxiv.–xcii.

‡ Amer. Journ. Sci., iii. (1897) pp. 132–4.

§ 'Ergebnisse einer zoologischen Forschungsreise in den Molukken und in Borneo.' I. Reisebericht. Abh. Senckenberg. Ges., xxii. (1896) 321 pp., 63 pls., 4 maps and 5 figs.

sand; and (3) the region of horny corals and sponges. About 40 new species of Anthozoa (*Alcyonium*, *Sarcophyton*, &c.) were found. Noteworthy were a number of Gastropods parasitic on Echinoderms. The second region yielded a little lancelet. A small Gephyrean was found as a commensal of a small single coral.

The author has a good deal to say in regard to the wondrous colours of the "sea-gardens"—protective colours, warning colours, mimetic colours, sexual colours—originating in the course of metabolism, influenced by environment, and fixed by selection.

The theory of the polar origin of faunas is rejected on various grounds; in fact, too simple generalisations are fallacious; distribution is a function of very numerous factors. A discussion of the Malayan distribution, e.g. of such features as Wallace's line, is full of interesting material.

But a summary of such a large work is obviously out of the question here. We must be content to congratulate the author on his magnificent and important work.

Tunicata.

Development of Anterior Portion of Salpa.*—Signor F. Todaro divides the development of *Salpa* (*S. africana maxima*) into two periods. The first period embraces the formation of the gut, the endoderm of which, completely closed, is surrounded by ectoderm. Between these two membranes, separated by mesenchyme, there arise the peribranchial sac, the cerebral vesicle, the pericardial sac, and in the chain-embryo some traces of reproductive organs. The second period is initiated by the formation of the primitive buccal cavity, and includes the differentiation of the organs mentioned above into their adult state.

The primitive buccal cavity or *palæostome* shows palingenetic simplicity in its origin. In its first stage it is an open ectodermic invagination; in a second stage the external aperture is shut, and the palæostome is a closed sac; thereafter, when the brain shows three vesicles, a communication between buccal sac and gut is effected; an opening is formed between the anterior cerebral vesicle and a dorsal diverticulum of the palæostome—the anterior neurenteric canal of Kupffer, the "palæoneural canal" of Todaro; much later, a secondary ectodermic invagination forms the stomodæum, or neostome, or definitive mouth.

The communication between cerebral cavity and palæostome is subsequently lost, the diverticulum of the latter becoming a ciliated pit, the palæoneural canal becoming a blind infundibular canal. From the infundibular vesicle are formed two hypophysial vesicles, while two ectodermic diverticula give rise to the tubular part of the hypophysial gland. Thus the *paired* hypophysial or subneural gland of *Salpa* has a double origin—from the cerebral infundibulum and from the ectoderm of the palæostome. The last thing to be formed from the palæostome is the peripharyngeal groove.

Cerebral ganglia, olfactory ganglia, eyes, and peripheral nerves are derived from a mass of indifferent cells in the cerebral region. The paired olfactory ganglia are first mapped out and separated from the cerebral rudiment; the originally small cells become large, and two nerves are given off to the ciliated pit.

* Atti R. Accad. Lincei Rend., vi. (1897) pp. 54–61 (1 fig.)

In the remaining mass continued cell-multiplication goes on. A stratum of white matter appears dividing an upper part—the optic lamina—from a larger lower part—the cerebral ganglion. From the optic lamina there differentiates in the solitary form the horseshoe-shaped unpaired eye; in the aggregate form there arise the optic spheres which give origin to the rudimentary posterior eye and the two completely developed anterior eyes.

Grey and white matter are differentiated in the brain. From a zone of large nerve-cells motor nerves arise; very small cells, present in great abundance, are probably sensory. From the anterior surface of the ganglion there arise two mixed nerves with two roots—an inferior in the large motor cells, a superior in the small sensory cells. The nerves supply the buccal muscles and the sensitive epithelium of the buccal cavity.

Tunicata of Norwegian North-Atlantic Expedition.*—The handsomely illustrated volume which deals with these forms consists of five parts. The Synascidiæ are discussed by Mr. H. Hvitfeldt-Kaas, the Ascidiæ Simplices and Compositæ by K. Bonniere, who deals also with the budding of *Distaplia magnilarva* and *Pyrosoma elegans*. Mr. J. Kiær gives a list of Norwegian simple Ascidians; while Mr. J. Hjort has an essay entitled "Germ-layer Studies based upon the Development of Ascidians."

Of the 24 species of Synascidians, a third are new to science, but the slight amount of literature on the subject has made the determination of the forms a matter of some difficulty.

Eleven species of Simple and ten of Compound Ascidians were collected by the Expedition, and most were represented by a single specimen, not always in a good state of preservation. The development of the buds of *Pyrosoma* was found to proceed according to the same laws as those which govern gemmation in the Synascidiæ; the outer vesicle has no share in the development of the bud, the most important organs being formed from the inner vesicle. The peribranchial cavities and the nervous system are not formed, as in the Synascidiæ, by a simple evagination of the wall of the inner vesicle, but this is due to the great thickness of the layer of cells. The difference between the present results and those of Seeliger may be well explained by the difficulties of the investigation of *Pyrosoma*.

Our space does not permit us to give a full account of Mr. Hjort's memoir; we must content ourselves with saying that, after describing the embryonic development of Ascidians, the bud-rudiment in the various groups, and the formation of the organs in the bud, he compares larval and bud development and discusses gemmation in Ascidians and the germ-layer theory, as well as Ascidian development and the biogenetic fundamental law.

Tunicata of the 'Caudan' Expedition.—The few Tunicata collected by Prof. Koehler in the Bay of Biscay are divided between Prof. L. Roule, who takes the simple forms,† and M. M. Caullery,‡ who deals

* Den Norske Nordhavs-Expedition, xxiii. (1896). I. 27 pp. and 2 pls.; II. 16 pp. and 2 pls.; III. 23 pp. and 1 pl.; IV. 15 pp. and 3 pls.; V. 72 pp. and 4 pls.
† Résultats Scient. de la Campagne du 'Caudan,' fasc. ii. (1896) pp. 355–8.
‡ Op. cit., pp. 359 and 60.

with the only Compound Ascidian that appears to have been collected.

The simple forms belong either to *Ascidia* or *Ascidiella*, but the sole species of the latter, *A. scabra*, has not till now been known to be more than littoral in its habitat. *Ascidia guttulata* sp. n. is very near to *A. mentula*, and appears to represent it at great depths.

M. Caullery has some instructive notes on a phase in the reconstitution of a colony of *Diazona violacea*.

INVERTEBRATA.

Brook's Collection from the West Coast of Scotland.*—Mr. T. Scott has a report on a collection of marine dredgings and other natural history materials made on the West Coast of Scotland by the late George Brook. About 344 species of Invertebrates, chiefly Mollusca, Crustacea, Echinoderma, and Foraminifera, have been determined; nearly all the Amphipods are said to be of interest. *Echinus norvegicus* was taken in the deep water of Loch Buy, Mull.

Fauna of the Kaiser Wilhelm Canal.†—Prof. K. Brandt has studied the rapid peopling of this canal (from the lower Elbe to the Bay of Kiel) with marine animals. The sea-water was admitted in May 1895, and already five animals are found throughout the whole canal (100 kilometres), viz. *Balanus improvisus, Gammarus locusta, Mysis vulgaris, Polydora ciliata*, and *Membranipora pilosa*. Others, such as the edible mussel, the cockle, *Mya arenaria*, were found only in the eastern part. Others, namely, species of *Enchytræus*, *Carchesium*, and *Vorticella*, were found only in the western part. Two freshwater forms—a Perlid and a beetle larva—were found near the opening of a stream into the canal, but otherwise freshwater forms were absent.

Mollusca.

α. Cephalopoda.

Gigantic Cephalopod.‡—Prof. A. E. Verrill has received information of an immense "Octopus" having been cast ashore not far from St. Augustine, Fla., U.S.A. The body measured 18 ft. by 10. Prof. Verrill thinks it was a Squid, which probably weighed 4 to 5 tons. In a further note § Prof. Verrill reports that he has seen photographs of this huge creature, which show that it was probably a true *Octopus* of colossal size. The revised weight is given as at least 6 or 7 tons, and "this is doubtless less than half of its total mass when living." The species appears to be undescribed, and it is proposed to call it *O. giganteus*. It is probably one of the kinds on which the sperm-whale regularly feeds.

Embryology of Nautilus.‖—Dr. A. Willey has been successful in observing the first stages of the ova of *Nautilus macromphalus* at Lifu. The eggs are laid singly and at night in concealed situations; they are

* Proc. Roy. Phys. Soc. Edinb., xiii. (1896) pp. 166–93 (1 pl.).
† Zool. Jahrb. (Abth. Syst.), ix. (1896) pp. 387–408 (2 maps).
‡ See Ann. and Mag. Nat. Hist., xix. (1897) p. 240.
§ Amer. Journ. Sci., iii. (1897) pp. 162–3.
‖ Proc. Roy. Soc. Lond., lx. (1897) pp. 467–71 (6 figs.); and Nature, lv. (1897) p. 402 and 3 (6 figs.).

enclosed in two capsules of a milk-white colour and cartilaginous consistency. The egg, with its outer covering, may be as much as 45 mm. long; the yolk is of a rich-brown colour and very fluid; the large quantity present points to the occurrence of a long period of incubation. The breeding of this creature, as of so many other forms, appears to be subject to a definite law of periodicity.

γ. Gastropoda.

Yolk-Lobe and Centrosome of Fulgur.*—Prof. J. Playfair M'Murrich described some years ago (1886) the occurrence of a single large yolk-nucleus in *Fulgur carica*, but he now finds that this was a mistake. What he took to be a large polar globule is simply a small yolk-lobe comparable to that which occurs in many Gastropods. There are two or three true polar bodies. He describes the centrosomes and "astrocœls" observed at the stage preparatory to the appearance of four cells, and notes that the rapid increase in size of centrosomes and astrocœls begins just when the formation of the equatorial plate is completed, i.e. just when the movement of the chromatin towards the equator of the spindle ceases.

The Genus Doriopsilla.†—Dr. R. Bergh established this genus in 1880, on the strength of two specimens from Lesina, in Dalmatia, but he has not until recently been able to procure any others. Two more have been found by Dr. A. Nobre (Foz do Douro-Porto), and their distinctiveness from *Doriopsis* is confirmed. They are stiff and almost brittle animals, and the back has a granular appearance, thus differing from the soft and smooth-backed *Doriopsis*. The buccal ganglia, instead of being behind the central system, are shunted forwards towards the end of the suctorial apparatus. A general description is given.

δ. Lamellibranchiata.

Dreissensia polymorpha.‡—Prof. J. Frenzel maintains, on the basis of many observations, that the colonies of *Dreissensia* can move *en bloc*, without separation of the individuals being necessary. When winter approaches the colonies move gradually from the shallower regions, and no isolated individuals are to be found.

As to the actual movement, Frenzel notes that the young forms have three modes of motion:—(1) they fix their foot and draw the body after it; (2) they push their way with their foot behind; and (3) they clap their valves. The movement of the colony is probably altogether due to the younger members, for the foot eventually degenerates. Perhaps the strangest fact is the apparent unanimity within the colony, whose bond is little more than that of chance association. The author acutely suggests that the dissenting members break themselves off.

Anatomy of Sphærium soleatum.§—Mr. G. A. Drew has recently sent us a short account of the anatomy of this Cyrenid, which is intended as an introduction to an account of the comparative anatomy of the

* Anat. Anzeig., xii. (1896) pp. 534–9 (4 figs.).
† Zool. Jahrb. (Abth. Syst.), ix. (1896) pp. 454–8.
‡ Biol. Centralbl., xvii. (1897) pp. 147–52.
§ Proc. Iowa Acad. Sci., iii. (1895) pp. 173–82 (3 pls.).

Cyrenidæ. The byssal gland is much reduced, the inner gills alone function as brood-pouches; digestion is thought to be a continuous process, and it has seemed worth while to put on record that "the regular three pairs of Lamellibranch ganglia are present."

Bryozoa.

Notes on Cyclostoma.*—Mr. S. F. Harmer is able to confirm the normal occurrences of embryonic fission in these forms by an account of *Idmonea serpens*, the ovicell of which is shown to be a modified zoœcium.

Dealing next with the lately expressed view of Dr. J. W. Gregory that there are no true genera among Cyclostoma, Mr. Harmer urges that that naturalist has not sufficiently noticed the ovicells, the value of which in classification has been urged by Mr. Waters and himself. Dealing with various recent species the author shows that they may be distinguished by means of their ovicells, and he expresses the opinion that it is possible to draw precise diagnoses of recent Cyclostomatous genera. There is probably a law of growth common to all recent species.

Eschara lapidescens van Baster.†—Mr. R. T. Maitland discusses this calcareous zoarium from the brackish water of Zeeland. It seems—so far as we understand the paper—to be a form of *Membranipora;* but the author points out that neither Lamarck, nor Johnston, nor Hincks, nor P. J. van Beneden have taken knowledge of van Baster's observations (1759).

Arthropoda.

Tegumentary Innervation in Arthropods.‡—Herr E. Holmgren refers to his work (published in Swedish §) on the integument of caterpillars. The larger nerves show an arborescent branching, the smaller are dichotomous. The fine twigs end partly in bipolar sensory nerve-cells, the unbranched terminal process of which runs out into a hair or passes between two epidermic cells up to the cuticle. In caterpillars there seems to be no trace of a ganglionic grouping of nerve-cells such as is often seen in Crustaceans; and another difference is that the nerve-cells in caterpillars are much more superficial. Most of the hairs on the body are provided with sensory nerve-cells; they are at once glandular and sensitive. Sometimes, as Rina Monti has also shown, the nerve-cells in the skin of insects are multipolar, and a plexus arrangement, as in Ctenophora, is sometimes demonstrable. Like Retzius and vom Rath, the author has found only bipolar sensory nerve-cells in the Crustacean skin. Ramified connective and pigment-cells may be seen sending processes into the hairs. Perhaps the multipolar nerve-cells described in *Astacus* by Bethe are really connective.

a. Insecta.

Larvæ of British Butterflies and Moths.‖—Mr. G. T. Porritt continues the editing of the late William Buckle's work; this, the seventh,

* Proc. Cambridge Phil. Soc., ix. (1897) pp. 208–14.
† Tijdschr. Nederland. Dierk. Ver., v. (1896) pp. 10–14.
‡ Anat. Anzeig., xii. (1896) pp. 449–57 (7 figs.).
§ K. Svensk. Vetenskaps-Akad. Handl., xxvii. (1895) No. 4.
‖ London, printed for the Ray Society, 1897, xv. and 176 pp., pls. cvi.–cxxvii.

volume deals with part of the Geometræ. It is too late in the day to praise the plates, the excellence of which is known to every entomologist. The volume concludes with a list of parasites bred from larvæ or pupæ included in this part; of these there are more than one hundred.

Larvæ of the Higher Bombyces.*—Mr. Harrison G. Dyar describes the larval setæ of the Bombycides (this older name must be used instead of Noctuina or Agrotides), and applies his results to taxonomic purposes. He gives a genealogical tree of the family, and appends a synopsis of the superfamilies of Lepidoptera.

Mandibular Glands of Cossus ligniperda.†—M. Maurice Henseval describes the mandibular glands enormously developed in the larvæ of *Cossus ligniperda*. They open at the internal angle of the mandible; they include a secretory portion, a reservoir, and a duct; and they probably correspond to the coxal glands of *Peripatus*. The secreting part is lined by a cuticle like that in Gilson's glands in the Trichoptera. Like these, they secrete a substance oily in appearance, containing an aromatic nucleus, and composed of carbon, hydrogen, and sulphur in the proportions $C_{22}H_{35}S$. The substance does not attack wood, nor is it toxic; but it is perhaps protective against certain fungi, and against insects with parasitic larvæ. In another paper ‡ the author discusses more fully the physical and chemical characters of the secretion.

Structure of Nuclei in Spinning Glands of Caterpillars.§—Dr. F. Meves finds that the nuclei of these glands are extraordinarily rich in chromatin. This is in the form of small, almost equal-sized granules (Korschelt's microsomes), and exceptionally in clumps. But the nuclei also contain an unusual number of nucleoli (Korschelt's macrosomes), often several hundreds. These are frequently irregular in form, angular, spindle-shaped or rod-like, and may contain a large vacuole or several small vacuoles.

Abdominal Appendages.‖—Herr R. Heymons shows that there is very little evidence—either anatomical or embryological—in support of the opinion, held by Verhoeff for example, that gonapophyses are derivable from locomotor appendages. The styles seem to be skin processes replacing appendages; the cerci and the antennæ are on a higher level retaining vestiges of their appendicular nature. But what Heymons makes clear is that no strict line can be drawn between hypodermic processes and appendages. The facts of nature will rarely admit of rigid distinctions.

Cynips Calicis.¶—Herr M. W. Beijerinck discusses the formation of galls and the alternation of generations in the case of *Cynips calicis*. He has shown that the *Cynips calicis* of the *Stielleiche* (*Quercus pedunculata*) has as its second generation *Andricus cerri* of the *Zerreiche* (*Quercus cerris*). He describes what he has observed of this heterogenesis and the development of the galls. A digression is then made to discuss the

* Proc. Boston Soc. Nat. Hist., xxvii. (1896) pp. 127–47.
† La Cellule, xii. (1897) pp. 19–29 (1 pl.).
‡ Tom. cit., pp. 169–83.
§ Arch. f. Mikr. Anat., xlviii. (1897) pp. 573–9 (1 pl.).
‖ Biol. Centralbl., xvi. (1896) pp. 854–64.
¶ Verh. K. Akad. Wetenschap. Amsterdam, v. (1896) pp. 1–43 (3 pls.).

circulans-gall due to *Andricus circulans* in whose life-history heterogenesis is also probable, though not exactly demonstrated.

Of galls in general the author notes that the higher the final differentiation, the younger must be the initial cells of the vegetable tissue which are affected by the animal excreta. All Cynipid-galls arise from a group of vegetable cells, 250–2000 in the case of *Cynips calicis*. Any theory of the formation of the gall must keep in view the diffusion of the irritant substance through a cell-complex. The facts seem to Beijerinck to show that variation is a function of multicellular relations in the case of most galls. It seems to us that most biologists would regard galls as phenomena of modification rather than of variation, but the author is no doubt right in emphasising their importance in connection with the general problems of organic growth and organic change.

Coloration of Scales in Beetles.*—Sig. A. Garbasso has been investigating the physical coloration of certain insects, but has, he notes, been in part forestalled by Walter's book on *Schillerfarben*. In this paper he confines himself to a description of the structure of the scales in the Curculionid *Entimus imperialis*, and to showing that its brilliant colours are due to phenomena of interference.

Life-History of Dendroctonus micans.†—MM. A. Menegaux and J. Cochon call attention to the biology of this largest of xylophagous insects, which was unknown fifty years ago, and was long thought to be innocuous. The great danger connected with it is that it never attacks dead trees or trunks, but always healthy trees; a tree weakened by it may be subsequently attacked by other xylophagous forms, such as *Bostrichus*.

Abdomen of Scolytidæ.‡—Dr. C. Verhoeff has studied the abdomen of Scolytidæ, with special reference to the work of Prof. C. Lindemann (1875) on the same subject, and with general reference to the morphology of the insect-abdomen.

As the tersest possible summary of his results fills three pages, we cannot do more than refer to the general tenor of Verhoeff's paper.

Bees Intoxicated with Honey.§—Mr. J. L. Williams describes the remarkable effect produced on humble-bees by the honey of certain flowers with dense capitulate inflorescence belonging to the Compositæ and Dipsacaceæ:—*Centaurea nigra*, *C. scabiosa*, *Carduus lanceolatus*, *C. nutans*, and *Scabiosa succisa*. The species chiefly observed were neuters of *Bombus lapidarius*. After extracting the honey, the insect suddenly turned on its side and moved the second pair of legs convulsively in the air; some even turned on their backs and rolled on the flowers. After a time a few tried to fly away, but their wings seemed powerless to raise them into the air, and they fell on the ground instead. As a rule, when driven away, they were eager to return. During this proceeding the bees invariably became covered with pollen, and the author suggests that the habit may be useful to the flower in promoting cross-pollination.

* Mem. R. Accad. Sci. Torino, xlvi. (1896) pp. 179–86 (1 pl.).
† Comptes Rendus, cxxiv. (1897) pp. 206–9.
‡ Arch. Naturges., lxii. (1896) pp. 109–44 (2 pls.).
§ Journ. Bot., xxxv. (1897) pp. 8–11.

Italian Coccidæ of Fruit-Trees.*—Prof. A. Berlese deserves to be congratulated on his memoirs dealing with Coccid insects living on fruit-trees in Italy. These insects are interesting in their structure and life-history; they are not less interesting to the practical man whose orchards they infest. Both aspects receive due consideration from Prof. Berlese, who furnishes on the one hand a most detailed morphological account, and on the other hand what we may call a system of practical lore. As will be seen from our reference the abundance of illustrations is a feature of these memoirs. The first deals with the genus *Dactylopius*, with two species, *D. citri* Risso and *D. longispinus* Targ. Tozz. The second deals with the genus *Lecanium*, with two species, *L. hesperidum* Linné, and *L. oleæ* Bernard. The third deals with six species of Diaspitidæ—*Mytilaspis fulva* Targ. Tozz., *M. pomorum* Bouchè, *Parlatoria Zizyphi* Lucas, *Aspidiotus dimonii* Signoret, *A. Ficus* Riley, and *Aonidiella Aurantii* Mask.

Buccal Glands of Larval Trichoptera.†—M. Maurice Henseval finds that the larvæ of Trichoptera may exhibit at the base of their masticulatory organs one or two pairs of glands with intracellular canals. They were absent in the Phryganid larvæ examined, but these have "Gilson's glands" much developed. The organs in question probably represent the coxal glands of the anterior metameres.

How Flowers attract Insects.‡—Pursuing his researches on this subject, Prof. F. Plateau has come to a different conclusion from that of Darwin, who held that it is chiefly the bright colour of the corolla that attracts insects to flowers for the purpose of pollination. His experiments were made chiefly on *Dahlia variabilis* (single), *Lobelia Erinus*, *Œnothera biennis*, *Delphinium Ajacis*, *Ipomæa purpurea*, *Centaurea Cyanus*, and *Digitalis purpurea*. In the case of the *Dahlia* and other Compositæ the removal of the conspicuous ray-flowers had very little effect in diminishing the number of insects which visited them; these cannot therefore play the part of signals or banners attributed to them by Darwin and others. Similar results were obtained by removing the conspicuous part of the corolla in the other flowers which were subjected to observation. Covering up of the flower by leaves also had but little hindering effect on the visits of insects. The author concludes that insects are attracted to flowers chiefly by some other sense than that of sight, probably by that of smell.

Prof. Plateau further states as the result of experiments on these points, that insects visit indifferently flowers of different colours belonging to the same species; § that they light without hesitation on flowers habitually neglected when these are artificially supplied with honey; and that they at once cease their visits to the customary flowers when the nectary has been removed from them.

* Part I. ex Rivista Patologia Vegetale, ii. (1893) 106 pp., 3 pls. and 45 figs.; Part II. ex op. cit., iii. (1894) 201 pp., 12 pls.; Part III. ex op. cit., iv. and v. (1896) 477 pp., 12 pls. and 200 figs.

† La Cellule, xii. (1897) pp. 7–15 (1 pl.).

‡ Bull. Acad. R. Sci. Belgique, xxx. (1895) pp. 466–88; xxxii. (1896) pp. 505–34 (1 pl.); xxxiii. (1897) pp. 17–41. Cf. this Journal, 1896, p. 305.

§ Similar results were obtained by Mr. A. W. Bennett (Journ. Linn. Soc.; Zool., xvii. (1883) p. 175).

Mallophaga from Land-Birds.*—Prof. V. L. Kellogg not only describes some new Mallophaga from American land-birds, but gives an account of the mouth-parts of these ectoparasites.

The parts in question are found to be distinctly fitted for biting; there is nothing which lends any probability to the old theory that the Mallophaga suck their food. The author has, indeed, seen these parasites biting off and eating bits of feathers, and the crop always contains tiny bits of feathers.

The Mallophaga seem to certainly belong to the group Platyptera, and it is, therefore, with other members of that group that the author compares their mouth-parts. There is a peculiar and interesting similarity of mouth-structures between the Mallophaga and the Psocidæ; the latter, it is important to note, have somewhat similar feeding habits to the former, for they live on dry dead organic matter, such as wood and paper, dried insects, dried bird and mammal skins.

The author concludes with a list of hosts and parasites.

δ. Arachnida.

Hydrachnida of Germany.†—Dr. R. Piersig has published the first part of a beautifully illustrated monograph on the Hydrachnida of Germany. He gives a history of previous researches dealing with this group. The family Hydrachnidæ is divided into five sub-families:—Hygrobatinæ, Hydryphantinæ, Eylaïnæ, Hydrachninæ, and Limnocharinæ. The Hydrachnidæ live wholly in water, almost all in fresh water. They are marked by the compressed body, unsegmented trunk, 5-jointed palps, and 6-jointed feet usually ending in a double claw. The mouth-parts form a suctorial proboscis; the mandibles are distinctly 2-jointed except in Hydrachninæ. There are four anterior lateral eyes, usually fused into a double eye on each side; and there may also be an unpaired median eye-spot. There are two tracheal stigmata above the mouth-opening, leading into air-reservoirs, and thence (except in *Atax*) into tracheæ. In addition a skin respiration is probably general. There is no heart nor vascular system. The alimentary system has marked resemblances with that of Trombidia. A ganglionic mass pierced by the gullet represents brain and nerve-cord. The sexes are separate and the females oviparous. The animals live on Crustaceans, dipterous larvæ, and Infusorians. They are very hardy; thus many can resist considerable salinity. Their distribution seems mainly due to insects.

Structure of Gamasidæ.‡—Sig. F. Neri describes the common *Dermanyssus gallinæ* Redi; the soft, depressed, oval body; the membranous, transparent, slightly chitinised integument; the variable coloration, partly depending on the contents of the gut; the rapid movements of the four pairs of limbs; the strongly developed striped muscles; the rostrum, buccal cavity, pharynx, œsophagus, stomach, stomachic diverticula, and intestine; the tracheal respiration; the two dorsal tubes which seem to be excretory; the sexual differences; the copulation; the

* Proc. Calif. Acad. Sci., vi. (1896) pp. 431–548 (14 pls.); also separately Leland Stanford jr. University.

† Bibliotheca Zool. (Leuckart and Chun), Heft 22, pp. 1–80 (8 pls.), Stuttgart, 1897.

‡ Atti Soc. Tosc. Sci. Nat., x. (1896) pp. 126–38.

colourless elliptical ova; the larvæ and the nymphs. A detailed account with figures is forthcoming.

Pseudo-Larval Copulation of some Sarcoptidæ.*—M. S. Jourdan has made a study of three forms of plumicolous Sarcoptids, often found on the domestic pigeon. In these forms the male copulates with an octopod larva, which has no sexual apparatus; this paradoxical arrangement cannot be understood till it is seen that beneath the skin of the larva a perfect female is being formed, and it is into this that the fertilising fluid passes; hence the suggested term "pseudo-larval."

Halacarina of the 'Caudan' Expedition.†—Dr. E. Trouessart has a full and interesting report on the marine Acarina collected by Prof. Koehler in the Bay of Biscay; they are the first of their kind known from great depths, and these latter extended from 180 to 1410 metres. They were chiefly found attached to *Amphihelia prolifera* and *Solenosmilia variabilis*; when these corals fail the halacarine fauna becomes excessively poor. As a fact, examples were dredged at five stations only, and representatives of new species were out of all proportion more numerous than those of old; by far the most abundant was *Halacarus abyssorum* sp. n.; there is a single representative of a new genus, *Atelopsalis tricuspis* sp. n.

The halacarine fauna of great depths is remarkable for the complete absence of phytophagous types, the scarcity of predacious or carnivorous forms, the frequency of types with a feeble rostrum and styliform palps, the thinning of the chitinous integument, and the variations in the development of the eyes.

Pycnogonida of the 'Caudan' Expedition.‡—M. M. Caullery reports on the three Pycnogonids collected by Prof. Koehler in the Bay of Biscay. One of these, *Paranymphon spinosum*, is a new genus and species, but it is to be observed that the sole distinguishing generic character given is the presence of six joints to the palp instead of five, as in *Nymphon*.

ε. Crustacea.

Functions of certain Diagnostic Characters of Decapod Crustacea.§—Mr. W. Garstang discusses the value of certain characters used by systematists to distinguish species and genera. For example, the frontal area of Crabs is frequently either 3- or 5-toothed, that is, either 2- or 4-notched. This is an arrangement by which the antennæ and antennules, which are organs of great importance, are specially protected against injury. In sand-burrowing species the denticulated margins have the function of sieves.

It is not, says the author, generally known that a crab's chelipeds are in many cases important agents in the process of respiration; this is explained and illustrated.

It appears, to conclude, that many of the specific and generic characteristics of Crustacea, which have been hitherto regarded as features of trivial significance, are really of primary importance to their possessors.

* Comptes Rendus, cxxiv. (1897) pp. 209 and 10.

† Résultats Scient. de la Campagne du 'Caudan,' fasc. ii. (1896) pp. 325–53 (3 pls.).

‡ Tom. cit., pp. 361–4 (1 pl.).

§ Rep. Brit. Ass., 1896, 2 pp. (sep. copy).

Crustacea of the 'Caudan' Expedition.—M. J. Bonnier * gives an account of the Hedriophthalmia collected by Prof. Koehler in his deep-sea dredgings in the Bay of Biscay. Of the fifty-two species collected many are new, but we notice that a number of them are based on single specimens, and many of the examples are said to be considerably injured. Specimens were taken from depths varying from 200 to 1700 metres. There are three new genera of Cumacea, two of Isopoda, and two of Amphipoda.

In conclusion the author describes a new Copepod of the family Choniostomatidæ, which was taken from the branchial apparatus of a Cumacean; this is, it would seem, the first time that a member of this family has been observed to lead a parasitic life.

The Schizopoda and Decapoda † found during the expedition were entrusted to M. M. Caullery, who has distinguished forty-eight species, five of which are new and representative of two new genera and one subgenus. A number of the already described forms have not till now been known to inhabit the Bay of Biscay.

The Copepoda ‡ generally fell to the care of M. E. Canu, who reports on a small but interesting collection, which is attractive as leading to the hope that a large number of interesting additions will be made to the "French Oceanic Fauna," when a more complete and methodical study is made of the pelagic life of the French shores. *Neoscolecithrix* is a new genus formed for *N. Koehleri* sp. n.

Embryonic Nervous System of Crustacea.§—M. N. de Zograf has made a fresh investigation of this system in the Nauplius of fresh-water Copepods by the aid of the method of Ramon y Cajal. He has found by it, under the chitinous covering layer, special cells arranged in the same way and in the same places as he found by the aid of methylen-blue. These cells are continued into long nervous filaments, which are connected with one another by very thick branches, and which terminate in the sub-œsophageal ganglion. In one exceedingly successful preparation the author can demonstrate two rows of subcuticular cells, connected with one another by the branchings of their filaments.

Entomostraca of Lake Mezzola.‖—Dr. N. Rizzardi gives a list of these in an appendix to Prof. P. Pero's recent monograph on the lake in question. There are eight pelagic species, including *Linceus sphæricus* and *Cypris ovum*, said to be rare in Italy. The genus *Daphnia* seemed to be unrepresented.

Revision of Cladocera.¶—M. J. Richard has undertaken and completed a work for which he will receive the thanks of microscopists. Dealing, as it does, freely with details, we cannot do more than call the attention of our readers to it. The extent of the author's work may be somewhat estimated by the fact that he cites no less than 587 titles in his bibliography, which is brought down to 1896.

* Résultats Scient. de la Campagne du 'Caudan,' fasc. iii. (1896) pp. 527–689 (13 pls.).

† Op. cit., ii. pp. 365–419 (5 pls.). ‡ Op. cit., ii. pp. 421–37.

§ Comptes Rendus, cxxiv. (1897) pp. 201–3.

‖ Boll. Soc. Rom. Stud. Zool., v. (1896) pp. 126–9.

¶ Ann. Sci. Nat., ii. (1896) pp. 187–363 (6 pls.).

Annulata.

Marine Annulata of the 'Caudan' Expedition.*—Prof. L. Roule reports that fifty species were collected by Prof. Koehler in the Bay of Biscay, but nearly a third of them cannot, for various reasons, be determined; this is especially the case with the tubicolar forms. There are only five new species, and three new varieties; the facts of bathymetric distribution recall what has been observed in other groups of animals.

Polychæta of the Netherlands.†—Dr. R. Horst gives a list of forty-one species of Chætopoda (including *Sagitta bipunctata*) known to belong to the Netherlands. It is interesting to compare it with the British list.

North American Oligochæta.‡—Mr. F. Smith has notes on various earthworms collected at Havana, Ill., by the University of Illinois Biological Station. Additional information to that of Ude, whose specimens were poorly preserved, is given concerning *Geodrilus singularis*; corrections are made in the account of *Diplocardia riparia*, first described by the author. *Thinodrilus* is a new genus formed for *T. incrustans*, a Lumbriculid from Quiver Lake. *Mesopodrilus asymmetricus* is another new Lumbriculid from the same lake.

Oligochæta of South America.§—Mr. F. E. Beddard has a report on the Naidæ, Tubificidæ, and Terricolæ collected by the Hamburg Expedition to the Strait of Magellan. The material was in excellent condition for microscopic examination, and the author has been able to describe a number of new forms. *Hesperodrilus* is a new genus with four new species, and a large number of *Acanthodrilus* are described; in all seventeen species of that genus are recorded. *Microscolex* is also well represented.

Lymphocytes of Earthworms.‖—Dr. D. Rosa distinguishes and describes four different kinds of lymphocytes in Oligochæta:—(1) In *Allolobophora rosea* (= *A. mucosa*) there are non-amœboid mucous elements; (2) in *A. fœtida*, *A. chlorotica*, &c., there are non-amœboid oily elements (*eleociti*); (3) a third type is distinguished as vacuolar; and (4) there are the ordinary amœboid lymphocytes.

Unpaired Gland of Hæmentaria.¶—Herr H. Bolsius describes a peculiar gland which lies above the proboscis of *Hæmentaria officinalis*, a leech which, though without teeth or tooth-plates, seems to be used for medicinal purposes in Mexico. The posterior part of the gland is delicate and coiled, the middle part is large and straight, the anterior part is an efferent canal which bifurcates behind the cerebral ganglia, re-unites its branches, and ends on the upper lip. It is peculiar in being unpaired. Its lumen seems to be intra-cellular. Its cells are remark-

* Résultats Scient. de la Campagne du 'Caudan,' fasc. iii. (1896) pp. 439–71 (7 pls.).

† Tijdschr. Nederland. Dierk. Ver., v. (1896) pp. 15–28.

‡ Bull. Illinois State Lab. Nat. Hist., iv. (1895 and 6) pp. 287–97, 396–413 (4 pls.).

§ Hamburg, L. Friederichsen & Co., 1896, 8vo (sep. copy), 62 pp. and 1 pl.

‖ Mem. R. Accad. Sci. Torino, xlvi. (1896) pp. 149–78 (1 pl.).

¶ La Cellule, xii. (1897) pp. 101–12 (1 pl.).

able in showing a preponderance of the circular (as opposed to radial and longitudinal) components of the cytoplasmic trabecular framework.

"Urns" of Sipunculus.*—MM. J. Kunstler and A. Gruvel have traced the history of these peculiar bodies found in the perivisceral fluid of *Sipunculus nudus*. Some have regarded them as parasitic Infusorians, but that they are in reality free epithelial cells has been proved by Brandt, Ray Lankester, Cuénot, and others.

The normal "urn" most frequently seen is but one stage in a series. It becomes a disc, and gives rise to amœboid cells, which gradually grow into urns. The authors also describe the "enigmatic vesicles" found along with the urns, but, as they confess, it is very difficult to follow the complex transformations without figures, for which we must wait.

Rotatoria.

Locomotor Apparatus of Rotifers.†—M. N. de Zograf finds in all the Rotifers which he has examined that the cells which carry the vibratile cilia are connected by nerve-filaments with the nerve-ganglion of these animals; *Floscularia* and *Stephanoceros* are said to be exceptionally interesting, as the cells in question show very markedly the characters of distinct nervous cells.

Nematohelminthes.

The Genus Ascaris.‡—Prof. M. Stossich has published a systematic monograph of the genus *Ascaris*. The list of species amounts to 218, and the list of hosts to 432. This compact account should prove useful to workers in this difficult field.

Life-History of Ascaris lumbricoides.§—Dr. G. Brandes notes that almost all the text-books are misty in regard to the mode in which man is infected by this common parasite, while others cite von Linstow's (quite theoretical) opinion that *Julus guttulatus* is the intermediate host. But in 1881 Prof. Grassi showed by experiment on himself that direct infection by eggs was effective. In 1888, Lutz showed the same, if the external shell is preserved. With this Davaine (1877) also agrees. Further experiments by Lutz and by Epstein (1892) were quite conclusive; and the results got by Epstein also show that mature females may develop in 10–12 weeks.

To this we may add that Prof. Stossich, in his monograph on *Ascaris*, credits von Linstow with suggesting that *Polydesmus complanatus* (as well as *Julus guttulatus*) as an intermediate host, while he mentions Calandruccio (1889?) as having experimentally proved the effectiveness of direct infection.

Ascaris megalocephala as Cause of Death.‖—Herr Graefe describes the case of a seven-year-old horse which suffered from progressive emaciation and cramps. A post-mortem examination revealed peritonitis, caused by two maw-worms (*Asc. megalocephala*) which had perforated the wall of the intestine. In the small intestine, the mucosa of which

* Comptes Rendus, cxxiv. (1897) pp. 309–12. † Tom. cit., p. 203.
‡ Boll. Soc. Adriat. Sci. Nat. Trieste, xvii. (1896) pp. 9–120.
§ Biol. Centralbl., xvi. (1896) pp. 839–41.
‖ Deutsche Tierärztl. Wochenschr., 1896, pp. 29–30. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) p. 932.

was much inflamed, were found a couple of pailfuls of *Ascarides*. There were none in the large gut. In the stomach was about another pailful of worms which had probably migrated there after death.

Simondsia paradoxa in the Stomach of Wild Boars.*—Sigg. V. Colucci and L. Arnone found in the stomachs of three wild boars numerous *Simondsia paradoxa*. The males were not free in the stomach, for the middle part of the body lay beneath the mucosa from which the ends projected. The authors believe that Cobbold confused the male of *Spiroptera strongilina* with that of *Simondsia paradoxa*. The latter has not two spines and two lobes on the tail. The posterior end of the female is mulberry-shaped. The histology of the worms is described at some length.

In the streams of the woods inhabited by the boars the authors found some nematode larvæ 0·65 mm. long and 0·02–0·025 mm. broad, devoid of sexual organs but possessed of a digestive system very similar to that of *Simondsia paradoxa*. The posterior end is thick and globose. The authors believe that they had to deal with a female of *Simondsia paradoxa*.

Helminthological Notes.†—Dr. M. Stossich notes seven worm-parasites from a large specimen of *Orthagoriscus mola*. The list includes *Anchistrocephalus microcephalus* Rudolphi, *Dibothriorhynchus gracilis* Wagner, and *Echinostoma lydiæ* Stossich.

In another paper‡ he records the occurrence of about eighty forms, e.g. *Ichthyonema filiformis* Stossich in the ovary of *Pagellus erythrinus* and *Trachinus draco*, *Strongylus ersiliæ* Stossich in a python, *Distoma vallei* Stossich in *Falco subbuteo*, and so on.

Platyhelminthes.

Excretory Organs and Blood-Vascular System of Tetrastemma græcense.§—Dr. L. Böhmig has a preliminary account of this freshwater Nemertine which he has found in abundance at the Botanic Garden at Graz. On either side of the body there is a system of clear, arborescent, and interconnected canals which extends through the whole length of the worm. At the anterior end of the body there is a single larger canal which ends in a fine closely-meshed plexus of very small vessels. The excretory organs may be considered under the three heads of terminal canaliculi connected with the terminal organs, connecting canals, and primary canals; these are all briefly described. There is not the close connection between the nephridia and the blood-vessels in *T. gracense*, which Bürger has described for the marine Metanemertines.

The blood-vascular system consists of two lateral and one dorsal vessel; anteriorly the latter opens into the right lateral vessel, and posteriorly into the anal commissure of the two lateral vessels.

Notes on Trematoda.‖—Herr P. Mühling describes *Distomum flexuosum* Rud. from the intestine of the mole; *D. longicauda* Rud. from the

* Mem. R. Accad. d. Sci. dell' Ist. di Bologna, serie v. tomo vi. (1 pl.). See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xxi. (1897) p. 215.

† Boll. Soc. Adriat. Sci. Nat. Trieste, xvii. (1896) pp. 189–91 (1 pl.).

‡ Tom. cit., pp. 121–36 (2 pls.).

§ Zool. Anzeig., xx. (1897) pp. 33–6.

‖ Arch. f. Naturges., lxii. (1896) pp. 243–79 (4 pls.).

gall-bladder of the grey crow; *D. hians* Rud. from the gullet of the white stork; *D. tenuicolle* Rud. from the liver of the grey seal; *D. cirratum* Rud. from the intestine of the carrion crow; *D. platyurum* sp. n. from the intestine of the long-tailed duck (*Harelda glacialis*); and *Cyathocotyle prussica* g. et sp. n. from the same.

Tænia Botrioplitis in the Intestine of the Fowl.*—*Tænia botrioplitis* is a tapeworm discovered by Piana, and is, says Herr G. Scagliosi, from 50 to 200 mm. long, has a circlet of hooks and roundish suckers on its head. The neck is unsegmented, and there are sexual organs in each of the proglottides of the segmented body. This specimen of *Tænia* was found by the author in numerous small nodules in the serosa of a fowl, the head of the worm being buried in the nodule. Microscopical examination of the gut in the neighbourhood of the *Tænia* showed necrosis of the intestinal wall, associated with a small-celled infiltration and the presence of giant-cells. In those nodules which contained no worm the necrosed parts had become encapsuled in connective tissue, and hung by a pedicle attached to the outer wall of the intestine.

Nervous System of Ligula in its Relations to the Arrangement of the Musculature.†—Herr M. Lühe has shown that the longitudinal muscles of *Tæniæ* can always be differentiated into an inner, an outer, and a subcuticular layer, and that the two latter have a common origin. Similar relations are found in the *Bothriocephali*, though in them the separation of the muscular layers is much less obvious than in the *Tæniæ*. Yet in *Ligula* the inner layer of muscle is somewhat sharply differentiated from the outer. This is owing to the position of a band of longitudinal nerves which separate the two layers of muscle. The nerves of this separating layer are connected with one another and with the main lateral nerves by commissures. Owing to this, the nervous system of *Ligula* is much more complicated and more nearly approaches that of the *Trematoda* than has been hitherto supposed. The observation is all the more noteworthy, inasmuch as, up to the present, commissures uniting the longitudinal nerves have been found only in a few Cestoda.

Ctenoplana.‡—Dr. A. Willey has been able to make an interesting and important study of this remarkable genus, which presents affinities both to the Turbellaria and the Ctenophora.

The most important generalisation to which the author is led is that the group Bilateralia have had a diphyletic origin, and he exhibits his results in the following table:—

O	Archiplanoidea	Ctenophora
		Platyhelminthes
	Cerianthidæ	Anthozoa
		Cœlomata

* Virchow's Arch. f. Path. Anat., cxliv. pt. iii. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xxi. (1897) pp. 35–6.

† Zool. Anzeig., 1896, No. 511. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) p. 931.

‡ Quart. Journ. Micr. Sci., xxxix. (1896) pp. 323–42 (1 pl.).

One advantage of this view is, the author urges, that theories which at one time "appeared to be logical necessities, will be quite ruled out of the field of possibilities."

The new group Archiplanoidea is for the reception of the families Cœloplanidæ and Ctenoplanidæ. Off New Guinea the author found, at any rate, one new species of *Ctenoplana*, and as his specimens were active, he was able to see that the ctenophoral plates are the sole organs of locomotion. The circlet of sensory tentacles was found to consist of two distinct and separate halves, and this observation is crucial for deciding upon the homologies of the axes of *Ctenoplana* with those of other bilateral animals. Cilia do not appear to be as generally distributed as Korotneff thought.

Dr. Willey was so fortunate as to discover the male genital organs of this creature. The author thinks he has proved that—

(1) The tentacle axis of *Ctenoplana* = the longitudinal axis of Planarians.
(2) „ stomachal „ „ = the transverse „ „
(3) „ main axis of *Ctenoplana* and Ctenophores = the dorsoventral axis of Bilateralia.

Ctenoplana would, finally, appear to be an ancestral form, and not a highly modified creeping Ctenophore.

Echinoderma.

Embryology of Starfish.*—Mr. S. Goto has a preliminary note on the development of *Asterias pallida*, which he has studied at Newport, R.I. From a careful examination of the axes of the larva the author concludes that the oral side of the adult is the anterior, the aboral the posterior, the madreporic (interradius) the dorsal, and the side opposite this the ventral, side of the larva. Both definite mouth and anus are new formations. With Mr. Bury the author distinguishes four portions in the body-cavity of the larva. The formation of the water-vascular ring is found to be not a mechanical result of the breaking through of the adult mouth, for this ring exists as such some time before the mouth is formed.

In agreement with both Mr. Bury and Mr. M'Bride, Mr. Goto distinguishes sharply the pore-canal and the stone-canal. There is a stage when the first of these alone is present; the two canals are, probably, distinct phylogenetically, and, in comparing Echinoderms with Enteropneustans it seems right that the pore-canal alone should primarily be taken into consideration. It seems likely that the openings of these canals into the body-cavity persist throughout life in all starfishes.

Bury's "dorsal organ" arises as a tube from the left posterior enterocœl, and, as M'Bride has taught, it forms the periœsophageal portion of the body-cavity of the adult. The perihæmal spaces (with the exception of the inner ring) as well as the peribranchial spaces are reported to be of true schizocœl origin.

Echinocystis and Palæodiscus.†—Dr. J. W. Gregory has some very interesting observations on these two enigmatical Echinoderms; he

* Proc. Amer. Acad. Sci., xxiii. (1896) pp. 333–5.
† Quart. Journ. Geol. Soc., liii. (1897) pp. 123–34 (2 figs.).

does good service in redescribing the structure of both these Silurian genera. As to the first, he concludes that it is an Echinid and not a Cystid; and as to the second, that it also is an Echinid and not an Asterid. The diagnoses of the Cystoidea lately offered by Prof. v. Zittel and Prof. Haeckel are considered, and it is strongly urged that they do not enable us to draw any sharp line of distinction between the Cystoidea and the Echinoidea.

The masticatory apparatus of the two genera is described and discussed, and it is shown how they may be found to explain the origin of the same apparatus in gnathostomatous Echinoids. Dr. Gregory joins in the attack on the Lovenian doctrine of the homologies of the "calycinal plates," and suggests that the plates so called in Echinoids are homologous with the plates of the valvular pyramid of the Cystoidea.

Affinities of Echinothuriidæ.*—Dr. J. W. Gregory comes to the conclusion that the apparently primitive features of these Echinoids are secondarily acquired and are not primeval. The recent genera, therefore, are extremely specialised and not primitive forms. The family should be regarded as belonging to the order Diademoida, and as derived from the Pedinidæ. The oldest member of the family appears to be *Pelanechinus*, and the flexibility of the tests of the existing *Asthenosoma* and *Phoronosoma* is regarded as due to a diminished calcification of the plates.

The author describes a new genus *Pedinothuria*, and gives reasons for regarding it as a connecting link between the Pedinidæ and the Echinothuriidæ; another new genus—Helikodiadema—has a flexible test, due apparently to its deep-sea life; it is a modified form of *Pseudodiadema*.

Holothuriidæ of Norway.†—Mr. Hj. Östergren reports that *Stichopus griegi* sp. n., *S. tremulus*, and *H. ecalearea* are the only Norwegian Holothurians that belong to the true Holothuriidæ. The new species is said to be closely allied to *S. tremulus*, but, though he has only a single specimen on which to found his judgment, the author appears to have satisfied himself that it is specifically distinct.

Synallactinæ.‡—Herr Hj. Östergren has made a study of some forms thought to be well known, and finds that their anatomy has not been thoroughly investigated. For example, the long known *Holothuria intestinalis* is shown to be a *Mesothuria*, of which a fresh diagnosis is given. Similarly Sars' *Stichopus natans* is found to belong to the subfamily lately instituted by Professor Ludwig, and it is necessary to make for it a new genus which the author calls *Bathyplotes*; *Stichopus tizardi* of Théel must be put into the same genus, and apparently others also.

With regard to the systematic position of the Synallactinæ the author does not agree with Prof. Ludwig: the latter, it will be remembered, regarded them as a sub-family of the Holothuriidæ, and as forming a link with the Elpidiidæ. Herr Östergren thinks that their points of resemblance to the Elpidiidæ are so great that they ought to be placed in that order; the two families just named may, with the Pelago-

* Quart. Journ. Geol. Soc., liii. (1897) pp. 112–22 (3 figs.).
† Bergens Mus. Aarbog, 1896, No. 12, 10 pp. and 1 pl.
‡ Festskrift för Lilljeborg, Upsala, 1896, pp. 347–60 (1 pl.).

thuriidæ, form a group for which the old name of Aspidochirotæ will be appropriate.

Cœlentera.

Stinging-Cells.*—Dr. N. Iwanzoff has investigated the stinging-cells of a large number of Cœlentera. All are modified epithelial cells (cnidoblasts), and each encloses a single nematocyst. The nematocyst, or capsule, may be round, oval, or cylindrical in form; the thread is a tubular invagination of the capsule-wall. Only in Anthozoa are there threads which are ruptured out instead of being evaginated. There are always two kinds of stinging-cells in an animal, and in most Siphonophora there are four or five kinds.

The capsule-wall has two layers—the inner thicker, the outer continuous with the lasso. At the opening of the capsule there is usually a plasmic lid. Within the capsule there is a gelatinous, not fluid substance, which stains with anilin dyes, swells up in water, and has corrosive, acrid qualities. It is the swelling which expels the lasso. Water enters when the lid is thrown off, or when the beginning of the lasso is protruded in consequence of external pressure.

The proximal part of the thread is often stronger, and may then be called the axis body; it lies straight in the capsule, while the rest of the thread is coiled. Both axis-body and thread may be smooth, or beset with roughnesses, bristles, or spines arranged in three spirals. The smooth thread is doubtless the more primitive.

The nematocysts have both a mechanical and a chemical effect. The spines of the axis-body may fix firmly in the victim, and the poisonous gelatinous material may enter the wound.

Herr Iwanzoff describes the structure of the cnidoblast in detail—the peripheral layer, the distal fringe of bristles or the single cnidocil, the supporting (non-muscular) processes at the proximal end, and so on. The development is also described.

No nematocysts were found in sponges, though Eimer has described their occurrence. Those in Turbellaria are noticed, and those in Æolididæ.

Coral Reef at Funafuti.†—Such borings as Prof. W. J. Sollas was able to make on this reef lead him to think that its structure is that of a coarse " sponge " of coral with wide interstices, which may be either empty or filled with sand. The chief constituents of this sand appear to be large Foraminifera, of the genera *Orbitolites* and *Tinoporus.* Though the boring proved a failure, a thorough investigation of the fauna and flora was successfully made, while important soundings were taken by Captain Field, R.N.; these appear to Prof. Sollas to support Darwin's theory of the coral atolls, but the bathymetrical limit of coral life is a subject which stands in need of renewed investigation; our accepted conclusions rest on too frail a basis.

Cœlentera of the 'Caudan' Expedition.‡—The report on the Cœlenterates collected by Prof. Koehler in the Bay of Biscay has been drawn

* Ex Bull. Moscow, 1896, 99 pp. and 3 pls.

† Proc. Roy. Soc. Lond., lx. (1897) pp. 502–12. Nature, lv. (1897) pp. 373–7 (5 figs.).

‡ Résultats Scient. de la Campagne du 'Caudan,' fasc. ii. (1896) pp. 299–323.

up by Prof. L. Roule. Forty-five species were collected, and the groups best represented were the Alcyonaria, Antipathidæ, and Hexacoralla. No new species are described, but the collection is of great importance as confirming the doctrine of the extreme uniformity of abyssal faunæ.

Funiculina and Kophobelemnon.*—Mr. J. A. Grieg has taken the opportunity of studying a young (175 mm. long) specimen of *Funiculina quadrangularis*, to compare it with *Leptoptilium gracile* var. *norvegicum*, and he comes to the conclusion that they are identical; but he is careful to limit himself to the variety in question, and does not at present venture to strike out the whole genus and species. The author significantly remarks that it can hardly be a mere accident that two such characteristic forms as *Funiculina* and *Kophobelemnon* occur in both the Northern and the Southern Seas.

Variations in Eucope.†—Prof. A. Agassiz and Dr. W. M'M. Woodworth have been engaged in a study of the variations of this jelly-fish, and for that purpose have examined nearly four thousand specimens. Into the statistical details it is, of course impossible for us to enter, but we may say that there is no such general correlation between the number of segments, of genital sacs, of buccal lobes, and of tentaculocysts in *Eucope* as there is in *Aurelia*. Neither multiplication nor abortion of parts in *Eucope* is symmetrical. The suppression of genital sacs, which is rare in *Aurelia*, is quite common in *Eucope*.

Porifera.

Sponges of the 'Caudan' Expedition.‡—M. E. Topsent dismisses most of the Sponges collected by Prof. Koehler in the Bay of Biscay as "banales," but he finds points of interest in *Phegadrella phœnix* O. S., in *Hyalonema infundibulum* and *Leptosia Koehleri*, which are new, and in some others; attention is drawn to the wide geographical distribution of *Gellius flagellifer* of Ridley and Dendy.

Non-Calcareous Sponges from Port Phillip Heads.§—Prof. A. Dendy has published the second part of his catalogue of the Sponges collected at Port Phillip Heads by the late Mr. Bracebridge Wilson. He here deals with the Monaxonid family Desmacidonidæ, which are very abundant in Victorian waters; no less than fifty-eight species are here catalogued, of which twenty-eight appear to be new. For the three new genera which Prof. Dendy finds himself called upon to establish the names *Microtylotella*, *Amphiastrella* and *Fusifer* are proposed.

Protozoa.

Foraminifera of the Adriatic.‖—Sig. A. Silvestri has published his first contribution to this subject, which does not appear to have excited the interest of any modern investigator. The author here enumerates sixty-two distinct "forms" which belong to forty-six species, and these

* Bergens Museums Aarbog, 1896, No. iii., 11 pp.
† Bull. Mus. Comp. Zool., xxx. (1896) pp. 121–50 (9 pls.).
‡ Résultats Scient. de la Campagne du 'Caudan,' fasc. ii. (1896) pp. 273–97 (1 pl.).
§ Proc. Roy. Soc. Victoria, viii. (1896) pp. 14–51.
‖ Atti Acad. Sci. Acireale, vii. (1896) pp. 27–63.

to twenty-two genera; the genus which is far the best represented is *Miliolina* of Williamson. The author appears to have collected at ten stations.

Trypanosomata of Mammalia.*—Dr. J. Rouget has studied Trypanosomata for two years and a half from a series of inoculations in different animals, the original source being a Barb stallion which died of the disease called "dourine." *Trypanosoma*, as observed in the blood of the horse, is an extremely mobile wormlike body composed of homogeneous protoplasm, bounded by an undulating membrane, and having at its anterior extremity a small bright sphere. It is from 18–26 μ long and from 2–2·5 μ broad. Morphologically it resembles the parasites described by Lewis, Evans, and Chalachnikow as occurring in the blood of mules, horses, camels, and rats.

The author's attempts at artificial cultivation were unsuccessful. With direct transference from animal to animal there was marked success in the case of white and grey mice, white rats, rabbits, and dogs, while others, such as snakes, lizards, frogs, birds, and bats, were refractory. Mice offer the best field for the study of the parasite, which swarms in the blood a few hours after inoculation. In rabbits, dogs, and horses there is marked affection of the genitalia. The parasite was never found in sections of viscera and organs of animals affected with the disease. Very good preparations of the parasite are easily made in blood-films on cover-glasses, the best stain being eosin and methylen-blue after Chenzinski's method. The best fixative is alcohol, or equal parts of ether and alcohol.

* Ann. Inst. Pasteur, x. (1896) pp. 716–28 (3 figs.).

BOTANY.

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

α. Anatomy.

(1) Cell-Structure and Protoplasm.

Structure and Physiology of the Cell.* — According to researches made on vegetable cells (*Anacharis*, *Hydrodictyon*) by M. M. Tswett, strongly plasmolytic solutions determine the accumulation in the protoplasts of the *polioplasm* (the circulating portion of the cytoplasm) and of the plastids included in it. To this process he applies the term *plasmosynagy*. It is a phenomenon of irritability, a vital reaction of the protoplasm to plasmolytic irritation.

The chloroplasts (*Elodea*) are composed of a network of dense refringent substance (*chloroplastin*), the sole support of the chlorophyll, and of an uncoloured interstitial substance (*metaxin*); both substances are of a proteid character. The chloroplasts have no differentiated protoplasmic membrane resembling that of the vacuoles. Their chemical composition varies with the season of the year.

Non-Nucleated Cells.† — Herr J. J. Gerassimoff states that cells without a nucleus can be obtained, not only, as previously indicated, by exposure to a low temperature during the process of cell-division, but also by the action of certain reagents, as chloral hydrate, ether, or chloroform. The daughter-cell which contains no nucleus exists only for a short time, but contains normal chlorophyll-bands of a somewhat darker colour, and may form starch in the light. These phenomena had been observed chiefly in *Spirogyra*, but occur also in *Zygnema*.

Influence of Traction and Pressure on the direction of Partition-Walls.‡ —As the result of experiments on potatoes and on tap-roots, Herr L. Kny confirms, as a general rule, Hofmeister's law that the position of newly formed septa is determined by the preceding growth, the dividing-wall standing at right-angles to the direction of the strongest previous growth of the cell. This is, however, modified by the law that the orientation of the nuclear figure, and consequently that of the septum, may be affected by giving an arbitrary direction, through traction or pressure, to the preceding most intense growth.

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

Formation of Secretions.§—According to Prof. A. Tschirch, resin, oil, and other secretions are never formed within the cell-membrane, but in a special layer known as the resinogenous layer. The septa which occur in the vittæ of Umbelliferæ are remains of this layer. The substance of the layer, which the author calls *vittin*, is of a pectinaceous

* Arch. Sci. Phys. et Nat., ci. (1896) pp. 228–60, 467–86, 565–74 (1 pl.).
† 'Ueber ein Verfahren kernlose Zellen zu erhalten,' Moskau, 1896, 4 pp.
‡ Ber. Deutsch. Bot. Gesell., xiv. (1896) pp. 378–91 (2 figs.).
§ SB. 68 Vers. Deutscher Naturf. u. Aerzte. See Bot. Centralbl., lxviii. (1896) p. 212.

character, and appears to be identical with the substance of mucilage. In schizo-lysigenous oil-passages, like those of the Rutaceæ, there is first a cap-like formation of the resinogenous layer, followed by a dissolution of the cells, and a resorption of the protoplasm.

Encapsuling of Starch-Grains.*—In the lowest of the three layers which Macchiati describes † as constituting the testa of the seeds of *Vicia narbonensis*—a description which applies equally to the seeds of all Leguminosæ—Dr. L. Buscalioni finds starch-grains which display the curious phenomenon of encapsulisation. Some of the cells of this tissue contain single starch-grains of colossal size, while in others are a number of much smaller grains. Connecting these grains with the protoplasm in which they lie is a ring composed of a substance coloured brown by tannin, consisting of short rods placed perpendicularly to the plane of the ring. This peculiar membrane is formed with great rapidity. A similar phenomenon, but not so well marked, was observed in the seeds of *Eschscholtzia californica*.

Peculiarity of Soluble Starch.‡—Prof. W. Beijerinck remarks that soluble starch in aqueous solution will not mix with an aqueous solution of gelatin even at boiling heat. When the two are shaken together an emulsion is formed—an emulsion of gelatin droplets in starch solution. The gelatin droplets in their turn contain very minute starch droplets, as may be shown by treatment with iodine and microscopical inspection. It is quite possible that this observation may lead the way to new researches and new views as to the nature of colloidal bodies.

Reserve-Stores of Seeds.§—M. E. Couvreur finds that during the ripening of the seeds of *Ricinus*, the stores of oil and starch have a parallel increase. Even when separated from the plant, the seeds show for a time an increase in reserves, the increase of oil and starch being still parallel. The author compares this to the increase of glycogen within the silkworm chrysalis. During germination, the starch disappears very rapidly, the oil much more slowly.

Arrow-Poisons.‖—Herr L. Lewin gives a detailed account of the source of the various poisons used for arrows. The order from which the greatest number are derived is the Apocynaceæ; next follow the Leguminosæ, Loganiaceæ, and Euphorbiaceæ. Among the Apocynaceæ, the most important poisons are obtained from the genera *Adenium*, *Acokanthera*, and *Strophanthus*; of Leguminosæ, the genera *Erythrophlœum* and *Physostigma* supply the most important poisons. *Antiaria toxicaria* (Moraceæ), *Pothos* (Araceæ), *Aconitum*, and *Helleborus* also yield important arrow-poisons.

(3) Structure of Tissues.

Influence of Fruit-bearing on the Development of Mechanical Tissue.¶—Mr. A. J. Pieters has made a series of experiments on this

* Malpighia, x. (1896) pp. 479–89 (1 pl.).
† Cf. this Journal, 1892, p. 63.
‡ Centralbl. f. Bakteriol. u. Parasitenk., 2te Abt., ii. (1896) pp. 697–9.
§ Ann. Soc. Linn. Lyon, xlii. (1896) pp. 145–8.
‖ 'Die Pfeilgifte,' Berlin, 1894, 152 pp. See Bot. Centralbl., lxviii. (1896) p. 328.
¶ Ann. Bot., x. (1896) pp. 511–29.

subject, in the case of some fruit-trees, especially varieties of the apple, pear, peach, and plum. Among the conclusions arrived at are the following :—One-year old fruit-bearing shoots of the apple and pear had less wood in proportion to their diameter than vegetative shoots of the same age. This is largely due to an increase of the cortex of the fruit-bearing shoot, which is also well supplied with supplementary mechanical tissue. In the peach, the fruit-bearing has more wood than the vegetative shoot. The effect upon the tissues is generally local. This local effect of fruit-bearing tends to an increase of cells, with a decrease in the thickness and lignification of the walls of the xylem-cells. In all cases the increase in growth is greatest on the side nearest the fruit-stalk. The local effect of fruit-bearing on the xylem-cylinder disappears with time. Fruit-bearing has a temporary local effect on the lignification of the walls of the xylem-cells, preventing it wholly or in part, according to their distance from the fruit-stalk. The lignification of other cell-walls is promoted by fruit-bearing.

Fibrovascular Bundles of Nymphæaceæ.*—Further examples of the occurrence of several steles in the Nymphæaceæ are given by Mr. D. T. Gwynne-Vaughan, in the stalks or stolons which bear small tubers at their ends in *Nymphæa flava* and *tuberosa*. The tubers bear buds, which grow into fresh rhizomes, containing six or seven vascular bundles.

Endoderm and Pericycle in Trifolium.†—Dr. S. Belli has made a very detailed study of the stele-theory in reference to the genus *Trifolium*. Histogenetic researches lead him to conclude that in *Trifolium* there is no pericycle in van Tieghem's sense. The elements referred to this layer belong to the bast and to the interfascicular cambium. A general endoderm and pericycle are to be found only in the hypocotyl; after that disappears there is none. The memoir concludes with a general criticism of the stele-theory.

Anatomy of the Stem of Macrozamia.‡—Mr. W. C. Worsdell calls attention to the resemblances and differences in the structure of the stem of *Macrozamia* as compared with that of other genera of Cycadeæ. The pith possesses a well-developed network of vascular bundles similar to that of *Encephalartos*; it has a distinct adventitious origin, and is not directly continuous with the primary leaf-trace system. The normal cylinder is surrounded by two or three anomalous zones of secondary thickening, the innermost of these being the best developed. The stem is characterised by the presence of a tertiary cambium, producing bundles with inverted orientation. In the above points the author points out the resemblance to the fossil group Medullosæ. Other characters are referred to which are characteristic of the genus, viz. the presence of leaf-traces in the cortex, which run directly inward to the vascular rings after very short courses; the structure of the girdles during their tangential course; and the structure and mode of action of the periderm at the periphery of the cortex; the phelloderm being largely composed of stone-cells, and producing subsequently a second phellogen in its midst.

* Ann. Bot., x. (1896) pp. 624–5. Cf. this Journal, 1896, p. 537.
† Mem. R. Accad. Sci. Torino, xlvi. (1896) pp. 353–441 (6 pls.).
‡ Ann. Bot., x. (1896) pp. 200–20 (2 pls.).

Anatomy of the Zingiberaceæ.*—Herr W. Futterer has investigated the anatomy and development of the stem, leaf, leaf-sheath, and root, in many species of Zingiberaceæ. The following are some of the more important general results. Where the leaf possesses a hypodermal tissue, the epiderm consists of small cells; but where the hypoderm is wanting, which is uncommon, the epidermal cells are considerably larger, and assume the form of hypodermal cells. There is almost always a clear differentiation between palisade-cells and spongy parenchyme; rarely does one pass into the other. In the interior of the stem there is, in almost all the species, an inner sheath, composed of from one to six layers of small cells, usually running in a regular circle parallel to the periphery of the stem. The structure of the rhizome resembles that of the aerial stem, but is simpler. The crystals of calcium oxalate belong to the monoclinic system; they are never in the form of raphides. Nearly all the species examined possess in the mesophyll of the leaf cells filled with a volatile oil. The hypoderm is especially characterised by the presence of tannin. The growing-point of the stem is the result of the activity of a meristematic layer.

Structure of Dipterocarpaceæ.†—Prof. Sir D. Brandis describes in detail the structure and geographical distribution of this arborescent order, of which the most marked characteristics are the vascular bundles in the cortex and the resin-passages. The latter contain a volatile oil which hardens in the air into a resin.

Structure of Umbelliferæ.‡—From the anatomical structure Prof. O. Drude classifies the genera of Umbelliferæ in three groups,—the Hydrocotylineæ, Saniculineæ, and Apioineæ. In the first section there are no oil-passages; the fruit has a woody endocarp covered with cells that contain crystals. In the second section there is no woody endocarp, and the oil-passages are generally wanting. The Apioineæ, in which oil-passages are always present, are again divided into a number of families.

Anatomy of Onagraceæ.§—From a study of the anatomy of the stem of several genera of Onagraceæ, Mr. F. Ramaley draws the conclusion that no anatomical characters can be used to distinguish the species, or even the genera. Bicollateral vascular bundles were found in all the species examined. Intraxylar phloem-islands occur in the stems of all the robust species. Raphides of calcium oxalate are also present; generally in the cortex or pith, often in the pericycle and phloem.

Anatomy of Betulaceæ.‖—From their anatomical structure M. A. M. Boubier divides the Betulaceæ into two groups, the Betuleæ and Coryleæ; the former comprising *Betula* and *Alnus*, the latter *Corylus* and *Carpinus*. The fibrovascular system of the leaf is open in *Betula*, closed, at least at the base of the lamina, in the other genera. Various other anatomical characters of the stem and leaf are given, by which the genera can be distinguished.

* Bot. Centralbl., lxviii. (1896) pp. 241–8, 273–9, 346–56, 393–400, 417–31; lxix. (1897) pp. 3–10, 35–46 (1 pl.).
† SB. Niederrhein. Gesell. Bonn, 1896, pp. 4–42.
‡ SB. 68 Vers. Deutscher Naturf. u. Aerzte. See Bot. Centralbl., lxviii. (1896) p. 211.
§ Minnesota Bot. Studies, 1896, pp. 674–90 (3 pls.).
‖ Malpighia, x. (1896) pp. 349–436 (24 figs.) (French).

(4) Structure of Organs.

Anatomy of Loranthaceæ.*—Mr. F. W. Keeble calls attention to the following anatomical details in the Cingalese Loranthaceæ. In *Loranthus neelgherensis* the hypocotyl of the fully developed embryo is densely covered with green columnar emergences, the cortical cells of which contain chlorophyll, starch, and tannin. A single stomate occurs on the free surface of each emergence. In this species there is not, as in most, a well-developed suctorial disc at the free end of the hypocotyl, the sucker obtaining entrance in another way.

Floral Leaves without Vascular Bundles.†—M. P. van Tieghem applies the term *meristele* to the branch of the cauline stele which enters the lamina of the leaf, and there branches into the veins. He further states that the non-ovulate orders of Phanerogams comprised in the Loranthineæ, which exhibit such remarkable simplicity of structure in other ways, are further characterised by a frequent entire absence of meristele in the foliar leaves; these being then reduced simply to cortex and epiderm. In the majority of the dichlamydeous families, the Loranthaceæ, &c., this is the case with the sepals. In those in which the corolla is wanting, the Viscaceæ and the Arceuthobiaceæ, the calyx is not reduced to this simple condition, but reduction is frequently presented by the stamens. In the Arceuthobiaceæ and Balanophoraceæ, again, the carpels present a similar simplicity of structure, being entirely destitute of meristele.

Variation in Flowers of Salix.‡—Dr. W. Haacke has studied the variations which occur in the groups of catkins borne by branches of *Salix caprea* when the undergrowth of the tree has been cropped for years. The main catkin of a group gives up its female character much less frequently than the accessory catkins, and the apex of the catkin loses its female character much more readily than the other part. Both facts are explained as due to differences of position in relation to nutritive supply. From the fact that definite forms, e.g. male flowers, occur at definite places, Dr. Haacke argues in favour of the definiteness of organic reactions.

Protection of Pollen from Rain.§—Prof. A. Hansgirg classifies under four types the flowers in which the pollen is protected against rain by phytodynamic contrivances, viz.:—(1) Flowers which close their perianth in rainy weather, so as to prevent the entrance of rain-drops without changing the position of the flower-stalk or stalk of the inflorescence. (2) Flowers with erect flower-stalks, which curve in rainy weather so as to alter the position of the opening of the corolla and prevent the access of rain to the pollen and nectar. (3) Flowers in which a curvature of the axis or stalk of the inflorescence serves the same purpose of protecting the flowers against the access of rain. (4) Flowers which are erect and open in fine weather, but, during rain, both close their perianth and at the same time protect the pollen by a curvature of the flower-stalk.

* Ann. Bot., x. (1896) pp. 626–7.
† Rev. Gén. de Bot. (Bonnier), viii. (1896) pp. 481–90. Cf. this Journal, 1896, p. 327.
‡ Biol. Centralbl., xvi. (1896) pp. 817–25 (8 figs.).
§ Oesterr. Bot. Zeitschr., xlvi. (1896) pp. 357–8.

Twisting of Filaments.*—Herr I. Robinsohn calls attention to the peculiar torsion of the filaments of some of the stamens in some Labiatifloræ (Labiatæ, Scrophulariaceæ, Acanthaceæ) and Irideæ (*Gladiolus*). This appears to be connected with contrivances for pollination. In *Digitalis*, e.g., the two shorter filaments are quite straight, while the two longer ones are twisted in their lower part, the effect of the torsion being to bring the anthers of the longer filaments into a position immediately above those of the shorter filaments, where the pollen will be carried away by the visiting insects from the proterandrous anthers while the stigmas in the same flower are still closed.

Elongation of the Axis.†—Herr E. Ule describes the remarkable elongation of the flower-stalk after flowering which takes place in a Brazilian orchid, *Wullschlaegelia Ulei*, but only if the flower has been fertilised. The purpose of the growth appears to be the dissemination of the seeds. Similar elongations of the flowering axis occur also in *Chevreulia acuminata* (Compositæ) and *Utricularia nelumbifolia*.

Xerophilous Plants.‡—Herr Grevillius has studied the characteristics of the xerophilous vegetation of the Swedish island of Oeland. The most prominent are a cæspitose habit, shoots or rosettes of leaves growing closely adpressed to the soil, and the great thickness of the leaves in proportion to their surface. Protection against excessive transpiration is afforded by a clothing of hairs, a covering of wax, or the thickening of the cuticle. The mechanical tissue in the lamina of the leaves is either feebly developed or entirely wanting. The internodes of the stem are generally shorter.

Leaves of Xerophilous Plants. §—Herr B. Jönsson describes a peculiar form of leaf characteristic of certain tropical xerophilous genera, consisting in a great reduction of the assimilating tissue and a great development of the system for protection against transpiration. The palisade-parenchyme consists of a single layer of cells ; the chloroplasts are usually few, but of large size; the upper half of each cell is usually destitute of chlorophyll-grains, and often contains a cluster of crystals of calcium oxalate. This peculiar position of the chlorophyll-grains does not change with the varying direction of the light, and is apparently connected with the storing up of acids in the aquiferous tissue which lies above this layer.

Structure and Function of Stomates.‖—Herr H. C. Schellenberg classifies stomates under two types, viz. :—(1) The *Amaryllis*-type, in which each guard-cell may be regarded as a sac with two thickening-bands on one side only of the opening; (2) the *Helleborus*-type, in which the cavity of the guard-cell presents, on transverse section, an inequilateral obtuse-angled triangle.

As concerns their function, the author regards stomates as assisting in assimilation, in transpiration, and in the interchange of gases, the

* Oesterr. Bot. Zeitschr., xlvi. (1896) pp. 393–401 (1 pl.).
† Ber. Deutsch. Bot. Gesell., xiv. (1896) pp. 255–60 (1 fig.).
‡ Engler's Bot. Jahrb., xxiii. (1896). See Bot. Centralbl., lxviii. (1896) p. 223.
§ Acta Univ. Lund, xxxii. (1896) 20 pp. and 2 pls. See Bot. Centralbl., lxviii. (1896) p. 324.
‖ Bot. Ztg., liv. (1896) 1te Abtheil., pp. 169–85 (1 pl.).

first of these functions being indicated by the presence of chlorophyll in the guard-cells. He supports the view of Schwendener,* that the opening and closing of the stomates is brought about by changes in the turgor of the guard-cells, rather than that of Leitgeb,† that an important part in this process is played by the adjacent cells (*Nebenzellen*), whether these be of the form of ordinary epidermal cells or not. In opposition also to Leitgeb, he finds the stomates to be always closed at night; light is the only factor in causing the opening of the stomates, and acts through the increase of turgor due to the assimilation of the guard-cells. Stahl's "cobalt-test" for the intensity of assimilation ‡ the author does not regard as wholly satisfactory in determining whether the stomates are open or closed.

Tubers of the Artichoke.§—According to Herr G. Meyer, the tubers of the artichoke are formed by the thickening of the lowermost of the stolons which spring from the underground stem. This thickening is due to the activity of the original cambium which produces new masses of parenchyme; to the production of parenchyme from interfascicular cambium; and to the subsequent elongation of the parenchymatous cells. Glucose is found in the young tuber; inulin is a subsequent formation, both in the tuber and in the aerial plant; starch is found in the vascular bundle-sheath, and disappears only in the autumn from the lower part of the tuber.

β. Physiology.

(1) Reproduction and Embryology.

Fertilisation of Salisburia.‖—According to Dr. S. Hirase, the mode of impregnation of *Salisburia adiantifolia* (*Gingko biloba*) differs from that of other Conifers, being effected by antherozoids formed within the pollen-tube. The two nuclei resulting from the final division of the generative nucleus of the pollen-tube become transformed, before entering the oosphere, into motile antherozoids. These differ somewhat in form from the antherozoids of the higher Cryptogams. They are ovoid, 82 μ long by 49 μ broad; the nucleus is placed in the middle, and is entirely surrounded by cytoplasm. The head consists of three spiral coils, which are never completely unrolled, and on them are seated a number of cilia; there is also a sharp tail. As soon as the antherozoids have escaped through the apex of the pollen-tube, they swarm with a rapid twisting movement. The attraction-spheres which accompany the final division of the pollen-tube-nucleus were well observed.

Fertilisation of Cycas.¶—Prof. S. Ikeno has made a similar observation with respect to the mode of impregnation in *Cycas revoluta*. The antherozoids are somewhat larger than those of *Salisburia*, and consist of a central nucleus completely surrounded by cytoplasm. The head is composed of four coils, and bears a large number of cilia. Two nuclei are found in each pollen-tube, resulting from the division of the generative

* Cf. this Journal, 1882, p. 216. † Op. cit., 1887, p. 264.
‡ Op. cit., 1895, p. 130.
§ Ber. Deutsch. Bot. Gesell., xiv. (1896) pp. 347–62 (1 pl.).
‖ Bot. Centralbl., lxix. (1897) pp. 33–5. Cf. this Journal, 1896, p. 328.
¶ Tom. cit., lxix. (1897) pp. 1–3.

nucleus. No swarming motion was actually observed. The phenomena of impregnation in *Cycas revoluta* resemble those of *Salisburia adiantifolia*, and differ from those in all other Gymnosperms at present known in this respect, that the pollen-tube does not penetrate deeply into the archegone, but remains at some distance from it, even at the time of impregnation. It would hence be impossible for the male nuclei to impregnate the oosphere were they not previously transformed into motile antherozoids. The conveying fluid is supplied by the water which is copiously excreted by the female organ at the time of impregnation.

Cross-Fertilisation and Self-Fertilisation.—Prof. A. Borzì* describes a type of Epacrideæ, *Cystanthe sprengelioides*, which is anemophilous, the corolla dropping as soon as it has opened.

Mr. C. Robertson † describes the mode of pollination, and the insect-visitors, in species of *Rhus*, *Rhamnus*, and some other genera.

In another paper ‡ the same author gives the results obtained from the investigation of the genera *Hepatica*, *Asimina*, *Podophyllum*, *Solea*, *Euonymus*, *Æsculus*, *Astragalus*, *Stylosanthes*, *Gymnocladus*, *Spiræa*, *Gillenia*, *Viburnum*, *Symphoricarpos*, *Aster*, *Silphium*, *Heliopsis*, *Rudbeckia*, and *Cacalia*.

In the Cruciferæ there are, according to Herr F. Hildebrand,§ all gradations between entire self-fertility in *Alliaria officinalis* and perfect self-sterility in *Cardamine pratensis*.

Mr. B. Fink ‖ records the results of a series of experiments on castrating a number of varieties of the tomato, and finds that they are not then visited by bees, which seek them for the sake of the pollen. They were in all cases readily fertilised by cross-pollination. The period required for the pollen-tube to pass through the style after pollination is about 12 hours.

M. J. Briquet¶ describes the contrivance for entomophilous pollination by bees in *Erythronium dens-canis* and *E. Smithii*.

Degradation and Transformation of Sexual Organs.**—According to Herr J. Familler, arrest or transformation of the floral organs takes place at various stages of their development; there may be a great difference in this respect even in different flowers on the same plant. In the male organ the archespore may remain in its primitive condition, although other normal processes of division proceed as usual. In the female organ the embryo-sac is often present when the integument is greatly reduced. The degradation of pollen is usually indicated by the smaller number of grains rather than by their diminished size. Filiform staminodes often exhibit a survival of the formation of an anther in this early stage. Transformed male organs serve for various purposes, such

* Il Naturalista Siciliano, i. (1896) pp. 65–6.
† Bot. Gazette, xxii. (1896) pp. 154–65.
‡ Trans. St. Louis Acad. Sci., vii. (1896) pp. 151–79.
§ Ber. Deutsch. Bot. Gesell., xiv. (1896) pp. 324–7.
‖ Minnesota Bot. Studies, 1896, pp. 636–43.
¶ Mém. Soc. Sci. Nat. Cherbourg, xxx. (1896) pp. 71–90 (1 pl.). See Bot. Centralbl., lxix. (1897) p. 120.
** 'Biogenetische Unters. üb. verkümmerte u. umgebildete Sexual-organe,' München, 1896, 38 pp. See Bot. Centralbl., lxviii. (1896) p. 404.

as increased conspicuousness, a guide to the visits of insects, the formation of nectar, &c. Organs may undergo actual transformation in the course of their development. The author attributes these transformations to an inner force originating in the protoplasm.

Influence of Nutrition on the Colour and Sex of Flowers.*—As the result of experiments on *Dahlia variabilis* and *Petunia hybrida*, Herr F. Hildebrand finds that the nature of the soil has a considerable influence on the colour of the flowers in hybrids, a more or less diffused etiolation being the result of a diminished supply of nutriment. The monœcious or diœcious condition of *Ruscus aculeatus* appears also, in part at least, to be determined by conditions of growth.

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

Röntgen Rays and Vegetation.†—Herr N. J. C. Müller asserts that ordinary sunlight contains no Röntgen rays; their presence not being indicated either by the help of photographic reagents or by any heliotropic effect on the growth of *Lepidium sativum*.

Influence of Electricity on the Growth of Plants.‡—As the result of a series of experiments made on aquatic plants, M. M. Thouvenin has arrived at the conclusion that a continuous electric current promotes assimilation by accelerating the decomposition of carbon dioxide by the plant.

Influence of Electricity on Germination.§—From a series of experiments on different seeds, Sig. G. Tolomei comes to the conclusion that currents of electricity of great frequency exercise an injurious effect on the vitality, and consequently on the germination, of seeds; and that the intensity of this injurious action varies with the species.

Germination of Barley.‖—Pursuing his investigations on the chemical changes which take place during germination, Herr J. Grüss states that in barley the solution of the cell-walls of the endosperm commences in the neighbourhood of the scutellum, and advances towards the apex of the grain, most actively in the outer part; a small portion at the apex usually remains intact. The cell-walls are not dissolved, but corroded; they are rendered permeable to enzymes by allöolysis. Congo-red stains intact cell-walls an intense red, while those that have been affected take only a slight light-red tint. The starch-grains are attacked only after the corrosion of the cell-wall, and first in the neighbourhood of the scutellum. Diastase may be produced spontaneously in the endosperm of ungerminated seeds from which the embryo has been removed.

Influence of Nitrogen on the Formation of Roots.¶—As a result of a series of experiments on the growth of different plants in soils contain-

* Ber. Deutsch. Bot. Gesell, xiv. (1896) pp. 327–31.
† Tom. cit., Gen.-Versamm.-Heft, pp. 66–72 (1 pl.).
‡ Rev. Gén. de Bot. (Bonnier), viii. (1896) pp. 433–50 (9 figs.).
§ Malpighia, x. (1896) pp. 493–511 (3 figs.).
‖ Wochenschr. f. Brauerei, 1896, 4 pp. and 1 pl. See Bot. Centralbl., lxviii. (1896) p. 323. Cf. this Journal, 1896, p. 652.
¶ JB. d. Versuchs-Stat. in Wädensweil, iv. pp. 48–52. See Bot. Centralbl., lxviii. (1896) p. 298.

ing or destitute of nitrogenous substances, the late Prof. R. Müller-Thurgau concludes that nitrogen has both a direct and an indirect influence on the growth of plants; the former by the supply of material for the formation of proteid substances; the latter by increasing the strength of the root-system, and thus enabling the plant to draw a larger amount of nutriment from the soil.

Antidromy.*—Mr. G. Macloskie gives further illustrations of this mode of growth, both dextrorse and sinistrorse. A forking rootstock (in *Nuphar*) may produce antidromic plants on the two branches of the fork. The same phenomenon is illustrated in the stem of the fossil *Lepidodendron Sternbergii*, and in the cones of *Encephalartos Altensteinii.*

Ascent of Water in Trees.—Prof. F. Darwin gives a *resumé* of all the more important observations and theories on this subject, including those of Sachs, Boehm, Strasburger, Schwendener, Dixon and Joly, and Askenasy,† pointing out the great importance of the discovery of Dixon and Joly that a confined column of water possesses a power of resisting tensile stress. According to the most modern views, imbibition, this resisting power of suspended threads of water, and the turgescence of the cells of the mesophyll, all play their part in the phenomenon.

Prof. S. H. Vines ‡ calls special attention to the fact that a very considerable suction-force is developed by a branch independently of leaves or of life; this force continues even after the branch has been actually killed.

Prof. Joly § sums up his and Mr. Dixon's conclusions as follows:—We have in the tracheal system of the plant a water-way which is freely open to water-movement, while closed to the movement of free gas. Every bordered pit is an open door to the sap, and a closed one to the gas-bubble, and one which locks and bars itself against the exit of an imprisoned bubble. In a word, it is a structure semi-permeable towards matter in the three states—the solid, the liquid, and the gaseous.

Transpiration.‖—Herr E. Kröber contests the statement of Müller-Thurgau that the energy of transpiration of a plant may be taken as the measure of its capacity for absorbing water. The amount of transpiration for different branches of the same tree differs as widely as that for different individuals of the same species, or even as much as that for different species. The energy of transpiration depends largely on the external conditions, both at the time of observation and at preceding periods.

(3) Irritability.

Transmission of Irritation in Sensitive Plants.¶—Prof. D. T. MacDougal describes an arrangement by which the effect of increased or decreased pressure on the sensitiveness of sensitive plants can be ob-

* Bull. Torrey Bot. Club, xxiii. (1896) pp. 420–3, 536–7. Cf. this Journal, 1896, p. 541.

† Ann. Bot., x. (1896) pp. 630–43. Cf. this Journal, 1895, p. 550.

‡ Tom. cit., pp. 644–7. Cf. this Journal, 1896, p. 650.

§ Tom. cit., pp. 647–60. Cf. this Journal, 1896, p. 542.

‖ Landwirthsch. Jahrb., xxiv. (1895) pp. 503–37. See Bot. Centralbl., 1896, Beih., p. 330.

¶ Bot. Gazette, xxii. (1896) pp. 293–300 (1 pl.). Cf. this Journal, 1896, p. 89.

served. A fresh series of experiments on *Mimosa pudica* and *Oxalis sensitiva* confirm his previous statement that the irritation is not transmitted through the vesicular cells, and lead to the following conclusions. Impulses may be transmitted through dead portions of stems or petioles in which the conditions are such that a transmission by the cell-wall or the water in the wall only is possible. Great variations in the pressure exerted on portions of the plant in such manner as to set up hydrostatic disturbances extending throughout the entire plant are not followed by reactions; hydrostatic disturbance, therefore, does not constitute an impulse.

Irritability of Catasetum.*—Mr. J. H. Hart contests Darwin's statement of the irritability of the flowers of *Catasetum tridentatum.* He states that the ejection of the pollinia can be caused by other means than the irritation of the "antennæ" by insects; a concussion of the flower, the removal of the anther-cap, or pressure exerted on almost any part of the column, and especially any irritation on the margins of the stigmatic pit, will effect this readily if the flower is at a favourable stage of maturity. The expulsion of the pollen does not depend on any special irritability, but on mechanical action alone. The "antennæ" are merely a prolongation of the edges of the stigmatic pit. When the flower opens, they become turgid, stiff, and non-elastic. In this state they furnish levers which are amply sufficient to cause a disturbance of the grip they hold on the margin of the caudicle.

Gamotropic and Carpotropic Movements of the Flowers of Grasses.†—Prof. A. Hansgirg finds a common type of these movements to be that displayed by *Avena*, in which the flowers, which are closely crowded together in the bud-condition, become widely separated from one another before flowering by the curving of the flower-stalk or of the axis of the raceme or panicle. After flowering, the ripening fruits may either remain in the same position, or may revert to that which the buds occupied before flowering. A large number of species are mentioned in which the carpotropic movements are especially conspicuous.

Phyllocarpy.‡—By this term, Prof. A. Hansgirg proposes to designate the movement which takes place of the flower-stalk, after flowering, in many climbing plants (*Tropæolum*, *Cobæa*, &c.), by which the ripening fruit is hid in the foliage for its better protection.

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

Formation of Proteids from Asparagin.§—By a series of experiments, chiefly on *Lemna*, Herr B. Hansteen has determined that when asparagin and grape-sugar occur together in the same cell, they combine rapidly, the result being the formation of proteids. If, however, the grape-sugar is replaced by cane-sugar, no considerable chemical combination takes place. The contrary is the case with glycocoll; with grape-sugar, this amide is inactive, while with cane-sugar, an abundant forma-

* Bull. Misc. Inform. R. Gard. Trinidad, ii. (1896) p. 225. See Bot. Gazette, xxii. (1896) p. 505.
† Oesterr. Bot. Zeitschr., xlvi. (1896) pp. 320–5. Cf. this Journal, 1893, p. 69.
‡ Oesterr. Bot. Zeitschr., xlvi. (1896) pp. 401–2.
§ Ber. Deutsch. Bot. Gesell., xiv. (1896) pp. 362–71.

tion of proteid takes place. In the formation of proteids from grape-sugar, ammonium chloride or sulphate may take the place of asparagin. Contrary to the statement of some other observers, Hansteen asserts that light has no, or very little, direct influence on the formation of proteids.

Formation and Dissolution of Hemicellulose.*—Dr. J. Grüss has studied the formation and dissolution of cell-walls composed of cellulose, and its connection with the formation of gum. He states that the hemi-celluloses mannan, galactan, and araban are formed directly or indirectly as reserve-substances. In the first case, this takes place as thickened walls in the endosperm (*Phœnix*, *Phytelephas*), or as secondary thickening-layers in libriform and wood-parenchyme cells (*Prunus, Acacia, Astragalus*). They take the form of indirect reserve-substances when they compose the walls of starch-bearing cells, as in the endosperm of grasses. In a cell-wall composed of a mixture of two hemicelluloses, one of the two constituents is decomposed sooner than the other by the action of diastatic enzymes. The hemicelluloses galactan and araban are transformed by enzymes into the gums arabin and galactin, and may pass as such into the tissue before they become converted into the sugars arabinose and galactose. These gums occur in the dormant reserve-reservoirs in *Prunus, Acacia*, and *Astragalus*, and may be termed "reserve-gums."

Respiration of Wounded Plants.†—Mr. H. M. Richards gives the results of a series of experiments on the effect of injury to the tissue on respiration in the case of a number of plants, the potato, bean, carrot, and others. The general immediate result of injury is a greatly increased respiration, falling to the normal intensity as the wound heals. This increase may be ascribed to an effort on the part of the plant to recover from the injury, by which the ordinary functions are stimulated, thereby necessitating an increased supply of oxygen. In bulky tissues there is, in the natural condition, a certain amount of enclosed or absorbed carbon dioxide, some of which is given off very suddenly during the first two or three hours after injury. The ratio of the absorption of oxygen and production of carbon dioxide does not appear to vary within very wide limits before and after injury. The amount of oxygen absorbed is always in excess of the amount theoretically required for the quantity of carbon dioxide evolved.

Nitrification.—In confirmation of previous results Herr E. Godlewski ‡ concludes, from a fresh series of experiments, that nitrifying organisms derive their carbon from free carbon dioxide and not from carbonates. The amount of free nitrogen produced varies with the conditions of the experiment.

As the result of experiments M. Mareille § states that the energy with which a soil is nitrified depends not only on the temperature, aëration, and humidity of the soil, and on the energy of the organisms present, but also on the nature of the organic matter to be nitrified.

* Biblioth. Bot. (Luerssen u. Frank), Heft 39, 1896, 15 pp. and 1 pl.
† Ann. Bot., x. (1896) pp. 531–82 (2 figs.).
‡ Anzeig. Akad. Wiss. Krakau, 1895, pp. 178–92. See Journ. Chem. Soc., 1896, Abstr., p. 668.
§ Ann. Agron., xxii. (1896) pp. 337–44. See Journ. Chem. Soc., 1896, Abstr., p. 669.

In their works on the micro-organisms of nitrification Herren A. Stutzer and R. Hartleb * have alluded to a mould-fungus characterised by a much-branched mycele, and by having both mega- and microspores. In the three stages of development the fungus exerts different actions. Hence, for exciting definite effects, the composition of the medium and the presence or absence of atmospheric air are of great importance. Under certain circumstances the fungus lives on organic nitrogenous compounds, and is then able to set up nitrification directly, under other conditions to produce nitrite, and under still others nitrate. The mycele may split up into indifferent cells which resemble bacteria.

B. CRYPTOGAMIA.

Muscineæ.

Rhynchostegium.†—Sig. U. Brizi gives a monograph of this genus of Musci, which he divides into two subgenera, *Eurhynchostegium* and *Eurhynchium*. Twenty-eight species in all are described, with a large number of sub-species and varieties. There are two new species, *R. romanum* and *Pirottæ*.

Rabenhorst's Cryptogamic Flora of Germany (Musci).‡—Parts 28–30 of this important work by Herr K. G. Limpricht are still occupied with the Hypnaceæ. After the completion of *Brachythecium*, the following genera are treated of:—*Bryhnia* (1 sp.); *Scleropodium* (4 sp.); *Hyocomium* (1 sp.); *Eurhynchium* (21 sp.); *Rhynchostegiella* gen. n. (5 sp.), with the following diagnosis: a central bundle, leaves narrowly lanceolate, not or scarcely decurrent, basal cells not broadened, rib single, cells of the leaf-wings not or scarcely different from the basal cells, stomates 2-celled, epidermal cells collenchymatous, seta curved, usually warty; *Rhynchostegium* (6 sp.); *Rhaphidostegium* (2 sp.); *Thamnium* (2 sp.). The third group, Hypneæ, then follows, consisting of the genera *Plagiothecium*, *Amblystegium*, *Hypnum*, and *Hyloconium*, and a commencement is made of *Plagiothecium* with 18 species.

Development of Geothallus.§—Pursuing his investigations into this new genus of Hepaticæ, Prof. D. H. Campbell describes in particular the germination of the spores and bulbils, and the structure of the antherid and archegone, as well as that of the sporogone. He regards the genus as most nearly allied to *Sphærocarpus*, agreeing both with that genus and with *Riccia* in the form of the apical cell, and the general position and structure of the sexual organs, including the characteristic envelope with which each is surrounded. In the structure and development of the sporogone there is a close resemblance between *Sphærocarpus* and *Geothallus*. *Geothallus* differs from *Sphærocarpus* chiefly in the more massive thallus, the sessile archegone, the development of true leaves, and the formation of bulbils by which the plant becomes perennial. It has also some affinities with *Fossombronia*, and may be regarded as intermediate between that genus and *Sphærocarpus*.

* Centralbl. f. Bakteriol. u. Parasitenk., 2te Abt., ii. (1896) p. 701.
† Malpighia, x. (1896) pp. 227–57, 437–78 (1 pl.).
‡ Cf. this Journal, 1896, p. 212.
§ Ann. Bot., x. (1896) pp. 489–510 (2 pls.). Cf. this Journal, 1896, p. 441.

Characeæ.

Bulbils of the Characeæ.*—Dr. K. Giesenhagen has studied the structure and mode of formation of the clusters of bulbils formed at the nodes of the roots of various species of *Chara*, especially *C. stelligera*, *aspera*, *baltica*, and *fragifera*. Their development is fully described in the case of *C. aspera*. The bulbils in this species occupy a somewhat intermediate position in structure between the truly unicellular bulbils of *Lamprothamnus alopecuroides* and *Lychnothamnus macropogon*, and the multicellular bulbils of *Chara baltica*, *fragifera*, and *delicatula*. The remarkable regularity and uniformity which characterises the structure of the Characeæ in other points is not subject to any exception in the case of these organs.

Rabenhorst's Cryptogamic Flora of Germany (Characeæ).†—Dr. W. Migula's exhaustive and admirable monograph of the Central European species of Characeæ is now completed. Besides a description of every species and of the very numerous forms of some of the species—all of the former and many of the latter being admirably figured—it contains a full account of the morphology and history of development of the family, an essay on the position of the Characeæ in the natural system, an account of their geographical distribution, and instructions as to their collection, examination, and determination. All the non-German European species are also referred to.

Algæ.

Klebs on Reproduction in Algæ and Fungi.‡—In this most important work Dr. G. Klebs gives the results of many years' observations on the relation between the sexual and non-sexual modes of propagation in certain Algæ and Fungi. He finds that, as a general law, it is the external conditions which determine the production by any species of zoospores on the one hand, or of gametes on the other hand.

With *Vaucheria*, zoospores are always produced when filaments which have been kept moist for some days are soaked with water, or when they are removed from a dilute nutrient solution into pure water, or when cultures in water or in a very dilute nutrient solution are darkened. If the filaments are placed in a 2–4 p.c. solution of cane sugar in bright light, gametes are always produced. Similar results were obtained with *Hydrodictyon* and some other Algæ. In *Spirogyra* parthenogenetic resting-spores can be produced by placing filaments with long conjugating-tubes in a strong solution of sugar. With fungi (*Eurotium*, *Mucor*) the results are more complicated and less clear than with Algæ.

Under the name *Botrydium granulatum* the author asserts that two quite distinct organisms have been confounded. On one of these he founds the new genus *Protosiphon*, distinguished from *Botrydium* by its propagation by means of gametes and non-motile spores instead of by uniciliated zoospores.

* Flora, lxxxii. (1896) pp. 381–433 (1 pl. and 25 figs.).

† Vol. v. Die Characeen, Leipzig, 1897, 765 pp. and very numerous figs. Cf. this Journal, 1896, p. 212.

‡ 'Die Bedingungen d. Fortpflanzung bei einigen Algen u. Pilzen,' Jena, 1896, 543 pp., 3 pls. and 15 figs.

Verticillate Ramification.*—M. P. van Tieghem points out a deviation in certain Algæ from the ordinary mode of verticillate ramification, where homologous elements are superposed at each node. The exceptional mode has been observed only in certain Algæ belonging to the Florideæ (*Ptilota*, *Euptilota*, *Pterota*, *Bonnemaisonia*), and consists in the superposition of homologous elements only in pairs.

Agardh's Analecta Algologica.†—In "Continuatio III." of this work Prof. A. G. Agardh establishes four new genera of Algæ, viz.:—*Homœostroma*, founded on *Punctaria latifolia*; *Endarachne*, near to *Phyllitis*; *Hooperia*, founded on *Chylocladia Baileyana*; and *Diplocystis* (*Agardhinula* De Toni), on *Callophyllis Browneæ*. The trichosporanges of *Dictyota crenata*, the cystocarps of *Cordylecladia furcellata*, and the antherids of *Sarcomenia dasyoides*, are described. The genus *Cystoseira* is divided into three subgenera,—*Rapidophora*, *Thesiophyllum*, and *Eucystoseira*; and *Liagora* into two,—*Euliagora* and *Goralia*.

Procarp and Cystocarp of Ptilota.‡—Mr. B. M. Davis describes in detail the structure and development of the procarp and cystocarp in this genus of Florideæ, especially in two American species, *P. serrata* and *plumosa*. The structure and development of these organs agree in general features with those of allied genera, e.g. *Callithamnium*, *Ceramium*, &c., but differ in some interesting points; and the author considers there is strong evidence that the ordinary mode of reproduction of *Ptilota* is non-sexual or apogamous. In no case were any pollinoids found attached to the trichogyne. The procarp consists of a trichogyne, a carpogenous cell, and an intermediate portion composed of one or two cells, the trichophoric apparatus. The distance between the trichogyne and the carpogenous cell is so great that it is difficult to conceive of the sexual fusion being transmitted from one to the other without the intervention of an ooblastema-filament; and no trace can be detected of a structure of this character. In *P. serrata* the cystocarp is always developed from a single carpogenous cell; in *P. plumosa* from one of two cells.

Thorea.§—Herr F. P. R. v. Wellheim describes several points in the structure of *Thorea ramosissima*, especially the gelatinous sheath which envelops both the medullary filaments and the basal cells as well as the monosporangial filaments. The sheaths of the separate filaments are seldom to be clearly distinguished, and have then usually only a single septation; more often they are more or less confluent.

Pilinia and Stigeoclonium.‖—Miss Josephine E. Tilden has cultivated the rare alga *Pilinia diluta*, and finds it to be a stage in the development of *Stigeoclonium flagelliferum* or some nearly allied species, which also has a *Chætophora*-form (*C. pellicula*) and a *Palmella*-form. The *Pilinia* stage is characterised by a calcareous secretion; bristles are formed under cultivation. In *Pilinia* the authoress observed conjugation between microzoogametes, resulting in the production of a planozygote. In

* Ann. Sci. Nat. (Bot.), ii. (1896) pp. 350–71.
† Acta R. Soc. Phys. Lund, xxxii. (1896) 140 pp. and 1 pl.
‡ Bot. Gazette, xxii. (1896) pp. 353–78 (2 pls.).
§ Oesterr. Bot. Zeitschr., xlvi. (1896) pp. 315–20 (1 pl.).
‖ Minnesota Bot. Studies, 1896, pp. 601–35 (5 pls.).

Pilinia the number of megazoospores in a gonidange is usually four; in *Stigeoclonium* it may be as high as sixteen.

Snow-Flora of Mont Blanc.*—Prof. R. Chodat records the following low forms of life observed on the snow-field of the Col des Ecandies. An organism corresponding closely to *Hæmatococcus lacustris*, consisting of ellipsoidal cells of a brick-red to purple-red colour, the contents frequently dividing into spores, and producing zoospores under culture. The author considers it probable that *Sphærella nivalis* is a stage of the same organism. Generically it can hardly be distinguished from *Chlamydococcus*. A new species, *Raphidium nivale*, is described, not associated into colonies. A little known desmid *Ancylonema Nordenskiöldii*, found also in Norway, was also met with.

Fungi.

Protoplasmic Connection in Fungi.†—Herr A. Meyer asserts that filaments connecting the protoplasts of adjoining cells are common in the higher Fungi, as in all the larger plants. They are especially readily recognised in the mycele of *Hypomyces rosellus*, in which cells of the septated hyphæ have from 3 to 5 nuclei, and the septa are traversed by protoplasmic threads. The same occurs in the sclerotes of *Claviceps purpurea*. The cytoplasms of hyphæ which are at first isolated become in this way combined and capable of carrying on a common work. The fusion of the spores in *Hypomyces* may be compared to that of the myxamœbæ into a plasmode in the Myxomycetes.

Acid-loving Fungi.‡—In dilute solutions of citric acid, Herr C. Wehmer finds a fungus-mycele which he determines as belonging to *Verticillium glaucum*. In solutions containing tartaric acid, *Citromyces* makes its appearance. *Penicillium luteum* was found when nutrient solutions containing sugar were treated with citric acid; and *Aspergillus niger* when tartaric acid was added.

Dissemination of Spores by Rain.§—Prof. K. Goebel calls attention to the fact that not only the spores of Mosses, but those also of Fungi (*Geaster*) are greatly aided in their dissemination by the action of rain-drops. This appears to be the object of the highly hygroscopic property of the fructification.

Mucor proliferus sp. n.‖—Under this name Herr W. Schostakowitsch describes a new species readily cultivated on bread or horse-dung, distinguished by the form of the columel, the mode of branching, the tendency to prolification, and the dimorphism of the sporanges; those which terminate the main branches being larger and having a thicker wall than those which occur on the secondary branches.

Action of Nitrate of Ammonia on Aspergillus niger.¶—M. C. Tanret finds that by doubling or trebling the amount of nitrate of

* Bull. Herb. Boissier, 1896, pp. 879–89 (1 pl.).
† Ber. Deutsch. Bot. Gesell., xiv. (1896) pp. 280–1.
‡ Beitr. z. Kennt. einheimischer Pilze, ii. (1895). See Bot. Centralbl., 1896, Beih., p. 414.
§ Flora, lxxxii. (1896) pp. 480–2. Cf. this Journal, 1895, p. 660.
‖ Ber. Deutsch. Bot. Gesell., xiv. (1896) pp. 260–2 (1 pl.).
¶ Comptes Rendus, cxxiii. (1896) pp. 948–50.

ammonia in Raulin's fluid, the growth of *Aspergillus niger* is much altered. At a temperature of 30°–40° C. the mycele grows profusely, but forms no spores. At 20°–22°, even with 1 gr. of ammonium nitrate to 100 ccm., the fructification is retarded, but is not entirely arrested, while the growth of the mycele still goes on. The author notes the appearance of free nitric acid in the culture-fluid in which the vegetating *Aspergillus* is growing. Moreover starch (though not in grains) is formed in the mould, both in light and darkness.

Rotting of Fruits.*—Herr C. Wehmer asserts *Penicillium glaucum* to be much the most common cause of the rotting of fruits. In apples and pears it is accompanied by *Mucor pyriformis*, and in the case of medlars the latter species is the most common fungus. In lemons, oranges, and most tropical fruits, *P. glaucum* is associated with two other closely allied species, *P. italicum* and *olivaceum*. In plums *Mucor racemosus* was also observed. *Botrytis cinerea* forms grey tufts on walnuts. This last species and *P. glaucum* are the common fungi on grapes.

Parasitic Fungi.—Messrs. L. M. Underwood and F. S. Earle † clear up the difficult synonymy of the species of *Peridermium* which are parasitic on pines. In the eastern United States there are two species which inhabit leaves, *P. acicolum* and *orientale*; and one, *P. cerebrum*, which is found only on stems, producing extensive gall-like swellings, often of enormous size.

M. N. Patouillard ‡ describes a remarkable deformation of a pine-cone produced by the attacks of an apparently new species of Uredineæ which he names *Cæoma conigenum*.

A disease of the sugar-cane very similar to that known as "red-rot" (*Rothfäule*), is attributed by Herr J. H. Wakker § to the attacks of a new species of *Marasmius* which he names *M. Sacchari*.

Mr. J. J. Davis ‖ describes a new species of Uredineæ *Burrillia globulifera*, parasitic on culms of *Glyceria fluitans*.

Prof. M. C. Potter ¶ details the development and nature of the conidial stage of *Botrytis cinerea*, a saprophyte which is the initial cause of the rotting of stored turnips.

Sugar-Cane Diseases.**—Prof. F. A. F. C. Went gives details of the life-history of two fungi which cause destructive diseases of the sugar-cane, *Colletotrichum falcatum* and *Thielaviopsis ethaceticus*, producing respectively the "red smut" and "pineapple disease." The first is a saprophyte on the leaves of the sugar-cane, but can become a wound-parasite. It does not appear to produce any other disease besides the red smut of Java. The second is a general saprophyte, behaving sometimes as a wound-parasite, and causing the pineapple disease of Java. The evidence is at present insufficient which proposes to identify this latter

* Beitr. z. Kentniss einheimischer Pilze, ii. (1896). See Bot. Centralbl., lxviii. (1896) p. 267.
† Bull. Torrey Bot. Club, xxiii. (1896) pp. 400–5.
‡ Journ. de Bot. (Morot), x. (1896) pp. 386–8 (1 pl.).
§ Centralbl. f. Bakteriol. u. Parasitenk., ii. (1896) 2te Abt., pp. 45–56.
‖ Bot. Gazette, xxii. (1896) pp. 413–4.
¶ Journ. Board Agric., iii. (1896) 14 pp. and 4 pls. See Bot. Gazette, xxii. (1896) p. 503.
** Ann. Bot., x. (1896) pp. 583–600 (1 pl.). Cf. this Journal, 1894, p. 380; 1896, p. 550.

fungus with *Trichosphæria Sacchari* and *Melancomium Sacchari*. The author was unable to obtain positive evidence that either of these forms can give rise to the other.

Parasites of the Beet.*—In addition to a number of animal parasites, Herr J. Stoklasa describes the following fungi as attacking the cultivated beet in Bohemia:—*Rhizoctonia violacea*, the most destructive of all, the mycele attacking the root, and causing enormous losses; *Cercospora beticola*, attacking the leaves; *Phoma Betæ*, the cause of dry-rot; and *Peronospora beticola*.

Fungi Parasitic on Lichens.†—Prof. W. Zopf gives a detailed list of all the lichens on which parasitic fungi have been observed, amounting to 309 species. The parasites themselves belong to 344 species and 76 genera. In the greater number of cases each fungus attacks only a single kind of lichen, though this is not always the case, *Trichothecium pygmæum* having been found on as many as forty different species. Similarly each kind of lichen is, as a rule, attacked by only a single species of parasitic fungus, though there are many exceptions also to this rule.

Organs of Attachment of Botrytis.‡—From a series of observations on *Botrytis cinerea*, Miss M. E. C. Horn comes to the conclusion that the organs of attachment and the conidiospores are equivalent both physiologically and morphologically, having, in fact, the same origin. The formation of the organs of attachment appears to be determined by external conditions, which may be artificially produced by placing a hard substance in proximity to the hyphæ.

Development of Teichospora and Ceratostoma.§—Miss M. A. Nichols describes the morphology and development of these two genera of Pyrenomycetes. In *Teichospora* no male organ could be detected (in *Teichosporella* there is a possible rudimentary antherid), and there is no probability of any process of fertilisation. A single cell of the mycele forms, by successive division and growth, a solid sphere of parenchymatous tissue. Certain of the inner cells of this tissue become enlarged and differentiated into asci. Each ascus contains at first a single large nucleus, which, by successive karyokinetic divisions, furnishes a single smaller nucleus for each compartment of the multiseptate spores.

In *Ceratostoma* and *Hypocopra* the spores, upon germination, send out multinucleated mycelial threads, which become septate, branch, and form circular colonies. Upon the mycele are borne short thick branches, which become curved, or sometimes several times coiled, and perform the function of archicarps. Near these archicarps are usually found long slender branches, the antherids. These intertwine with the archicarps, and their tips meet and fuse. But in some cases the archicarps appear to develop without fertilisation. The archicarp furnishes, by growth and division, the cells which make up the interior of the perithece; and the asci arise from certain of these cells of the interior. In each young ascus there is a single primary nucleus; this divides karyo-

* Zeitschr. f. Zuckerindustrie in Böhmen, 1896. See Bot. Centralbl., 1896, Beih., p. 464. † Hedwigia, xxxv. (1896) pp. 312–66.
‡ Bot. Gazette, xxii. (1896) pp. 329–33 (1 pl.). § Tom. cit., pp. 301–28 (3 pls.)

kinetically, the daughter-nuclei dividing in the same manner, to furnish a nucleus for each spore. Nuclear division probably continues within the spore after the formation of the spore-wall. The wall of the perithece is formed from surrounding filaments.

Eurotiopsis Gayoni.*—M. J. Laborde describes, chiefly from the physiological side, a new mould which was found growing on starch. The fungus was discovered from the presence of red patches resembling those produced by *Micrococcus prodigiosus*. Microscopical examination disclosed a red-coloured mycele ramifying through the starch, which in its turn was stained by the pigment secreted by the mycele. Morphologically, the new fungus belongs to the Ascomycetes, and it is denominated *Eurotiopsis Gayoni* sp. n. Besides the mycele and the red pigment, other facts noted are that reproduction is aërial, and the presence of peritheces and conids. *Eurotiopsis Gayoni* is cultivable on artificial media, Raulin's fluid being especially suited to it. Certain carbohydrates, such as ethylic alcohol, glycerin, mannite, and lactose, are utilisable, while saccharose and inulin are not.

The experiments, which are numerous and physiological, show that *Eurotiopsis* is a most perfect example of the class of fungi connecting on the one hand the moulds which are pure agents of combustion, with the yeasts whose chief function is to effect the alcoholic fermentation of sugar. This ferment function seems highly elastic in *Eurotiopsis*, as it was found to vary from 1 to 10.

Consumption of Acids by Yeasts.†—Herr J. Shukow finds that yeasts are capable of taking up and using citric, malic, tartaric, and succinic acids: citric acid is that which is most easily assimilated, then malic, tartaric much less so, and succinic least of all. Different races of yeasts use up different quantities of acid under the same conditions. The intensity of the consumption depends on the presence of nitrogenous substances and of ash; the richer the medium is in these substances, the better it is for the nutrition of the yeasts, and the more acid they can consume.

Fusicladium.—Dr. R. Aderhold ‡ identifies the various parasitic species of *Fusicladium* as the conidial form of corresponding species of *Ventura*. *F. dendriticum*, common on the leaves of the apple, is referred to *V. chlorospora*, while the ascoform of *F. pirinum*, parasitic on the leaves of the pear, is erected into a new species under the name *Ventura pirina*. The identity was, in both cases, established by inoculation.

The same author § describes a new species, which he names *Fusicladium Betulæ*, parasitic on the leaves of several species of *Betula*, and identifies it as the conidial form of *Ventura ditricha* f. Betulæ.

Coleosporium Pini.‖—Prof. B. T. Galloway gives details of the life-history of this fungus, and of the injuries inflicted by it, resulting in a casting of the leaves, on *Pinus virginiana*, the only pine which it attacks in America. The full development of the fungus lasts through twelve

* Ann. Inst. Pasteur, xi. (1897) pp. 1–43.
† Centralbl. f. Bakteriol. u. Parasitenk., 2te Abt., ii. (1896) pp. 601–12.
‡ Landwirth. Jahrb., 1896, p. 875. See Bot. Centralbl., lxix. (1897) p. 247.
§ Centralbl. f. Bakteriol. u. Parasitenk., 2te Abt., ii. (1896) pp. 57–9.
‖ Bot. Gazette, xxii. (1896) pp. 433–53 (2 pls. and 3 figs.).

months, and during a large part of this time it does not seriously interfere with the functions of the host. The ultimate result of the attacks of the parasite is to rupture the tissue of the leaves, causing excessive evaporation. This brings about a loss of turgidity and other physiological changes which lead to the gradual death and casting of the leaves.

Melampsora Tremulæ.*—According to Herr G. Wagner, different forms of this parasite of the aspen are connected genetically with three distinct æcidioforms, viz.:—(1) *Cæoma pinitorquum* on *Pinus sylvestris*, and *C. Laricis* on *Larix europæa*; (2) *C. Mercurialis* on *Mercurialis perennis*; and (3) *C. Chelidonii* on *Chelidonium majus*. The last two forms he names *Melampsora Rostrupii* and *M. Magnusiana* respectively.

Rhizoctonia.†—M. E. Roze calls attention to the frequent concurrence of *Rhizoctonia Solani* and *Oospora scabies* in potato-plants affected with the scab, and suggests that the chains of small spherical hyaline cells which constitute the latter fungus are a form of fructification of the *Rhizoctonia*.

Tuberaceæ and Gasteromycetes.‡—Following out his division of the Tuberaceæ into the three families, Eutuberineæ, Balsamieæ, and Elaphomycetineæ, Dr. E. Fischer seeks to draw out a parallel between these and corresponding members of the Gasteromycetes. Parallel forms to the Eutuberineæ are to be found among the Gasteromycetes; on the one hand, in the genera *Gautieria* and *Hysterangium*; on the other hand, in *Hymenogaster*. But while in the Tuberaceæ the differentiation does not advance beyond *Tuber* or *Pachyphlœum*, the development of the fructification attains, among the Gasteromycetes, a much greater height in the Clathreæ and Phalleæ. The Balsamieæ may be compared to the Lycoperdaceæ among the Gasteromycetes. Among the Elaphomycetineæ, certain families present parallel forms to genera of Sclerodermeæ among the Gasteromycetes.

Receptacle of Clathrus.§—Pursuing his investigations on the Phalloideæ, Dr. E. A. Burt now describes in detail the development of the receptacle of *Clathrus columnatus*, differing in several points from the conclusions of Fischer.‖ The resemblances and differences between the two families of the Phalloideæ, the Phalleæ and the Clathreæ, are further elucidated; one of the most important differences is that in the mature stage, the position of the glebe is outside the receptacle in the Phalleæ, while it is within it in the Clathreæ. The author believes that the Phalleæ and Clathreæ have both arisen independently from lower forms outside the family; the highest specialised forms in each family resemble one another from being adapted to the same end.

In another paper,¶ Dr. Burt gives a synopsis of all the Phalloideæ of the United States.

Actinomycosis.**—Dr. G. Gasperini protests against confounding several quite distinct species of *Actinomyces*. Bovine actinomycosis is

* Oesterr. Bot. Zeitschr., xlvi. (1896) pp. 272–3.
† Comptes Rendus, cxxiii. (1896) pp. 1017–9.
‡ Ber. Deutsch. Bot. Gesell., xiv. (1896) pp. 301–11. Cf. this Journal, *ante*, p. 59.
§ Bot. Gazette. xxii. (1896) pp. 273–92 (2 pls.). Cf. this Journal, 1896, p. 661.
‖ Cf. this Journal, 1891, p. 78.
¶ Tom. cit., pp. 379–91.
** Atti Soc. Tosc. Sci. Nat., x. (1896) pp. 144–9. Cf. this Journal, 1896, p. 221.

not solely due to *A. bovis*, but to several distinct species; of which he has isolated *A. albus, sulphureus*, and *luteo-roseus*. In man, infection has been observed by *A. albus, asteroides*, and *carneus*. He confirms the opinion that Madura foot is a form of actinomycosis, and that this is not solely due to *A. ruber*. He shows the ætiological identity of lesions with clavate and those with filamentous forms of the micro-organism; and emphasises the practical importance of the simulation of true tuberculosis by actinomycosis in man.

Protection of the Organism against Blastomycetes.*—Dr. G. Jona injected *Saccharomyces apiculatus* into the blood-circulation, the peritoneal sac, and beneath the skin of rabbits, for the purpose of ascertaining how the animals get rid of the germs. In the first case, it was found that the *Saccharomyces* was killed, and finally absorbed by the blood itself, by means of its inherent physiological properties; thus negativing the supposition that the parasites were excreted by the kidneys, or had betaken themselves to the viscera. Injections of suspensions of *Saccharomyces* cultures in water into the peritoneal sac showed the effect of the agglutinative action of the peritoneal fluid on the parasites, which in a few hours were either destroyed or rendered incapable of reproduction. Similar results were obtained from subcutaneous injections.

Myxomycetes.

Myxobotrysaceæ, a new Order of Myxomycetes.†—On the bark of a willow, Herr H. Zukal found an organism belonging to the Myxomycetes, *Myxobotrys variabilis*, which he makes the type of a new order, Myxobotrysaceæ. The Exosporeæ are divided into two orders, the Ceratiomyxaceæ, of which *Ceratiomyxa* is the type, and the Myxobotrysaceæ, which are characterised by the spores arising by budding from the plasmode, without any previous breaking up of the protoplasm into distinct portions. In *Myxobotrys*, the spores are of two kinds, larger and smaller. The former are the result of the creeping plasmode forming itself into nearly spherical branches, which ultimately become elliptical, and transform themselves into spores by the excretion of a delicate membrane. These spores are either sessile on the substratum or on a membranous hypothallus, or have a very short stalk; the contents are orange-red. In the latter case, the plasmode puts out conical or cylindrical processes, at the apex of which are developed the ellipsoidal shortly-stalked orange-red spores. The swarmspores and myxamœbæ were not observed. The author describes a peculiar process which takes place in the plasmode. At the time when the ingesta are expelled, and the formation of spores begins, the rod-shaped microsomes disappear, and are replaced by a great number of long filaments.

According to F. Ludwig,‡ the alleged new genus is identical with Berkeley's *Chondromyces*, placed by Thaxter § in the Myxobacteriaceæ, in which Zukal's Myxobotrysaceæ must be merged.

Amylotrogus, a new Genus of Myxomycetes.‖—M. E. Roze finds in gangrenous potatoes a parasite which attacks the starch-grains, be-

* Centralbl. f. Bakteriol. u. Parasitenk., xxi. (1897) pp. 147–50.

† Ber. Deutsch. Bot. Gesell., xiv. (1896) pp. 340–7 (1 pl.).

‡ Bot. Centralbl., lxix. (1897) p. 352.

§ Bot. Gazette, xvii. (1892) p. 389. Cf. this Journal, 1893, p. 370.

‖ Comptes Rendus, cxxiii. (1896) pp. 1323–4; cxxiv. (1897) pp. 248–50; Journ. de Bot. (Morot), x. (1896) pp. 424–6 (1 fig.).

longing to a new genus of Myxomycetes, which he names *Amylotrogus*. It attacks also the starch of wheat, and several distinct species are described. Some of these species develop their plasmodes superficially, others within the starch-grains; in the former case, they frequently branch and anastomose. The plasmodes can retain their vitality for a long period in a desiccated condition. They have a discoid form and a pale violet-red colour. Two species are specially described, *A. ramulosus* and *discoideus*.

Cytidium, a new Genus of Myxomycetes.*—In a list of Myxomycetes from the Miami Valley, Ohio, Mr. A. P. Morgan describes the new genus *Cytidium*, with the following diagnosis:—Sporange globose or rarely ellipsoidal, stipitate; wall a thin membrane, with an external layer of minute granules of lime, ruptured irregularly. Stipe more or less elongated, tapering upwards, and entering the sporange as a columel. Capillitium of slender tubules, arising from the columel, repeatedly branching and anastomosing to form a regular network, the extremities attached on all sides to the wall of the sporange, the tubules containing at intervals nodules of lime. Spores globose, violaceous. Near *Physarum*, but distinguished by the columel, which gives origin to the capillitium.

Protophyta.

α. Schizophyceæ.

Reproduction of Marine Diatoms.†—Mr. G. Murray describes a remarkable mode of propagation observed in certain pelagic diatoms chiefly belonging to the genera *Biddulphia*, *Coscinodiscus*, and *Chætoceros*. In *Biddulphia mobiliensis* "cysts" were observed within the parent-cell, with only slightly silicified wall, and without the characteristic spines. They appear to have the power of dividing and multiplying before assuming the characteristic parent-form. A similar phenomenon was observed in *Coscinodiscus concinnus*, but here the protoplasm divides before the production of the "cysts," two of which were found within the same parent-frustule, differing from one another in form, and in the width of the girdle-zone. It is not uncommon to find the young *Coscinodisci* in "packets" of eight or sixteen, resulting apparently from further binary division within the frustules, which are found accompanying them in an empty state. These young forms have their membranes either very slightly silicified or not at all, and are, therefore, capable of increasing in size. A similar formation of "packets" of eight or sixteen young indididuals within the parent-frustule was observed in several species of *Chætoceros*.

Diatomaceous Earth.‡—Mr. T. W. E. David gives particulars of the position and composition of the diatomaceous earth found in various localities in N.S. Wales. He states that they are always found in association with volcanic rocks, probably in consequence of the large amount of silica contained in solution in the hot springs. One of the most important deposits, that of the Warrumbungle Mountains, is associated with trachytic lavas and tuffs of early Tertiary, possibly of late Cretaceous Age.

* Journ. Cincinnati Soc. Nat. Hist., xix. (1896) pp. 1–44 (3 pls.).
† Proc. Roy. Soc. Edinburgh, xxi. (1896) pp. 207–19 (3 pls.). Cf. this Journal, 1896, p. 704. ‡ Proc. Linn. Soc. N.S. Wales, xxi. (1896) pp. 261–8 (2 pls.).

Structure of Cyanophyceæ and Bacteria.*—While agreeing with many of Bütschli's conclusions, especially with his pronouncement of the honeycomb structure of protoplasm and of the cell-wall, Herr H. Zukal dissents from his view as to the nature of the "central body" in the Cyanophyceæ and Bacteria, which he maintains to have no relation to the true nucleus in higher plants. He points out that the protoplasm has naturally a denser consistency in the smallest organisms. From his observations of the phenomena in Fungi, he has convinced himself that the nucleus has been gradually developed from microsomes by differentiation and specialisation.

Oscillatoria rubescens.†—Prof. R. Chodat has studied in detail the structure of this rare organism, which appears occasionally (in warm seasons) on the surface of Lake Morat, in Switzerland, in such quantities as to impart a pink colour to the water. The protoplasm contains a number of corpuscles, similar to those which have been taken for sulphur in other Algæ; they are, however, vacuoles filled with a gas. The pigment is not in a state of solution, but is intimately associated with the protoplasm, filling up the vacuoles; although nearly invisible under the Microscope, it can readily be detected by the spectroscope. It appears to be identical with Sorby's "pink phycocyanin," and Chodat proposes for it the term *myxoporphyrin*. The vacuoles have a remarkably resistant membrane.

β. Schizomycetes.

Effect of Röntgen Rays on Bacteria.‡—Dr. J. Wittlin exposed several kinds of pathogenic bacteria to the influence of the Röntgen rays for a full hour, and found, from bacteriological examination, that the action of these was *nil*. Exposure of the medium before inoculation to the rays was also without influence.

Loose Combination of Oxygen in certain Bacteria.§—Prof. W. Pfeffer remarks that, as a rule, plant-cells do not store up oxygen in a loose combination, so that the streaming of the protoplasm very soon ceases when oxygen is absent. The author has made the theoretically important discovery that there are both coloured and colourless bacteria which, after the manner of hæmoglobin, are able to pick up a considerable quantity of oxygen, retaining it, however, in loose combination; and that they are able to gradually give up this oxygen when they are confined in places devoid of it. *Bacterium termo* was used as a test of the presence of oxygen. *B. termo* was placed in a hanging drop in a gas chamber, on the floor of which the organism to be examined was put. Hydrogen was then passed through until *B. termo* stopped moving. When the organism gave off oxygen, *B. termo* began to move again. It was found that oxygen could be given off for twelve hours. The presence of CO_2 and the volume of oxygen were also determined in the course of these experiments. From the fact that these bacteria, even when dead, will form a combination with oxygen, it would seem possible that the

* Ber. Deutsch. Bot. Gesell., xiv. (1896) pp. 331–9. Cf. this Journal, 1896, p. 662. † Journ. de Bot. (Morot), x. (1896) pp. 341–9, 405–9 (1 pl. and 1 fig.).

‡ Centralbl. f. Bakteriol. u. Parasitenk., 2te Abt., ii. (1896) pp. 676–7.

§ K. Sächs. Gesell. Wiss. Leipzig, July 1896, 5 pp. See Centralbl. f. Bakteriol. u. Parasitenk., 2te Abt, ii. (1896) pp. 763–4.

effective substance may be chemically isolated; and this view is supported by the fact that a cold alcoholic extract combines with oxygen in a remarkable manner.

Fossil Bacteria.*—M. B. Renault, in an exhaustive memoir dealing with fossil bacteria, claims to have proved that Bacteriaceæ are coeval with the first living organisms. The coccoid form appears to have been more frequent than the bacillar, and the cocci to be divisible into small and large. The action of both kinds of cocci is essentially destructive; for in most cases disorganisation of structure is associated with their presence. According to this, it would seem to follow that coal containing skeletons of organised structures is not the result of a complete microbic fermentation, while amorphous coal may be so. As certain bacilli, *B. Tieghemi*, *B. vorax*, *B. gramma*, and others are found only where there is evidence of considerable decomposition, the inference is that they appear after microbic fermentation has been set up by cocci. The cocci and bacilli found in fossil bone, teeth, scales, and coprolites have much the same size and appearance as those described by Vignal, Miller, and others in caries of bone and teeth. Certain bacilli, such as *B. ozodeus*, and *B. gramma*, are constantly found inside the sporanges of ferns, attacking first the spores and later the spore-cases. The destructive action of bacilli seems also to be great, and the reason why so much has been preserved is apparently the presence of ulmic acid in considerable quantity. In regard to coal formation, the presence of a coccus of a very dark colour, measuring $0 \cdot 4\ \mu$, is mentioned, but it is not affirmed that there are specific coal-forming bacteria. Before cell-destruction is complete, the bacteria often assume the zooglœa form; and under these conditions spheroliths are formed. In the space at our disposal it would be difficult to impart an adequate notion of the author's researches in the little known field of fossil bacteriology, but it is obvious that there is a future before it. The numerous illustrations are extremely effective.

Bacterial Disease of Solanaceæ.†—Mr. E. F. Smith finds several species of Solanaceæ—the potato, tomato, and egg-plant, *Solanum melongena*, attacked by a disease which he calls "brown-rot," due to an undescribed parasite, *Bacillus Solanacearum*, resembling *B. tracheiphilus* and that known as "Kramer's bacillus," but differing in several characters.

Bacteriosis of the Hemp.‡—Dr. V. Peglion describes a disease which attacks the stem of the hemp, and which, though always accompanied by a number of mould-fungi, he believes to be primarily due to the attacts of a Schizomycete. This organism, which is of the nature of a bacillus imbedded in mucilage, closely resembles *B. cubonianus*, a parasite of the mulberry, and may possibly be identical with it.

Influence of the Cerium and Zirconium Groups on the Growth of Bacteria.§—Dr. G. P. Drossbach states that the salts of cerium, didymium, lanthanum, yttrium, erbium, thorium, and zirconium have

* Ann. Sci. Nat. (Bot.), ii. (1896) pp. 275–349 (46 figs.). Cf. this Journal, 1896, p. 555.

† U.S. Department Agriculture, Div. Veg. Phys., Bull. No. 12, 1896, 26 pp. and 2 pls.

‡ Malpighia, x. (1896) pp. 556–60.

§ Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xxi. (1897) pp. 57–8.

a marked inhibitory and preventive action on the growth and development of bacteria, and suggests that these substances will possibly be used as antiseptics.

Fixation of Free Nitrogen by Bacilli of Root-Tubercles.*—M. Mazé made some experiments which show that when the bacilli of the root-tubercles of Leguminosæ are placed in a suitable medium and under conditions which correspond as nearly as possible to those in the tubercles, they develop in quite a surprising way, and fix free nitrogen from the air. Hence the fixation of nitrogen belongs to the bacillus alone, and it is no longer necessary to explain this fixation by means of symbiosis.

The cultivation media were solid surface cultures, composed of an infusion of haricots blancs, saccharose, gelose, with some sodium chloride and bicarbonate. The medium was placed in thin layers in fermentation flasks, and air supplied by aspiration. The air was purified from nitrogen in combination by passing it over heated copper shavings and sulphate of copper, and the moisture restored by causing the air stream to bubble through water. The inoculation was made by means of a spraying pipette, so that the surface of the medium was uniformly covered with germs. In another series the medium was devoid of gelose, but the results obtained were the same, that is to say, the weight of nitrogen at the end of the experiment was greater than at the beginning. It was, therefore, proved that the bacilli of the root-tubercles of Leguminosæ have the power of fixing the free nitrogen of the air.

Adaptability of Bacillus radicicola to Foreign Nutritive Media.†—Herren A. Stutzer, R. Burri and R. Maul made experiments with *Bacillus radicicola* for the purpose of ascertaining whether it could adapt itself to an unaccustomed environment. After obtaining pure cultures from strong and healthy lucerne plants grown in a medium made from lucerne, grape-sugar, and gelatin, the cultures were sown on a medium the basis of which was white mustard. It was found that, after several transferences on this latter medium, *B. radicicola* lost its vitality. Success was, however, attained by gradually accustoming the microbe to the mustard medium, and this was done by starting with a lucerne medium containing 5 per cent. of mustard medium, the proportion being gradually increased until *B. radicicola* grew well on the pure mustard medium. The success of these experiments shows that *B. radicicola* possesses a high degree of adaptibility to unaccustomed nutritive conditions.

Bacteriology of Mumps.‡—Messrs. P. M. Mecray and J. J. Walsh † examined the secretion from the parotid and the blood in some cases of mumps. A coccus resembling that described by Laveran and Catrin, occurring in pairs chiefly, but also in fours and in larger groups, and about the same size as the ordinary suppuration cocci, was isolated. The colonies are circular white shiny points, with slow growth and gradual liquefaction of the gelatin. On potato the growth resembles at first thin white streaks, gradually extending to form a thin film. On

* Ann. Inst. Pasteur, xi. (1897) pp. 44–54.

† Centralbl. f. Bakteriol. u. Parasitenk., 2te Abt., ii. (1896) pp. 665–9.

‡ Med. Record, Sept. 26, 1896. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xxi. (1897) p. 68.

blood-serum the growth is more rapid, but the colour of the colonies less white. Litmus milk turns red on the third day and coagulates. Milk is an excellent medium. Of eight cultures made from blood, two were negative; three gave pure cultures of the diplococcus; while the remaining three contained other cocci, notably a *Staphylococcus*, probably *St. epidermidis albus.*

Non-Microbic Toxins.*—From an elaborate series of experiments made for the purpose of ascertaining the mechanism of immunity, M. A. Calmette and M. A. Delarde draw conclusions which may be summarised as follows:—The serum of animals naturally refractory to the toxins used (abrin and venin) rarely possesses antitoxic properties against these toxins. It may be remembered that the same phenomenon has been observed with regard to microbic toxins (tetanus). When the serum is antitoxic, as in the case of the hedgehog and mongoose, to serpent venom, the antitoxic power is but slightly marked, and bears no relation to the degree of immunity. Hence there is no correlation between the naturally refractory condition possessed by certain animals, and the antitoxic powers of their juices with regard to the toxins to which they are insensible. While warm-blooded refractory animals are able to form antitoxins under the influence of repeated injections of non-fatal doses of toxin, cold-blooded refractory animals are unable to do so. Cold-blooded refractory animals may acquire immunity to fatal doses of toxin without their serum becoming antitoxic. Antitoxic non-microbic serums may be practically employed for imparting passive immunity to man and animals against abrin and venin, and for the diagnosis of toxins in toxicological inquiries. The active substance of antitoxic serums is not altered by certain chemical reagents which destroy or profoundly alter the toxins; when mixed *in vitro* with toxins the latter are unaffected. It seems to exist normally and abundantly in the protoplasm of leucocytes of vaccinated animals, whence it becomes diffused in the blood-serum and other organic fluids. It does not dialyse, and it has an energetic action on the leucocytes of fresh animals. Certain other substances devoid of specific action against toxins, such as meat-broth, normal serum, &c., appear to be able to impart preventive properties when injected into fresh animals.

The authors further generalise their results and conclusions by pointing out that the antitoxic function is independent of immunity, as the latter may exist in the absence of the former, and that the two kinds of immunity, natural and acquired, are derived from a special property of the cells. The action of the toxins on the cells is compared to that of a magnet on a bar of soft iron.

Ubiquity of the Typhoid Fever Bacillus.†—MM. P. Remlinger and G. Schneider have made a series of observations which tend to show that the bacillus of typhoid fever has a universal distribution, that it exists in the soil, in water, and in the intestinal canal of persons unaffected with typhoid fever. Their remarks are preceded by an enumeration of the test characters of Eberth's bacillus; of these, eleven well-known and generally accepted criteria are merely mentioned, while two more are discussed at some length. These are the difficulty which the typhoid

* Ann. Inst. Pasteur, x. (1896) pp. 675–707. † Op. cit., xi. (1897) pp. 55–66.

bacillus experiences in developing in a cultivation medium previously used for typhoid cultures, and the mode of action of the serum of immunised animals; that is to say, the agglutinative action on cultures and the preventive action against infection.

Out of 37 samples of water of various sources, 9 contained bacilli presenting all the characters of typhoid bacilli. In soils of different origin, 7 samples out of 13 showed typhoid bacilli. In five out of ten persons unaffected with typhoid, the stools contained bacilli identical with Eberth's bacillus.

Independent of the foregoing, bacilli were frequently met with, which while they presented the greatest resemblance to the typhoid bacillus, were distinguished therefrom by the absence of pathogenic properties and their indifference to typhoid serum. These organisms, the authors believe, are not only closely related to, but are possibly identical with, the *Bacillus typhosus*. According to the view laid down, typhoid fever is the result of depressing circumstances, which lead to a lowered vitality of the body. This depression allows the typhoid germs to assume the offensive, and overcome the resistance of the tissues of the body.

Homology of Streptococci.*—Dr. C. Zenoni records some observations on a *Streptococcus* obtained from the peritoneal exudation of a man suffering from peritonitis and orchitis. The coccus was of large size, and formed chains. It stained with Gram, and had the cultural appearance of *Streptococcus*. In different cultivation media the size varied considerably, as also did the length of the chains. The effect of virulent cultures was neutralised by means of Marmorek's anti-streptococcous serum. The author regards his results as supporting the doctrine of the homology of *Streptococci*.

Tonsillitis caused by Friedländer's Bacillus.†—MM. Ch. Nicolle and A. Hébert record the fact that they have met with eight cases of membranous tonsillitis caused by Friedländer's bacillus; six times in a state of purity, and twice associated with the diphtheria bacillus. The bacilli isolated from these membranes were examined as to their morphological, cultural, and fermentative characteristics; their virulence was also tested, and attempts made to reproduce a membrane in animals.

Presence of Pneumobacillus of Friedländer in Water.‡—According to M. L. Grimbert, the bacillus described by Mori under the name of *B. capsulatus* is identical with *B. pneumoniæ* Friedländer. *B. capsulatus* was isolated from water in which, the author points out, the pneumobacillus of Friedländer may be frequently met with, and there in conjunction with *B. coli*. These two species have frequently been confounded, from a general similarity of appearance, and a not too critical examination. Neither stains by Gram's method, nor liquefies gelatin; both ferment lactose; Friedländer's bacillus is devoid of movement, and does not form indol. The author shows that these two organisms, *B. coli* and *pneumobacillus*, may be distinguished, first by the *pneumobacillus* never producing indol in a pepton solution, and secondly, by its ability to ferment glycerin. On the other hand, *B. coli* does produce indol, and does not attack glycerin. The bacillus of Friedländer is easily isolated from

* Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xxi. (1897) pp. 10–19 (3 figs.).
† Ann. Inst. Pasteur, xi. (1897) pp. 67–79. ‡ Op. cit. (1896) pp. 708–15.

water by Péré's method, in which procedure carbolic acid is added to the bouillon.

Micrococcus cyanogenus.*—Messrs. L. H. Pammel and R. Combs obtained *Micrococcus cyanogenus* from a culture of *B. aromaticus* in milk. Within three or four days, the milk assumed a blue colour. *M. cyanogenus* is a small aerobic coccus which liquefies gelatin. The growth on agar is white, with faint blue colour. The blue colour imparted to milk disappears later on, and the milk is coagulated. In twenty-five days the coagulated milk is liquefied. No colour was developed on Dunham's pepton.

Termobacterium Aceti.†—Herr A. Zeidler describes a bacterium *Termobacterium aceti*, the first prominent characteristic of which is its power to convert alcohol into acetic acid. Morphologically and culturally it resembles the Termobacteria as described by Cohn, except that it has a great tendency to produce involution forms. Its vitality is less than that of most acetifying bacteria, and it does not appear to have any particularly harmful qualities as far as brewing is concerned.

* Proc. Iowa Acad. Sci., iii. pp. 135–40. See Centralbl. f. Bakteriol. u. Parasitenk., 2te Abt., ii. (1896) pp. 764–5.

† Centralbl. f. Bakteriol. u. Parasitenk., 2te Abt., ii. (1896) pp. 729–39.

MICROSCOPY.

a. Instruments, Accessories, &c.*

(1) Stands.

Stands and various Equipments.†—Attention may be called to an editorial article in which recommendable stands are described from the catalogues of Zeiss, Schieck, Leitz, and others. General remarks are made concerning apertures, eye-pieces, magnifying power, apochromatic lenses, focusing arrangements, and the methods of using Abbe's apertometer and test-plate.

(2) Eye-pieces and Objectives.

Apertures of Objectives.‡ — Mr. R. B. L. Rawlings describes a simple method for roughly comparing the apertures of objectives, to be used when the Abbe apertometer is not available. As in the Abbe instrument,§ a 3 in. auxiliary objective is attached to the under part of the draw-tube; but in place of the bevelled semicircular glass plate, a sub-stage condenser and an iris diaphragm are used. The objective to be examined is first focused on the upper surface of the condenser, and then, without disturbing this adjustment, the auxiliary objective is screwed to the draw-tube, which is slid into such a position that the diaphragm is clearly seen; when the margin of the diaphragm is brought to the edge of the field of view, the diameter of the opening is in direct ratio to the aperture of the objective. Examining another objective in the same way, the apertures of the two are proportional to the diameters of the diaphragm openings in the two cases. It is suggested that a direct reading of the aperture could be made by combining the iris diaphragm with a graduated arc and index pointer; this would give a measure of the diameter of the opening, and so a measure of the aperture of the objective.

(3) Illuminating and other Apparatus.

Monochromatic Light Apparatus.‖—Mr. A. E. Tutton describes an instrument of precision for producing monochromatic light of any desired wave-length, and explains its use in the investigation of the optical properties of crystals. It consists essentially of a spectroscope, with one large 60° prism, in which the eye-piece of the telescope is replaced by a fixed slit. Light of different colours is caused to pass through this slit by rotating the dispersing apparatus, the position of which can be read off on the graduated circle, and this, after the instrument has been empirically graduated, will give an indication of the

* 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. ang. Mikr., ii. (1897) pp. 321–35 (2 figs.).

‡ Amer. Mon. Micr. Journ., xviii. (1897) pp. 3–6; and English Mechanic, lxv. (1897) pp. 57–8.

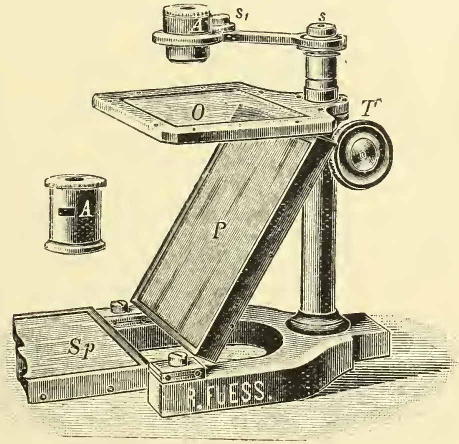
§ This Journal, 1878, p. 19; 1880, p. 20; 1896, p. 247.

‖ Phil. Trans., clxxxv. (1894) A, pp. 913–41; and Zeits. f. Krystall., xxiv. (1895) pp. 455–74 (7 figs.).

wave-length of the light passing through the slit. The light, after being diffused by a plate of finely ground glass, passes directly into the observing instrument—axial angle apparatus, goniometer or Microscope, &c. As a strong light is necessary, a lime-light lantern is used.

Lens-Support, with Polarising Apparatus.*—Dr. C. Leiss describes an instrument for examining large mineral, rock and palæontological sections in polarised light, which is also useful for examining crystal groups, separating minerals, &c.; it is made by Fuess after the designs of E. Kalkowsky. To the foot are hinged an illuminating mirror S*p*, and a glass plate P, which acts as the polariser. The glass plate O,

FIG. 8.



which may be replaced by metal plates having suitable openings, carries the object. The lens can be moved about in a horizontal plane by means of an arm jointed at s_1 and *s*, and the rack and pinion T gives an extended range of vertical motion. The analysing nicol, a Glan-Thompson prism, fits over the lens, and a slot is provided for inserting a mica or gypsum plate. Two Steinheil lenses, giving a large flat field and magnifying four and eight times, are supplied with the instrument.

Thermostat heated by Mineral Oil for Paraffin Imbedding.†—Herr W. Karawaiew describes a thermostat devised by him, which is heated by petroleum or benzoline, and regulated automatically by electrical contact. When the temperature for which the apparatus is adjusted ascends above the desired degree, the mercury column of an air thermometer inserted in the interior of the thermostat rises until it comes into contact with a platinum point, thereby making a current which acts on an electro-magnet. The power of the magnet is exerted on a movable metallic plate, which is inserted between the source of heat and the bottom of the thermostat. In this way direct heating is prevented until,

* Neues Jahrb. Mineral., i. (1897) pp. 81–2; and Zeitschr. ang. Mikr., ii. (1897) pp. 289–90.
† Zeitschr. f. wiss. Mikr., xiii. (1896) pp. 289–99 (3 figs.).

by the sinking of the thermometer, contact is again dissolved. The apparatus is of small size (about 17 cm. square) and made of copper. It is stated not to vary more than $\frac{1}{4}°$ during the 12 hours.

(4) Photomicrography.

On a Simple Method of Photomicrography by an Inexpensive Apparatus.*—Except for bodies of inappreciable thickness, photomicrography will never be able to compete with accurate drawings made by the aid of the camera lucida.

As the finger plays on the focusing-screw the eye is capable of fixing its attention on the portions of the image in sharp focus to the exclusion of those that are outside the focal plane, but no mere optical instrument is capable of doing this, and the result is that, where a body is of any thickness, the distinctness of the photographic image of the plane actually in focus is blurred, and marred by the hazy images of planes outside or within that plane.

Something of the same kind is seen in ordinary landscape photography when lenses of long focus are employed; either the foreground is blurred and the background sharp, or *vice versâ*. Now, as the eye is accustomed to at once focus each object, whether near or distant, as it plays over a landscape, and cannot do this as it glances over the photograph, the result is unsatisfactory and unnatural. For this reason an enlargement from a view taken with a short focus lens, albeit it has special faults of its own, is often more satisfactory.

If this be so patent in the ordinary photography of opaque objects, how much more unsatisfactory will be the result when, owing to the transparency of the objects, images of different degrees of sharpness are not merely juxta- but super-posed. Nevertheless, although for most objects photomicrographs can never equal good drawings, especially for purposes of demonstration, the method presents great advantages on account of its facility and quickness, and is of special value in meeting the objections of that pestilential person, the sceptical negative observer. The man who, because he can find no free "plasmodia" in cases of Indian fever, refuses to believe that Laveran ever saw such bodies in Algeria, will be more convinced by a single photomicrograph than by a whole atlas of drawings.

These latter may, or may not, be representations of the numerous fallacious appearances with which one becomes quickly familiar after working for a while at the examination of blood under high magnifications; but as a photograph must be a correct representation of some one aspect of the body, i.e. of the combination of the images of planes in and out of focus, its identity or otherwise with any known fallacy can be established in a way which is quite out of the question in the case of drawings.

To be really useful, a photomicrographic apparatus should be so simple that it can be applied at once to the delineation of any object that may chance to be in the field of the Microscope; and the difficulty of attaining this lies in the fact that ordinary illumination, such as is

* By G. M. Giles, M.B., F.R.C.S., F.R.M.S., Surgeon I.M.S. Read February 17th, 1897.

most convenient for ordinary observation, is far too feeble to be visible on the focusing-screen of the camera. In the early days of the art, when gelatin-bromide plates were yet unknown, direct sunlight was the only practicable illumination for anything but the most moderate amplifications.

To secure this a heliostat was indispensable, and it is now more than twenty years ago since the writer described in the Monthly Journal of this Society a plan in which this necessity was overcome, by employing a condenser of such long focus that the image of the sun was vivid enough to give one time to insert one's dark slide and expose before it had passed across the object.

The wet collodion-plate, if not used quickly, was utterly spoiled. With the dry plate, on the other hand, apart from its greater sensitiveness, length of exposure is a matter of no moment. The difficulty, however, of obtaining adequate light to sufficiently illuminate the ground glass remains, and the method I am about to describe overcomes this by doing away with the focusing-screen altogether.

No special camera is required. Almost any quarter-plate or 5 × 4-in. landscape camera will serve for the purpose; but it is most convenient to select one with a conical bellows, in which the front is completely detachable from the standards that attach it to the base-frame when set up for ordinary work. The one I am using is an Adam's "Victor" camera. The movable front carrying the lens is only 2 in. square, and a spare one, to receive the collar that is to connect camera and Microscope, is of course necessary.

Take a piece of black velvet about 2 in. wide, and have it sewn round the draw-tube of the Microscope, not too tightly. Then take a long strip of brown paper 1 in. wide dipped in paste or gum, and wind it round the middle of the velvet till it is about 1/16 in. thick. When this has dried thoroughly, fold down the projecting part of the velvet over the outside of the pasteboard tube we have thus made, and sew the edges together so as to neatly cover the outside of the tube. Nothing more is required but to cut a hole in the spare front just large enough to tightly hold the velvet-covered pasteboard tube. If the hole be made the right size, the joint will be quite light-tight without any packing or cement of any sort.

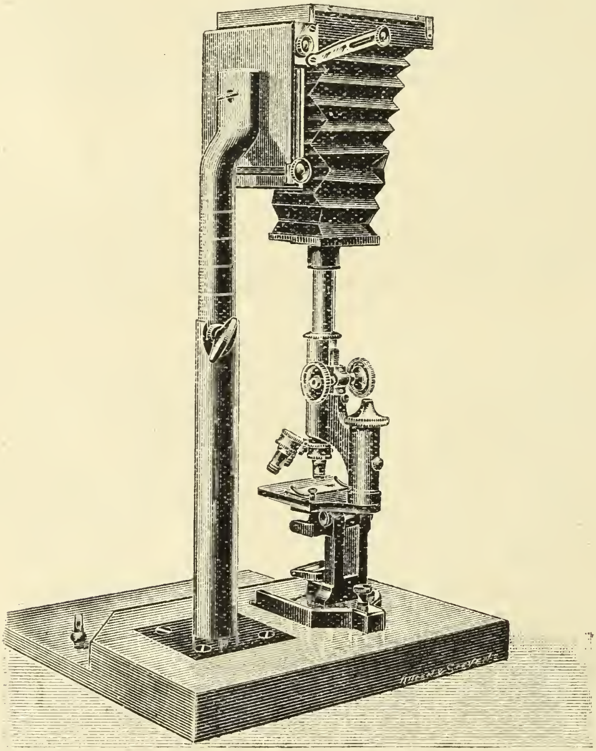
The Microscope is always used in the vertical position, and the camera is supported above it by means of a telescopic upright jointed vertically into a heavy base-board on which the Microscope stands.

The base-board should be about 1 ft. square, and at least an inch thick, standing on four low studs placed at the corners, or, better still, with studs at three corners, and the fourth stud replaced by a coarse-pitched, blunt-ended screw, so as to allow for inequalities of the surface on which it may be placed, as it is important that the apparatus be as little liable to vibration as may be. The upright consists of two stout drawn metal tubes, sliding one within the other, of such lengths that the inner tube can be fixed, by means of a clamping-screw, at any length between 15 and 20 in. The inner or sliding tube ends in a square metal plate about $2\frac{1}{2}$ in. square, with a central hole large enough to take the screw which ordinarily fixes the camera to its tripod. This plate must project a little clear of the surface of the tube, so that the base-board of the camera may clear the outer tube when it is being lowered. The upright is fixed nearly in the middle of the base-board, and the inner or sliding tube should be graduated to inches and tenths or millimetres, as may be preferred.

Any good Microscope-stand will serve, but it is essential that the fine-adjustment should have a graduated head, and a revolving stage is a great convenience.

The above dimensions are calculated for the largest but one of Zeiss' stands. I have not a catalogue by me, but it is, I believe, deno-

Fig. 9.



Camera attached to Microscope.

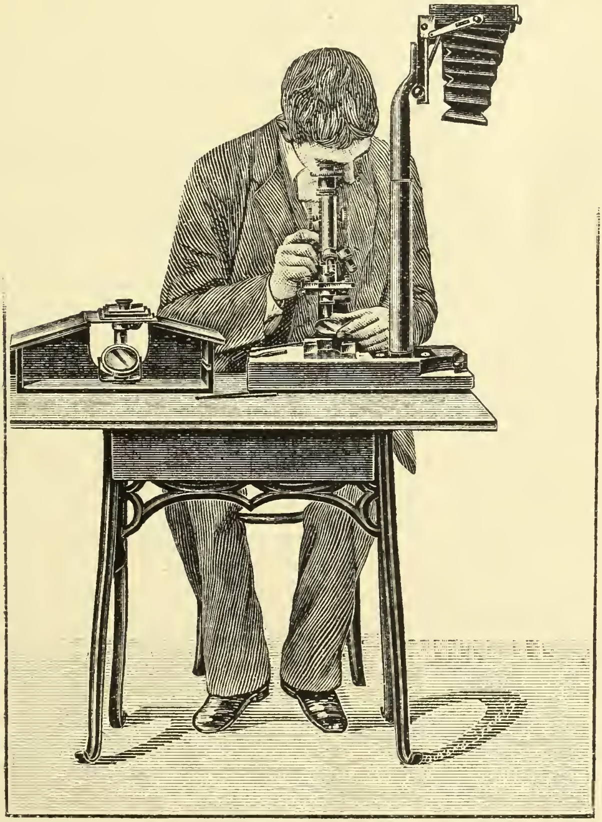
minated IIa. In this stand the milled head of the fine-adjustment is divided into 50 parts, marked from 2 to 100. If the Microscope which it is desired to use be not provided with a graduated fine-adjustment, a special one must be fitted, which can easily be done by turning up a flat button of hard wood, with a cavity below just large enough to slip tightly over the milled head, and with the upper surface flat, on which can be gummed a paper disc graduated to 2° or 4°, as may be convenient.

The provision of an index carried on some part of the arm of the

Microscope will not greatly tax ingenuity, but its position will necessarily vary with the type of Microscope employed.

When it is desired to use the apparatus, it is placed in front of an open window, and the Microscope is placed on the base-board at such a distance from the vertical pillar that the axis of the camera, when placed in position, may coincide with that of the Microscope. Having found this position, make a pencil outline of the foot of the Microscope on the

Fig. 10.



Camera swung aside to admit of adjustment of light, focusing, &c.

base-board, so that it can be, in future, removed and replaced without further trouble.

The camera is now screwed on to the plate of the upright, and adjusted so that its focusing-screen is accurately parallel with the base-board and the stage of the Microscope; but it is not, at this stage of the proceedings, placed over the Microscope, but turned aside out of the way, by twisting the inner tube of the standard within the outer one, so that one is able to examine an object under the Microscope as easily as if it were standing on the table, quite clear of any photographic attachment.

The pasteboard tube carrying the camera front is, however, fitted on to the draw-tube, as, owing to its small size, it does not interfere with the use of the Microscope any more than a micrometer eye-piece or other ocular attachment.

The easiest way to indicate the principles of the method I wish to advocate, will be to describe the method in a specific case.

Say it is desired to obtain a photograph of an object under Zeiss' C with oc. 3, the draw-tube at its full length.

The object is placed in position, accurately focused, and lighted to the best advantage by means of the concave mirror. If great exactitude be desired, exact parallelism may be secured by levelling the stage of the Microscope and the focusing-screen with a spirit-level. The camera, with the bellows hanging loose and unattached, is now swung round, so that it is suspended over the Microscope, and fixed at such a height that the length from the eye-piece to the focusing-screen may be about 8 in. Its front frame is now gently fitted on to the movable front already attached to the Microscope.

If the ground glass be now examined under a focusing-cloth it will be found that there is too little light on the plate to enable one even to see the position of the object, far less whether or no it is in focus; but, as a matter of fact, it will be nearly so—though, in all probability, the error, combined with the difference between actinic and visual foci, will necessitate the lens being focused a little away from the object to obtain a sharp picture.

Suppose now we focus the lens out four-hundredths, i.e. two divisions of the Zeiss milled head, and, having inserted an Ilford ordinary plate in the camera, proceed to expose for about one minute.

On developing the plate, if the lenses used at all correspond to those I am using, a very fairly sharp picture will result.

Now examine the plate closely for any portion of the picture that may be in sharp focus, and, having noted this, detach the camera front and swing the camera out of the way, and note exactly the number of divisions through which the milled head must revolve to bring this into sharp visual focus as one looks through the Microscope.

A few experiments may be necessary before this correction is accurately obtained; but, once it has been ascertained for any given combination of objective, ocular, and length of camera, sharply focused photographs may be obtained with far greater certainty than in the ordinary way, because it is far easier to focus sharply an object observed in the ordinary manner through the Microscope, than when the image is dulled by being examined through a ground-glass surface.

The weaker the objective, the larger will be the correction necessary; for instance, with draw-tube fully out, oc. 3, and a camera-length of 8 in., I find that I have for objective A to focus out 25 mm., for B 10 mm., for C 4 mm., and for D 2·5 mm.

The exposure, of course, must be increased as the square of the linear amplification or, given that one minute suffice for C, about 3 minutes will be required if D be substituted for it, which magnifies not quite twice as much. B, on the other hand, will require but 15 seconds, and A only 4 or 5.

The length of exposure will, of course, vary greatly with the quality of the light obtainable, but, as long as one has sufficient to see the object for ordinary purposes of microscopic observation, it is merely a question of so many minutes or seconds exposure more or less, and it is as easy to get a good photograph in an English November as in the brightest day of summer.

The correction necessary for each combination requires, of course, a few careful experiments; but this effected, is done once for always; and, as each experiment helps greatly towards the next combination, one soon obtains a table of corrections for all the combinations one is likely to require.

The photomicrographic expert will doubtless object that it is better to dispense with the eye-piece,* and employ the image given by the objective directly; but though this may be so in the case of difficult objects, such as diatoms under high amplification, it necessitates the use of a camera of unwieldy length, and is, moreover, an almost hopeless task, unless the tube of the Microscope be done away with altogether, and the objective be made to screw directly on to the camera-front; for, however carefully the tube may be blacked, the reflection from its sides produces an unbearable glare in the centre of the plate, and, in the case of a Microscope in regular use, the portion in contact with the eye-piece becomes so polished, that little else but central glare is visible on a negative given by the objective alone. For the purposes, therefore, of the working biologist, it is far better to use the eye-piece, in spite of the small theoretical disadvantages of the plan.

If the camera-length beyond the eye-piece be about 8 in., the scale of the resulting negative will be somewhere about the nominal magnifying-power of the combination in the case of Continental outfits. English opticians, however, calculate their amplifications at 10 in. from the eye-piece; so that, in the case of English Microscopes, the amplification will be a good deal less than the nominal power of the combination.

I cannot, however, recommend working with any greater extension, as very few lenses will bear the test.

The plates used should be the slowest obtainable. The more rapid the plate, the coarser is the grain of the film, and therefore the less suited it is for our purpose. In this respect, gelatin plates compare ill with the old wet collodion, the grain of which was so fine that a sheet of the 'Times' reduced to a square about half an inch square could still be easily read under a sufficiently powerful lens.

Collodion emulsions are, however, coming a great deal into use once more for a variety of purposes; and, though slow, would be doubtless to be preferred for photomicrographical work.

A writer in the current 'Photographic Almanac' praises highly the Hill-Norris collodion-plate (medium speed) for photomicrography; but

* [The general practice of the best photomicrographers in this country is to use an eye-piece.]

as I can find no reference to these plates in the advertisement-sheets of the Almanac, I have not been able to put them to practical trial.

To shut off the light preparatory to exposing, I employ simply a piece of black velvet gummed on to a visiting card, slipped on top of the ring that carries the Abbe condenser; but it would be undoubtedly better to use a flap-shutter working inside the camera just behind the eye-piece; as under all but the highest powers the object is more or less visible as an opaque object, after the light has been cut off from below; and though the amount of light so thrown is too small to have much effect during the short time that elapses between drawing the shutter of the dark slide and exposing, it must have a certain more or less fogging effect, and should therefore be avoided by those who have sufficient micro work to set aside a camera specially for the purpose.

As will be seen, the apparatus described need cost but little. Simple as it is, it may be further simplified by using a simple wooden upright, mortised into the base-board, to carry the camera. One misses the great convenience of being able to instantly swing the camera out of the way when changing objects and focusing; but, apart from the delay involved in having to unscrew and replace the camera on such occasions, such an appliance is quite as efficient as that first described, and reduces the cost of the appliance required to connect one's camera and Microscope to a few pence.

Many biologists are unhandy with their pencils, and, looking upon "micro" work as a particularly recondite branch of photography, are debarred from employing this means of illustrating their observations. If a few such can be induced to discover how simple a matter photographic recording can be made, I believe the space I have occupied in the Journal will not be wasted.

Photomicrographs.*—Dr. J. Eismond discusses the pros and cons in regard to photomicrographs. He suggests a compromise between them and drawings. A faint copy of the negative is taken on platinum paper or the like; and this is touched up with ink, pencil, or colours, so as to differentiate any particular structure.

A Simple Arrangement for taking Slightly Enlarged Stereoscopic Photographs.†—Dr. W. Gebhart points out that with an ordinary stereoscopic camera, in which the two objectives are fixed at only a small distance apart, the object cannot be brought close enough to the camera to produce an enlarged picture; this could be done by using two cameras having their axes converging to the object, or by moving one camera into two positions about a vertical axis passing through the object. In the majority of cases (except, for example, with a polished sphere) the same result would be obtained if the camera remained fixed and the object be turned through a small angle. For this purpose the object is placed at the centre of a wooden disc, which can be turned about a vertical axis, through the required angle, this angle, of 6–15°, depending on the distance of the camera, being indicated by graduations on the disc and an index-pointer.

* Biol. Centralbl., xvi. (1896) pp. 864–5.
† Zeitschr. f. wiss. Mikr., xiii. (1896) pp. 419–23 (1 fig.).

β. Technique.*

(1) Collecting Objects, including Culture Processes.

Practical Method for Preparing Agar for Cultivation Purposes.†—100 grm. of agar are first washed with cold water and then placed in a kettle containing 50 litres of boiling water and 200 grm. of Carraghen powder previously rubbed up with cold water. The boiling is continued until all the agar is dissolved, after which it is allowed to cool down to 50°, when ten whole hen's eggs, previously well beaten up, are added. The fluid is boiled for a further 5–10 minutes and then strained through linen. One per cent. of glycerin is added to the agar mass, which, after distribution into five litre flasks, is sterilised. When required for use a flask is liquefied in a steamer and the hot fluid poured through a thick layer of cotton-wool. The filtrate after subsequent sterilisation should be clear. If, however, the glass vessel be of inferior quality it may render the medium turbid owing to giving up alkali. On this medium, even without addition of pepton and nutritive substances, most fission and yeast fungi will grow.

Cultivation of Diphtheria Bacilli on Non-Albuminous Media.‡—Herr N. Uschinsky states that he has succeeded in obtaining cultivations of diphtheria in his medium.§ The toxin therefrom was copious and strong, 1·5 ccm. of a 4–6 weeks old culture killing a guinea-pig in 36–40 hours. The previous non-success was due to not recognising that young cultures are unsuitable, while old ones grow easily in non-albuminous media. The appearance of the cultures in Uschinsky's fluid resembles those in bouillon. The filtrate gives a distinct albuminous reaction, though, of course, it does not follow that this is due to the toxin.

Culture of Saprolegniaceæ.‖—Dr. A. Maurizio recommends pollen-grains (of a great variety of plants) as a favourable medium for the cultivation of Fungi belonging to the genera *Achlya* and *Saprolegnia*.

Growth of Diphtheria Bacilli in Milk.¶—Prof. M. Schottelius shows that for diphtheria bacilli raw warm cow's milk is an extremely favourable growth-medium, as compared with sterilised milk or alkaline bouillon. The figures, which speak for themselves, are, at room temperature, raw milk 21, sterilised milk 2, bouillon 7; at incubation temperature, raw milk 50, sterilised milk 6, bouillon 18.

Keeping Potatoes for Culture Purposes.**—Dr. W. Simmonds states that potatoes may be kept for quite a long time without getting mouldy or dry by the following method, which he has practised for a year and

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

† Marpmann's Bakt. Chem. Laborat. in Leipzig; Zeitschr. f. ang. Mikr., ii. (1896) p. 237.

‡ Centralbl. f. Bakteriol. u. Parasitenk., xxi. (1897) pp. 146–7.

§ See this Journal, 1893, p. 796.

‖ Arch. Sci. Phys. et Nat., ci. (1896) pp. 599–601. Cf. this Journal, 1896, p. 446.

¶ Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 897–900.

** Op. cit., xxi. (1897) p. 100–1.

a half. After having been cleaned and boiled in the usual way, the potatoes are, when cold, bound round with twine and suspended close together. They are then immersed in shellac solution thrice at intervals of half an hour. In the course of another hour they are quite dry, and may be stored away for future use.

Examining Rectal Mucus for Tubercle Bacilli.*—According to Dr. Sawyer, it is useful for diagnostic purposes to examine the mucus from the rectum if there be no sputum, or if tubercle bacilli cannot be demonstrated in the pulmonary excreta. The author quotes three cases in which he found tubercle bacilli in considerable numbers in the rectal mucus, but none elsewhere.

Simple Method for the Sero-Diagnosis of Enteric Fever.†—Prof. E. Pfuhl takes a drop of blood from the ear and mixes it in the hollow of a slide with ten times the quantity of water. This not only dilutes the blood, but gets rid of the red corpuscles. To the serum is then added an equal quantity of a bouillon culture of typhoid bacilli. This is done by dabbing the culture on a cover-glass and inverting it over the serum in the ground-out slide.

Improvement in the Sedgwick-Rafter Method for the Microscopical Examination of Drinking Water.‡—The Sedgwick-Rafter method, now extensively employed in America for the analysis of drinking waters, is, says Mr. D. D. Jackson, as follows:—A definite quantity of water, usually 250 ccm., is filtered through Berkshire sand placed in a funnel. The size of the grains is such that while they will pass through a sieve of 60 meshes to the inch, they will not through one having 120 to the inch. The organisms adhere to the sand, while the water passes through a hole at the bottom of the funnel closed by fine bolting cloth. The sand is dropped into a test-tube containing 5 ccm. of sterile water. The tube is then shaken and the water decanted with another test-tube. The micro-organisms are distributed by blowing into the water with a pipette, and 1 ccm. removed to a cell 50 mm. long by 20 mm. wide and 1 mm. deep. The Microscope is graduated so that each field examines one cubic millimetre of water. The improvement made by the author consists in altering the shape of the funnel, which has a diameter of 2 in., and a length to the beginning of the slope of 9 in. The length of the slope is 3 in. The leg of the funnel is 2½ in. long, and its internal diameter 1/2 in. The lower end is closed by a rubber plug, perforated by a small hole, and the latter covered with fine bolting cloth. Above the plug is a layer of fine sand about 3/4 in. thick.

The most important errors to which this method is liable, says Mr. G. C. Whipple,§ arise from the concentration of the sample. These are (1) the funnel error, or that caused by the adhesion of the organisms to the sides of the funnel; (2) the sand error, or that caused by the organisms passing through the sand; (3) the decantation error, or that caused by the organisms adhering to the particles of sand, and by the water used in washing the sand being held back by capillarity during decan-

* Med. News, May 23, 1896. See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xxi. (1897) p. 71.

† Centralbl. f. Bakteriol. u. Parasitenk., xxi. (1897) pp. 52–7.

‡ Technol. Quarterly, ix. (1896) pp. 271–4 (1 pl.). § Tom. cit., pp. 275–9.

tation. The decantation error is minimised by the shape of the funnel devised by Mr. Jackson. The amount of sand error depends on the character of the organisms, upon the size of the sand-grains, and the depth of the sand. The decantation error chiefly depends on manipulation, and arises from some of the organisms remaining attached to the sand-grains.

(2) Preparing Objects.

Isolation of the Elements of the Crystalline Lens.* — Dr. W. Gebhardt places the eyeball in a 4 to 10 per cent. solution of formalin for one or two days. All the transparent parts retain their transparency, and the vitreous its muco-gelatinous consistence. The bulb, which may be preserved in the formalin solution, is then transferred to 50–60 per cent. alcohol for a couple of hours. The lens is then taken up and gently squeezed between two fingers. By slight pressure it is broken up into separate lamellæ, which can be easily teased out in water or glycerin. Both the toothed and smooth fibres are easily isolated, the teeth being extremely clear. The preparation may be stained, and mounted in glycerin-gelatin.

Method of Preparing Rotifers.†—M. N. de Zograf has a note on this subject, in which he states that, after trying Mr. C. F. Rousselet's method of preserving rotifers, he found that formalin preserved the animals for a very short time only. To this it must be remarked that, while M. de Zograf's experience cannot have extended for more than twelve months, in this country the rotifers mounted by Mr. Rousselet in formalin for the last three years have kept extremely well, and look at present as if they were going to keep a great number of years more. The only difficulty experienced has been to prevent the evaporation of the watery fluid, which has now apparently been overcome by using thickened gold size and Bell's cement for sealing the slides.

M. de Zograf mentions a method by which he has succeeded in mounting rotifers in balsam. After narcotisation with cocain, killing, and fixing with ·25 per cent. osmic acid, a rather large quantity of a weak (10 per cent.) solution of raw wood vinegar is added, and the animals left therein from five to ten minutes ; they are then washed in three changes of distilled water, which is gradually replaced by alcohol of progressive strengths, finishing with absolute alcohol. In this way the rotifers do not shrink, and can be passed into glycerin or Canada balsam in the usual way. The protoplasm and organs are coloured by this method a bluish-grey or deep black, but the histological structure is well shown.

(3) Cutting, including Imbedding and Microtomes.

New Microtomes by Fromme.‡— Prof. J. Schaffer described two new microtomes, made by Fromme Brothers, of Vienna, for cutting large sections :—

1. *For Paraffin-Imbeddings.*—The object is carried at the side of a rectangular frame, which is fixed to a horizontal axis working in bearings

* Zeitschr. f. wiss. Mikr., xiii. (1896) pp. 306–7.
† Comptes Rendus, cxxiv. (1897) pp. 245–6.
‡ Zeitschr. f. wiss. Mikr., xiii. (1896) pp. 1–9 (3 figs.).

in the heavy foot of the instrument; the knife is fixed to the foot in a vertical position. The small side-movement of the object is effected by a micrometer screw and toothed wheel carried within the rectangular frame.

2. *For Celloidin-Imbeddings and for Cutting in Liquids.*—Here the knife is carried horizontally on a rectangular frame, which, in this instrument, works about a vertical axis; the object is fixed to the foot of the instrument, and the small movement is given to the knife by the micrometer arrangement within the rectangular frame. For cutting in liquids, a small bath is arranged round the object-holder, and the knife is carried on an arm bent twice at right angles and projecting over the edge of the bath.

Manipulation of Celloidin Sections.*—By the following procedure, devised by Dr. G. Aubertin, the chief inconveniences inherent in the celloidin-section may be avoided. The sections, cut in 70 per cent. alcohol, are arranged on the slide. The celloidin is then dehydrated, first in 70 per cent., and finally in absolute alcohol. When perfectly dehydrated, the celloidin is dissolved by dropping on very carefully a mixture of ether and alcohol in equal parts, with which the whole surface of the slide should be just covered. The ether-alcohol mixture may be renewed until the whole slide is covered with a very thin layer of celloidin. The ether-alcohol is allowed to evaporate, but not to complete dryness of the celloidin. The membrane thus formed is not only firm, but so delicate that staining is easily effected. The after-treatment suggested is—70 per cent. alcohol, water (20 minutes), dilute solution of borax-carmine (some hours), water (10 minutes), hæmatoxylin (10 minutes), hydrochloric acid-alcohol until the celloidin is decolorised. The preparations should be dehydrated in 95 per cent. spirit, cleared up in xylol-carbolic acid (3–1), and mounted in balsam.

(4) Staining and Injecting.

Investigation of Brain of Fishes.†—M. Catois has made use of a process which he describes as a combination of the injection-methods of Ehrlich and Meyer with the immersion-method of Dogiel, and the diffusion-process of Cajal.

Into the living animal there were injected 1 to 2 ccm. of concentrated salt solution of methylen-blue; on the brain being removed, sections were made of it, and the pieces placed for about half an hour in a saturated solution of methylen-blue, after which they were treated in the ordinary way.

Preparation of Embryonic Nervous System of Crustacea.‡—M. N. de Zograf has made use of Prof. Ramon y Cajal's method of double impregnation; he reports that he had many difficulties to overcome before succeeding with the larvæ of Copepoda. He could not cover the Nauplius with a layer of glycerin and gelatin to preserve it from the silver precipitate, as is often done with minute objects, for this reagent dehydrates the larvæ, and makes it impossible to recognise their struc-

* Anat. Anzeig., xiii. (1897) pp. 90–3.
† Comptes Rendus, cxxiv. (1897) pp. 204–5. ‡ Tom. cit., p. 202.

ture. He succeeded, however, by enveloping the Nauplii in pieces of cigarette paper.

Rapid Method of Fixing and Staining Blood-Films.*—Dr. G. L. Gulland fixes and stains blood-films in the following way :—The covers are dropped film-side downwards into the fixative, which is composed of absolute alcohol saturated with eosin 25 ccm., ether 25 ccm., sublimate in absolute alcohol (2 grm. to 10 ccm.) 5 drops. After an immersion of three or four minutes, the covers are removed with forceps and washed in water. The film is then stained for just one minute in a saturated aqueous solution of methylen-blue, after which it is washed in water, dehydrated in absolute alcohol, and mounted.

Modification of Heller's Method of Staining Medullated Nerve-Fibres.†—Dr. W. F. Robertson first treats healthy or morbid nervous tissue with Weigert's chrome-alum-copper fluid for ten days or longer. The fluid is composed of 2·5 per cent. chrome-alum, 5 per cent. copper acetate, 5 per cent. acetic acid, and formalin 2 per cent. The chrome-alum is boiled in the required amount of water, and when dissolved the acetic acid and copper acetate are put in. When cold the solution is filtered and the formalin then added. The author has reduced the quantity from 10 to 2 per cent., as too much formalin impairs the staining reaction. Sections of material may be obtained by the celloidin or gum-freezing method, and they are stained by placing them in 1 per cent. osmic acid for half an hour in the dark, then in 5 per cent. pyrogallic acid for half an hour, 0·25 per cent. potassium permanganate for 3–4 minutes, 1 per cent. oxalic acid for 3–5 minutes. Wash in water after treatment with each solution, dehydrate, then mount in balsam.

Staining Coccidium oviforme.‡—Dr. R. Abel stains *Coccidium oviforme* with the Ziehl-Neelsen solution for tubercle bacilli. The parasites may be stained on cover-glasses, or in sections. After staining with hot phenol-fuchsin, the preparations are to be decolorised in 5 per cent. sulphuric acid and 70 per cent. alcohol. Any contrast stain may be used.

Method for Staining Unnucleated Cells.§—Herr J. J. Gerassimoff states that if a *Spirogyra* cell be treated with chloroform, ether, or with chloral hydrate during fission, two daughter-cells will be obtained, one being devoid of nuclear substance, the other containing excess thereof, i.e. there is one large nucleus or two of ordinary size ; in fact, the results are exactly the same as those induced by the action of a low temperature. To 100 ccm. of the water containing the algæ were added 0·25–1·5 ccm. of saturated chloral hydrate solution, or 0·42–2·5 ccm. of ether, or 1·25–7·5 ccm. chloroform water. The time required varied from fifteen minutes to some hours, after which the algæ were removed to fresh water.

New Method of Staining Tubercle Bacilli.‖—Drs. A. Rondelli and L. Buscalioni propose the following method for staining tubercle bacilli, which they say is extremely rapid and simple :—The decoloriser is a

* Brit. Med. Journ., 1897, i. p. 652. † Tom. cit., pp. 651–2.
‡ Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xx. (1896) pp. 904–5.
§ Moscow, 1896, 4 pp.
‖ See Centralbl. f. Bakteriol. u. Parasitenk., 1te Abt., xxi. (1897) pp. 70–1.

modified eau de Javelle, made by mixing two solutions. The first is composed of calcium hypochlorite 6 grm. in 60 grm. of water. The second is composed of 12 grm. of potassium carbonate dissolved in 40 grm. of water, and after filtration is mixed with the first solution. The combination is stirred up for some time, then filtered and preserved in blue glass bottles. After the film has been prepared and stained in the usual way, the cover-glass is immersed in the Javelle decoloriser until it looks brownish-yellow.

Decoloration of Celloidin in Orcein Preparations.* — It is very difficult, says Prof. P. Schiefferdecker, to decolorise the celloidin when celloidin-sections are stained with orcein to show the elastic fibres. This inconvenience may be avoided by transferring the preparations, after they have been decolorised in hydrochloric acid alcohol, to water containing some liq. ammon. caustici. In this the sections become blue and give up some pigment. As soon as the dye ceases to be given off, the preparations are put back into the hydrochloric acid alcohol. The process is to be repeated until the celloidin is sufficiently decolorised.

Staining Centrosomes.†—Dr. R. Marchesini recommends, for a study of centrosomes and attraction-spheres in the leucocytes of the newt, a thorough mixture of 1 part of malachite-green solution to 2 parts of saffranin-green.

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

Marking Preparations.‡— Prof. P. Schiefferdecker advises that slides should be permanently marked in black or white by writing on the glass and then varnishing the surface. The liquid Chinese ink does well for the black, while Kremser white or permanent Chinese white is recommended for white. The Kremser white should be rubbed up with a sufficient quantity of gum-water. When the writing is dry it should be brushed over with water-colour varnish.

Herr E. Schoebel § points out that the method proposed by Schiefferdecker of writing on glass with Indian ink and then varnishing over, is much the same as that used for many years at the Zoological Station of Naples; here, however, the writing is done over the varnish. Schiefferdecker's objections to the author's method ‖ of writing on glass with a mixture of sodium silicate and fluid Indian ink are answered.

(6) Miscellaneous.

Plate Modelling.¶—Dr. A. Schaper, in preparing his models, uses Born's ** method, but takes special precautions for properly orientating the object, so that sections are made in known and definite directions. The details of the method, as applied to embryos, are described at length.

* Zeitschr. f. wiss. Mikr., xiii. (1896) p. 302.
† Boll. Soc. Rom. Stud. Zool., v. (1896) pp. 89–96 (1 pl.).
‡ Zeitschr. f. wiss. Mikr., xiii. (1896) pp. 299–301.
§ Tom cit., pp. 425–8.
‖ Op. cit., xi. (1894) p. 331. Cf. this Journal, 1895, p. 707.
¶ Zeitschr. f. wiss. Mikr., xiii. (1897) pp. 446–59 (10 figs.).
** This Journal, 1889, p. 144.

Tests for Ligneous Tissue.*—Dr. F. Zetzsche enumerates twenty-eight different methods which have been used and recommended by various experimentalists for the detection of woody tissue. Out of these the following eight are commended:—(1) indol with hydrochloric acid; (2) phloroglucin-hydrochloric acid; (3) carbazol-sulphuric acid; (4) anilin sulphate; (5) toluidin-diamin-hydrochloric acid; (6) ammoniacal fuchsin; (7) Bismarck-brown-hæmatoxylin; (8) solid-green deltapurpurin. The best results are obtained from the following:—(1) The indol-hydrochloric reaction gives a brick-red to chocolate-brown colour; may be used successfully in from 1/100 to 1/1000 per cent. solution; and has the great merit of allowing the objects to be mounted in glycerin and in balsam. (2) Phloroglucin is used in 2–3 per cent. alcoholic solution, together with an equal volume of dilute hydrochloric acid. The colour is brownish-red. Preparations do not mount well in either glycerin or balsam. (3) A mixture of equal volumes of alcoholic solution of Bismarck-brown and Böhmert's hæmatoxylin has the special merit of not requiring differentiation, but care must be taken not to overstain. Lignification is shown by the brown staining, the non-ligneous tissue being blue. The preparations should be mounted in glycerin-gelatin. (4) The ammoniacal fuchsin solution is made by freely diluting a saturated alcoholic solution of fuchsin with water, and then adding ammonia until the fuchsin just begins to precipitate. The objects are immersed therein for 1/2 minute, and, after having been well washed, are contrast-stained in saturated anilin-blue solution (1 minute). After dehydration in alcohol they are mounted in balsam.

The intensity of lignification is determinable by the use of solutions of phloroglucin-hydrochloric acid, of varying strengths, allowed to act for a definite time. Three minutes is suggested as the time limit, and 1/40 to 2 per cent. for the solution. The latter is made by dissolving the phloroglucin in 1 vol. of 90 per cent. alcohol and 1 vol. of strong hydrochloric acid. The phloroglucin is first dissolved in the alcohol, and the acid afterwards added very gradually in the cold.

Eight degrees of lignification are made by the author from this method, at the top of the list standing *Abies pectinata*, at the bottom, *Musa paradisiaca*.

Demonstrating Presence of Agar.†—According to Herr G. Marpmann, there are many edible algæ in tropical seas. These belong to the group of Florideæ, with red, leaf-like or membranous growth and upright thallus. Among these are *Gracilaria lichenoides* Ag., *Eucheuma spinosum* and *E. gelatinæ* Ag. All these, when boiled with water, produce a thick jelly, which in the dried condition is known as agar-agar. This agar appears to be chemically identical with the alga-mucus of *Gelidium corneum*. The agar jelly and *Gelidium* jelly, dissolved in boiling water, filtered through cotton-wool and precipitated with alcohol, form horny masses when dried, the former being known as gelose, the latter as gelinose.

As pectin, or vegetable jelly, appears to be of the same, or very nearly the same chemical composition as agar, and as fruit jelly is often adulterated with agar and gelatin, it becomes important to have a ready test to distinguish the presence of agar. This may be done micro-

* Zeitschr. f. ang. Mikr., ii. (1896) pp. 225-36. † Tom. cit., pp. 257-61.

scopically owing to the presence of the siliceous envelopes of the algæ having resisted destruction. The mass to be examined should be treated with dilute sulphuric acid and a few crystals of permanganate of potash. In this way a thin fluid is formed which is easily sedimented, the siliceous envelopes of the algæ being found in the deposit.

Disinfection of Books.*—Dr. von Schab records some experiments made for the purpose of testing the value of Pictet's gas-mixture and formaldehyd for disinfecting books from lending libraries. Pictet's mixture consists of equal volumes of sulphurous acid and carbonic acid gases. The test objects used were *Bacillus pyocyaneus*, *B. anthracis*, *Staphylococcus pyogenes aureus*, and tubercular sputum.

Neither disinfectant gave satisfactory results.

Demonstration of Small Quantities of Formaldehyd.†—According to Herr L. Keutmann, a solution of hydrochlorate of morphia in strong sulphuric acid is very convenient for showing the presence of formaldehyd. One decigram of morphia hydrochlorate is dissolved in 1 ccm. of strong sulphuric acid. This solution will detect the presence of 1 part of formaldehyd in 5000 or 6000 parts. The solution to be tested is poured upon (but not mixed with) the morphia solution, and within a few minutes assumes a red-violet hue.

* Centralbl. f. Bakteriol. u. Parasitenk., xxi. (1897) pp. 141–6.
† Zeitschr. f. ang. Mikr., ii. (1896) p. 267.

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 17TH OF FEBRUARY, 1897, AT 20 HANOVER SQUARE, W., THE PRESIDENT (E. M. NELSON, ESQ.) IN THE CHAIR.

The Minutes of the Anniversary Meeting held 20th of January last were read and confirmed, and were signed by the President.

The Secretary said he regretted that the February number of the Journal was not ready for issue to the Fellows that evening. The delay was due to the impossibility of getting the plates as early as necessary, but he believed these would be delivered at once, so that the Journal would probably be ready for delivery by the following Monday.

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

	From
A Slide-carrier for the Lantern	*The President.*
Dr. E. B. Wilson, The Cell in Development and Inheritance. (8vo, New York, 1896)	*The Publishers.*

The President said that on the occasion of Mr. Michael's very able address to the Society at their last meeting, he could hardly help having his attention attracted to the slide-carrier, and the unsatisfactory way in which it worked in the lantern, and he had therefore much pleasure in presenting to the Society a new carrier, which he hoped would be found to work more smoothly and with less trouble to the operator.

Prof. Bell said he should like to call attention to a book included in the list of donations, for which the Society was indebted to Messrs. Macmillan, 'The Cell in Development and Inheritance,' by Dr. E. B. Wilson. This was the fourth volume of a very interesting series of biological works now being issued by the Columbia University. It was exceedingly interesting and important to have a compendious account of all that was known at present about the cell; but though of great value now, at the rate at which researches were being made in these subjects, it was quite possible that, ten years hence, the information given in this book might be regarded as too antiquated to be of further service.

The President said that Mr. Curties had sent for exhibition a nose-piece which had been devised for rapidly attaching an objective to obviate some of the disadvantages in the older form of a similar contrivance where the attachment was made by a pinion, which might happen to be in some inconvenient position. The new form was made with a ring, which was much more easy to work. The article described was exhibited to the meeting, and the method of its application practically demonstrated.

The thanks of the meeting were given to Mr. Curties for sending, and to the President for exhibiting and explaining, this useful piece of apparatus.

The President said they had received a paper, 'On a Simple Method of Photomicrography,' from Dr. G. M. Giles, who was at present in India. Having read the principal portions of the paper to the meeting, the President further remarked that it would be seen that the author described what he might call a contrivance for rough-and-ready work. In India they would not be likely to have at hand any of the appliances we had, and Dr. Giles in his paper had described how he had managed without them. His remarks as to low-angled lenses would, no doubt, be the portion of the paper most likely to be criticised by those who were practically acquainted with the subject, and his use of these would no doubt largely account for the unfavourable comparisons made between photographs and drawings; for he thought it would be admitted by all who knew anything about the subject, that if photomicrographs were taken properly, no drawing could at all compare with them for accurate scientific work. Where, however, the best modern apparatus was not available, one had, of course, to make use of what was ready to hand, and that described in this paper was a cheap way of making a "rough-and-ready" vertical photomicrographic apparatus

The thanks of the meeting were unanimously voted to Dr. Giles for his communication, and to the President for reading it to the meeting.

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

Mr. E. M. Nelson:—Mr. Baker's Changing Nose-Piece.

Mr. J. E. Ingpen:—Tegmen of *Flata* sp. Natal, showing chordotonal papillæ?

New Fellows.—The following gentlemen were balloted for and duly elected *Ordinary* Fellows:—Mr. Jonathan Pollard and Dr. Siegfried Czapski.

MEETING

Held on the 17th of March, 1897, at 20 Hanover Square, W.
E. M. Nelson, Esq., President, in the Chair.

The Minutes of the meeting of 17th February last were read and confirmed, and were signed by the President.

The List of Donations to the Society since the last meeting was read, and the thanks of the meeting were given to the donors.

A. C. Cole, The Methods of Microscopical Research. (8vo, London, 1895)	*Mr. W. D. Colver.*
An old Microscope	*Mr. Jas. More, jun.*

The Secretary gave notice, on behalf of the Council, that the next meeting, which would be held on Wednesday, April 21st, would be made special for the purpose of making alterations in Bye-laws Nos. 10 and 20. Rule 20 read at present as follows :—" Every ordinary Fellow of the Society shall pay an admission fee of two guineas, and a further sum of two guineas as an annual subscription." It was now proposed to alter this so far as the first portion, relating to the admission fee, was concerned, by inserting after the words " admission fee of two guineas " the words " or at his option an annual sum of 10*s.* for a period of five years in lieu thereof." This would necessitate an alteration in Rule 10 also, and it was proposed to insert after the words " shall pay the admission fee " the words " or the first instalment thereof as provided by Rule 20."

The Secretary said that it appeared there was not a copy of the second edition of Mr. A. C. Cole's ' Methods of Microscopical Research ' in the Society's Library, and Mr. Colver had kindly supplied the want by presenting them with a copy.

The President said that Mr. More, who had some time since presented them with an old Microscope for the Society's museum, had just sent them another, with a letter asking him to present it to the Society on his behalf. This instrument, which he exhibited to the meeting, was a very perfect example of the old Culpeper and Scarlet type, but it was evidently not so old as the one which Mr. More formerly presented to them, because this one had a rackwork focusing arrangement which was not found in the earlier types. It had the usual box stand with drawer and accessories, and was in very good condition. He felt sure the Society would be very pleased to possess what was a very handsome model of this old form of Microscope, examples of which were becoming rather scarce just now.

The Secretary said there had for some time been a vacancy on their list of Honorary Members, consequent upon the death of Prof. Pasteur.

It was now proposed to fill this by the election of Dr. G. B. de Toni, and he gave notice on behalf of the Council that the ballot for this purpose would be taken at the next ordinary meeting.

The President said he wished to exhibit a lens which he had computed, of the loup type, giving a magnifying power of ten, but constructed upon an entirely new formula. The working distance, as compared with Zeiss's, was 60 per cent. greater, being no less than 8/10 in.

He also exhibited a new achromatic and aplanatic bull's-eye condenser for use with the Microscope. He thought it was likely to be very useful to those who were doing any special work in photomicrography, or wherever a really achromatic parallel beam was required.

Prof. A. E. Wright brought forward a method of measuring and counting microscopic objects. He was uncertain whether the method was a new one, but he had not seen it described, and he thought that the method was one which compared favourably with the micrometric methods which were described in the text-books, and which were ordinarily in use. The method consisted in projecting, by means of the substage condenser, a minified image of a scale or of a system of squares upon the plane upon which the microscopic objects were disposed.

By means of diagrams which were drawn upon the blackboard, it was explained that the scale or the system of squares could be placed in any one of the three following positions:—(*a*) On a glass plate (or on the window), which was interposed between the source of light and the plane mirror; (*b*) on the surface of the plane mirror; or (*c*) on a plate interposed between the plane mirror and the substage condenser. Under any of these circumstances it was shown that the image of the scale could, by proper focusing of the condenser, be superposed upon the microscopic object.

It was suggested that this method of projecting a system of squares upon the microscopic preparation might be employed with advantage in the enumeration of red blood-corpuscles. The employment of this method would obviate the necessity for the micrometric ruling on the bottom of the hæmocytometer cell.

It was further shown that the proposed method of mensuration presented advantages over the methods of mensuration which are at present in use, inasmuch as the value of the divisions of the scale did not vary with the magnification which was applied, but was a constant so long as no change was made in the relative positions of the Microscope and the scale. The value of the divisions of the scale could thus be determined once for all for a particular Microscope, comparing them with the divisions of a stage micrometer.

It was further explained—first, that the same scale, if set up at different distances from the Microscope, could be made to give either large or small micrometric divisions; and secondly, that the foreshortening of the interspaces between the horizontal divisions could readily be corrected for by disposing the glass plate upon which the scale was inscribed in a plane exactly parallel to the plane of the mirror.

It was shown that this correction for foreshortening was essential in cases where a system of squares is to be projected upon the microscopic specimen; and further, that it can be made in a very simple manner by suspending the ruled glass plate in such a manner as to allow its upper margin to tilt forward until an equal number of vertical and horizontal squares appear in the field of the Microscope.

These points were illustrated by setting up a Microscope in such a manner as to show the image of a system of squares superposed upon a film of blood.

Prof. Wright also called attention to a Microscope made by Messrs. Swift, in which a very simple plan had been adopted of swinging the substage condenser in and out of the optical axis.

Dr. J. L. Williams read a paper 'On the Formation and Structure of Dental Enamel,' the subject being illustrated by a large number of photomicrographs of mounted sections shown upon the screen, some of these showing an amplification of × 3000.

Mr. J. Howard Mummery said he felt sure that all the Members present who did any work in photomicrography would appreciate the great beauty of the slides shown by Dr. Williams, especially when they recognised the extreme difficulty of photographing the microscopic structure of enamel. It had always been a matter of some difficulty to understand how the growing enamel was nourished during the earlier part of its development, the blood-vessels being then separated from the stratum intermedium and ameloblasts by the stellate reticulum; but if, as Dr. Williams suggested, the meshes of the stellate reticulum are occupied at this time by large cells, the matter was explained. In the photograph shown it was rather curious to notice that all the nuclei of these cells seemed to be at the intersections and not in the middle of the cell; but this might be only an accidental result of the preparation of the specimen. In the later stages of enamel development the slides showed very distinctly the presence of an abundant blood supply in the stratum intermedium, and he certainly considered that Dr. Williams' communication demonstrated these points in the development of enamel very clearly, and he looked upon it as the most valuable contribution to the study of the development and structure of enamel that had been made for many years.

The President said he could most heartily concur in the opinion expressed by Mr. Mummery as to the great excellence of the slides which had been exhibited, and all would agree with him as to the very lucid way in which the subject had been presented. He had great pleasure, therefore, in moving a very hearty vote of thanks to Dr. Williams for his communication, and for one of the most beautiful lantern exhibitions that they had seen for some time.

The vote of thanks was put to the meeting, and carried by acclamation.

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

Prof. A. E. Wright :—Method of Measuring and Counting Microscopic Objects, illustrating his paper; An easy Method of Moving the Substage Condenser into and out of the optical axis.

The President :—An Achromatic Loup multiplying 10; an Achromatic and Aplanatic Bull's-eye; an old Microscope, presented to the Society by Mr. James More, jun.

New Fellows :—Mr. George Peter Dineen and Mr. John Blakeway Wolstenholme.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

JUNE 1897.

TRANSACTIONS OF THE SOCIETY.

V.—*On a New Mechanical Stage.*

By Edward M. Nelson, President R.M.S.

(*Read* 21*st April*, 1897.)

I have the honour to bring before the Society an improved mechanical stage which Messrs. Watson and Sons have made from my drawings.

The improvement consists in converting my semi-mechanical horse-shoe stage, figs. 11, 12, and 13 (exhibited here in February 1893 *) into a completely mechanical movement.†

This has been carried out in the following manner. The sliding bar has been slotted, fig. 14, and a movable piece, which may be called the shuttle, has been fitted in the slot; this shuttle has diagonal rack-work at the back, and a vertical spiral pinion gears in it, fig. 15. Above this pinion there is a horizontal bevel-wheel, which is geared by friction to a vertical wheel fixed on the usual horizontal pinion. The cock which holds, and is close to, the vertical bevel wheel in fig. 15 is slotted underneath; a capstan-headed screw (not shown in the figure) is fitted for the purpose of compressing this spring part; the amount of friction between the copper bevel wheels can therefore be regulated at will. This capstan-headed screw is placed some distance from the bearing, so that the length of the bar between it and the bearing may form a stiff spring; this renders the motion equable. It will be noticed, therefore, that the transverse movement is confined to the sliding bar. This sliding bar can be removed so as to leave the stage perfectly plain. The heads of the pinions which control the vertical movement have been kept below the level of the stage, so as to be out of the way of culture-plates (fig. 12).

In deference to the views expressed by Mr. Michael in his last

* Journ. R.M.S., 1893, p. 236.

† The 1893 stage was itself an improvement on a previous model I had designed and exhibited in 1888. All the main ideas in the plan of the 1888 stage are embodied in this new one, the alterations and improvements being in the mechanical details. See Journ. R.M.S., 1888, p. 477.

Presidential Address, -no less than $3\frac{1}{4}$ in. of transverse movement have been given to the stage. This will greatly facilitate the exami-

Fig. 11.

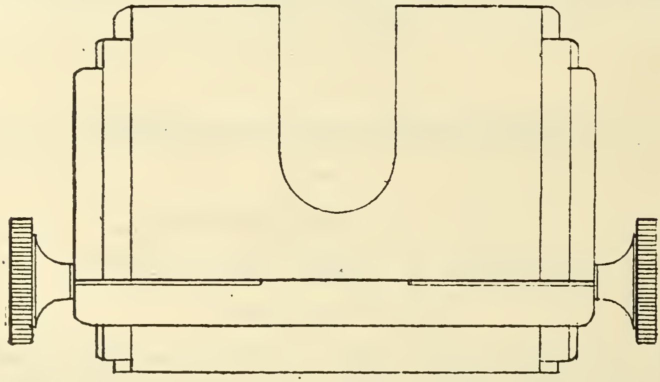


Fig. 12.

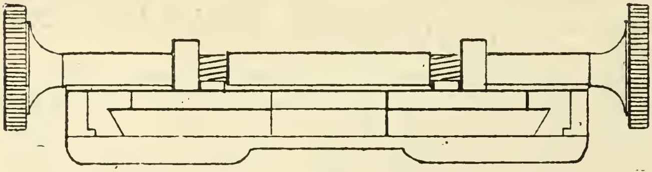
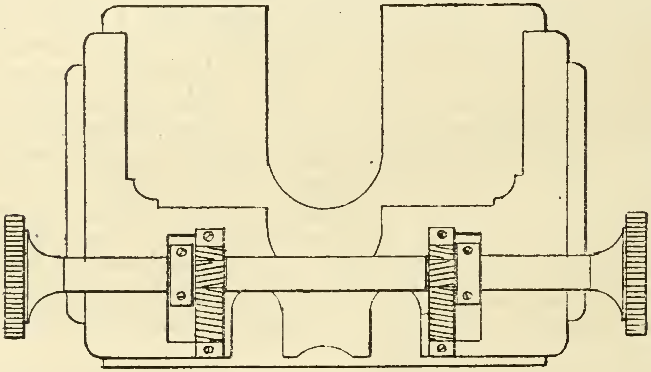
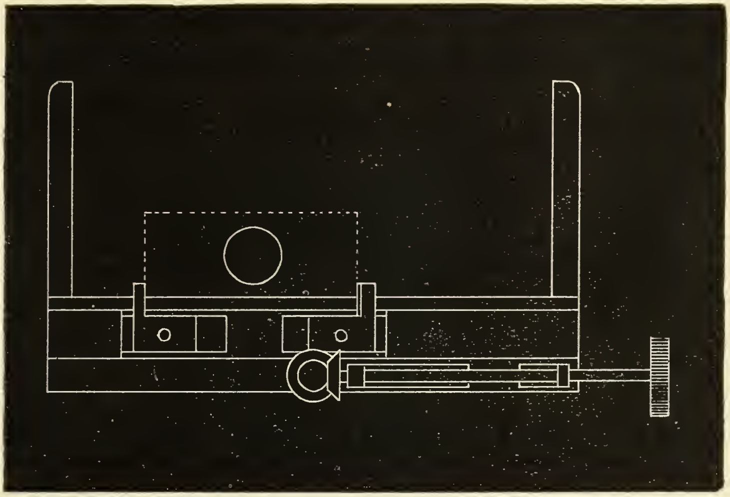


Fig. 13.



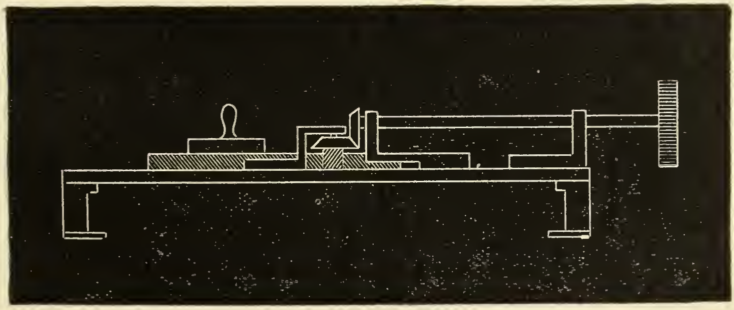
nation of serial sections. The manner in which the slip is held is entirely novel: on the shuttle there are two sliding pieces, and these hold the slip by the two lower corners, fig. 14. This method obviates all gripping of the slip, and does not interfere with the feeling of the working distance by the finger. Slips from 2½ in. to 4½ in. can be taken.

FIG. 14.



The stage has been made of aluminium for lightness, and its size is 4½ × 7 in. The stand has a spread of tripod of 8 × 8 in. The length of the body when closed, including the rotating nose-piece, is 5½, and when extended by means of the rack-work and sliding draw-

FIG. 15.



tubes is 11¼ in. long, so that it will work equally well with objectives corrected for either the long or short tube. The weight of the instrument is 7 lb. 10 oz.

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.†

Artificial Insemination.‡—Mr. W. Heape has made experiments which, so far as they go, point to the conclusion that both copulation and the presence of spermatozoa in the uterus are necessary to induce ovulation in the virgin rabbit when she is in "heat." But this is not so in certain other mammals, such as mice and dogs, as the results of artificial insemination show. The author summarises the experiments of Spallanzani, P. Rossi, Sir Everett Millais, and others, besides noting some which he has himself made. "It has been ascertained that if spermatozoa be placed artificially in the vagina of certain female mammals at the right season, they may conceive; it has been ascertained also that if spermatozoa be placed artificially within the uterus of certain individual mammals which have failed for particular reasons to breed by natural means, they may become pregnant in consequence." From one emission by a dog several bitches may be inseminated. "There is little doubt that an extended study of the subject will throw light on the physiological relations of coition and insemination, ovulation and fertilisation, and on certain of the causes which induce sterility in mammals, which will be of great interest to physiologists and of great value to practical breeders." The experiments should also facilitate the study of hybridisation and telegony.

Artificial Fertilisation of Rabbit's Ova.§—Herr W. S. Grusdew has followed Spallanzani, Schenk (1878), and Ott (1882), in making

* 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.

‡ Proc. Roy. Soc., lxi. (1897) pp. 52–63.

§ Arch. f. Anat. u. Entwicklgesch. (His u. Braune), 1896, pp. 269–304 (1 pl.). See Zool. Centralbl., iv. (1897) pp. 217–9.

experiments on artificial fertilisation. Ova and sperms were artificially placed in the oviduct; but out of 88 cases only 28 were in the least successful. The susceptibility to fertilisation seems to depend on invisible changes in the vitellus and zona pellucida. Ova in which the germinal vesicle is still visible are not fertilisable. In no case was more than one polar body seen. The movement of the ova through the tubes takes 22–47 hours. As many as 20 spermatozoa may be found associated with one ovum. The actual penetration of the ovum by a spermatozoon was observed. An albuminoid sheath is formed around the ovum only when the rabbit is in heat or in natural pregnancy.

Egg-laying in Rana fusca.*—Prof. M. Nussbaum adds to a previously reported communication a note to the effect that isolated females of *Rana fusca* produce spawn apart from the presence of males. Even with the presence of males the edible frogs do not spawn in captivity; both sexes become sterile.

Oogenesis in Anura.†—Herr J. F. Gemmil describes this in *Pelobates*. In the young ovary the primitive germ-cells lie superficially; genital strands grow inwards into the internal tissue and form a somewhat sponge-like structure with wide meshes lined by genital epithelium; the partitions disappear and a single cavity is formed. Thereupon the internal germ-cells form nests of cells by mitosis, and a struggle for existence occurs in these nests. Some of the cells form the granulosa or internal follicle cells, others disintegrate into nutritive material, usually only one forms an ovum. If there is abundant space, several ova occur in a nest. In the formation of the granulosa some indifferent cells of the genital epithelium also take part. The growing ova press towards the central cavity and protrude the genital epithelium before them as the external follicular envelope.

Development of Liver and Pancreas.‡—Prof. J. A. Hammar says that the divergences in the early development of the liver cannot be spoken of as due to the presence of one primary duct or of two. "Primary liver-ducts," in the usual sense, occur only in birds. The common feature is not the development of a duct or of ducts, but the development of a liver-fold or "liver-prominence" caudal to the heart, and the constriction thereof into a duct running cranialwards. In *Amphioxus* the simplest condition persists throughout life. In other Vertebrates, the duct forms the ductus choledochus; the cranial portion of the liver-fold forms the hepatic parenchyma; a diverticulum of the ventral wall of the liver-fold forms the gall-bladder and its duct. The author then discusses the various forms of the hepatic parenchyma in Vertebrates.

In another paper § Hammar denies that there is a double ventral rudiment of the pancreas in the rabbit, dog, &c. From its first emergence the rudiment is a single caudally directed diverticulum of the ductus choledochus.

Development of Thyroid Gland in Man.‖—Herr J. J. Streiff finds that the thyroid begins as a branched tubular gland. But the tubules

* Arch. f. Mikr. Anat., xlviii. (1897) pp. 545–50 (1 pl.).
† Arch. f. Anat. u. Entwicklgesch., 1896, pp. 230–8 (2 pls.). See Zool. Centralbl., iv. (1897) p. 184. ‡ Anat. Anzeig., xiii. (1897) pp. 233–47 (14 figs.).
§ Tom. cit., pp. 247–9 (2 figs.).
‖ Arch. f. Mikr. Anat., xlviii. (1897) pp. 579–86 (1 pl.).

enlarge into vesicles, and are separated from one another by proliferating vessels and connective-tissue strands. Thus the secretory parts discharge their secretion separately. It passes by pressure through the walls of the follicles into the lymph spaces of the connective tissue.

Prochorion of the Dog.*—Prof. R. Bonnet describes the blastodermic vesicle in the dog in its earlier stages, with special reference to the so-called "prochorion." Until it exceeds 14 mm. in length the ovum lies surrounded by the oolemma (zona pellucida)—at first wholly, afterwards less completely—and by an external gelatinous sheath or "prochorion" of Hensen. On eggs immersed in water a large number of transparent threads are seen floating out from the gelatinous sheath. These are merely secretion-threads from the uterine glands, of which the prochorion is a product.

Placenta of Weasel.†—Prof. H. Strahl concludes, from his study of the early attachment of the mammalian ovum to the wall of the uterus, that the syncytial formations occurring during this process arise from modifications of the uterine epithelium. Part of this is used in the formation of the placenta, and part is disintegrated into what may serve as nutritive material. The author has confirmed these conclusions by a study of the placenta of *Putorius furo.*

Development of Selachii.‡—Prof. C. K. Hoffmann begins by describing *the process of gastrulation and the rudiments of the two primary germinal layers.* He finds a large gastrular invagination at the posterior end of the blastoderm of *Acanthias.* It is at first a more or less spherical vesicle, readily visible to the naked eye; but the blastopore becomes a long narrow cleft, and the archenteric cavity extends forwards between the blastoderm and the yolk. The blastopore closes, and from its fused lips arises the embryonic rim which forms the first rudiment of the embryo. Many authors have mistaken the primitive archenteric cavity for the segmentation cavity. None have distinguished it as the primary gastrula cavity. But none of it passes into the embryo; indeed, of the whole blastoderm only the embryonic rim is persistent. A "secondary archenteron" is subsequently formed. The yolk-sac represents the last vestige of the original or archi-gastrula. From the appearance of the segmentation-cavity on to the time when the embryo proper begins to develop, no mitotic divisions are demonstrable in the yolk-nuclei, though amitotic divisions occur; but after the establishment of the embryo begins there is an abundance of mitotic divisions in the yolk-nuclei, which certainly have a direct share in the development of the germinal layers and embryo.

The bilateral mesoderm and the notochord arise from the embryonic rim (*Urmund*); the *gastral or axial* mesoblast seems to arise as a paired outgrowth from the archenteric wall.

The protovertebræ of the anterior head-region. In young stages the embryonic archenteron extends as a broad solid strand beneath that part of the brain which corresponds to the future thalamencephalon, and is continued on to the neuropore. This strand is soon divided into

* Anat. Anzeig., xiii. (1897) pp. 161–70 (1 fig.).
† Op. cit., xii. (1896) pp. 539–43.
‡ Morphol. Jahrb., xxiv. (1896) pp. 209–86 (4 pls.).

a median and two lateral portions, which probably correspond to the portions which give rise further back to gut and notochord on the one hand, and to mesoblast plates on the other.

The axial portion, beneath the thalamencephalon, degenerates; the paired portions seem to form the foremost palingenetic pair of somites, or anterior head-cavities of Platt. What van Wijhe has reported as to the three foremost palingenetic head-somites in *Scyllium* and *Pristiurus* is confirmed by Hoffmann in regard to *Acanthias*. He promises a future discussion of the three posterior palingenetic and the four cœnogenetic protovertebræ.

Olfactory organ and nerves. Apart from the optic nerve, the olfactory diverges from all the other cranial nerves. As van Wijhe has shown, both the olfactory organ and its nerve arise from the anterior neuropore.

Mouth and hypophysis. The hypophysis is formed very late, long after the oral opening.

Development of Auditory Vesicle in Vertebrates.*—Dr. C. Poli has studied this in a variety of types. In Sauropsida, the first hint of the ear is a zone of thickened ectoderm alongside of the still open medullary groove. This zone proliferates and thickens, perhaps representing a rudimentary somite. In relation to the segmentation of the medulla, the invagination occurs between the fourth and fifth neuromeres. On the appearance of the gill-pouches the auditory zone extends ventrally by thickening of the branchial zone. The ventral and dorsal margins of the invagination fuse, and a vesicle is formed. The space occupied is at first the dorsal portion of the posterior half of the hyoid arch rudiment; but when the vesicle is closed, the second branchial aperture corresponds to the boundary between the anterior two-thirds and the posterior third of the vesicle. The appearance of the auditory nerves is preceded by the development of a strand of spindle-shaped cells which forms the supporting tissue for the facial and auditory group. But these two nerves arise quite separately. The histogenesis of the auditory neuro-epithelium resembles in its earlier stages that of the medullary canal, supporting spongioblasts becoming distinct from the neuroblasts.

In Selachians a thickened ectoderm-ridge appears in the earliest stages alongside of the medullary groove, and in this the auditory zone arises. Goronowitsch's interpretation of the ganglion-ridge in birds is corroborated in Selachians,—it gives off supporting elements to the peripheral nervous system. The first histogenetic changes in the auditory epithelium, which indicate the maculæ acousticæ, begin earlier than in fowl-embryos. Two-thirds of the auditory vesicle lie in the posterior half of the hyoid arch region. After the vesicle has been formed there is still no appearance of lateral organs.

In Anura there is no sensory-plate common to the three upper sense-organs; what Goette described as such is the ganglion-ridge. The invagination arises from an insinking of the lower layer of the ectoderm, and is thus from the first bounded in front by the superficial layer of the ectoderm. The vesicle is closed by a proliferation of the margins of the invagination. Before the vesicle is closed, the *recessus labyrinthi*

* Arch. f. Mikr. Anat., xlviii. (1897) pp. 644–86 (2 pls.).

is visible in rudiment. The space occupied is between the second and third of Goette's segments.

The author regards the ear as representing a segment, and finds its remote homologue in the cirrhi dorsales of Annelids.

Fangs of the Adder.*—Prof. L. Kathariner has made some interesting observations on the growth of the reserve teeth in the adder, especially in regard to the growth of the mucous membrane folds which brings the opening of the poison-duct into functional connection with each successive fang. Anatomically the poison-duct always opens into the mouth, but the sheath of mucous membrane around the base of the tooth secures practical, though never organic, continuity between the poison-duct and the canal of the tooth. Ten is the usual number of reserve fangs; each seems to last about six weeks; the separation of an old fang is effected by odontoclasts in the pulp-cavity. The tooth consists of cement, dentin, fibro-dentin, and an enamel-cuticula, but there is no enamel. But the most important part of the paper is that which elucidates the establishment of the connection between a new fang and the poison-duct.

Attraction-Spheres in Spermatogenesis.†—Dr. R. von Erlanger summarises and discusses some of the recent papers—by Niessing, Rawitz, Wilcox, and others—on the rôle of attraction-sphere and centrosome in spermatogenesis. He concludes that the centrodeutoplasm [= archoplasm] consists of a special substance which is not present in the centroplasm (= attraction-sphere) of ova and of somatic cells. It collects around the centrosome when that has played its active part in cell-division, and it attains considerable dimensions only when the genital cells have passed through a long resting period. Thus there is a marked contrast between the centrodeutoplasm and the centroplasm (van Beneden's sphere), for the latter is formed *de novo* around each active centrosome in each division, unless, indeed, the divisions succeed one another very rapidly. Where a centrodeutoplasm occurs, it is diffused in the prophases of division by the fresh centroplasm; it is scattered in the cytoplasm by the growing spindle; it only collects again around the centrosome or centrosomes during the anaphases or telophases.

Life-History of the Eel.‡—Dr. C. G. J. Petersen regards the three so-called varieties of eel as representing three stages in development. The yellow eels comprise both males and females, but are all young fish, which have not yet commenced to assume the bridal dress of the adult, and in which the generative organs are little developed. The frog-mouthed eels are larger females still in the same conditions; while the silver eels comprise both males and females which have taken on the bridal dress, and are about to migrate to the sea to spawn.

Prof. G. B. Grassi § has shown that *Anguilla vulgaris*, the common eel, matures in the depths of the sea and spawns there, that its eggs float, and that the young pass through a larval form known as *Leptocephalus brevirostris*.

* Zool. Jahrb., Abth. Anat., x. (1897) pp. 55–92 (3 pls., 5 figs.).

† Zool. Centralbl., iv. (1897) pp. 153–71.

‡ Cited in Journ. Mar. Biol. Ass., iv. (1897) pp. 375–9, from 'Report of the Danish Biological Station to the Home Department,' v. (1894).

§ Proc. Roy. Soc., lx. No. 363, Dec. 1896. Cf. Quart. Journ. Micr. Sci., xxxix. (1897) part 3; and Journ. Mar. Biol. Soc., iii. (1896) pp. 278–87.

Lines of Variation and Germinal Selection.* — Prof. C. Emery emphasises the importance of Weismann's recent essay on Germinal Selection. A new departure may be due to germinal selection alone; personal selection will not influence its origin; there may be a conflict between germinal and personal selection, as when a strong new character exceeds the optimum. Emery does not agree with Weismann that all organic structure is adaptive; many characters appear to him to be quite indifferent. Nor does he admit the necessity of assuming an unfailing supply of fit variations; the extinction of races is eloquent proof of the reverse. He also points out that *if* an environmental change (e.g. of climate) influenced not only the body, but the determinants of the germ-plasm as well; and *if* it influenced not a fraction of similar determinants (which might lead to germinal struggle between the changed and the unchanged), but influenced all alike; and *if* the same factor operated for several generations; and *if* the resulting change was indifferent, i.e. without selection-value; then there is a logical possibility of the origin of a character without *any* selection.

Organic Selection.†—Prof. J. Mark Baldwin uses this phrase, which can hardly be called self-explanatory, to express "the perpetuation and development of congenital coincident variations in consequence of accommodation." By "accommodation" is here meant an adaptive reaction of the organism to its environment, which may result in a "modification." The idea is that congenital variations coincident or in the same line with adaptive modifications, are screened by the modifications, and thus indirectly selected. (Perhaps "indirect selection" might be suggested instead of "organic selection.") The results of organic selection are included under the term orthoplasy, which has, however, a wider connotation. Prof. Baldwin's contribution contains other suggestions towards a more definite terminology.

Study in Variation.‡—Mr. H. C. Bumpus has used X-rays in the investigation of the variations which occur in the vertebral column of *Necturus maculatus* Raf. A hundred specimens were examined. There is an average of 35 per cent. of homœotic variation, i.e. where a vertebra, for instance, assumes a structure which is proper to another in a different ordinal position in the series. These variations are all in the pelvic region. There is also considerable meristic variation, i.e. in the total number of segments in the column. The two forms of variation are associated; for specimens with abnormally placed sacra (homœotic) present a considerably increased meristic variation; and extremes in meristic vertebral variation tend towards homœosis. There is a ratio between the absolute length of the animal and the number of vertebræ. Some suggestions are made to show that forward homœosis is, so to speak, easier than backward homœosis, which is less frequent.

The author maintains that the differentiation of the sacral vertebra is the result of centripetal influence from the growing *Anlage* of the appendage, whose primitive position may readily vary a little, thus inducing an unsymmetrical sacrum. He argues that the appendage appears at a definite topographical point, without respect to the location of certain

* Biol. Centralbl., xvii. (1897) pp. 142–6. † Nature, lv. (1897) p. 558.
‡ Journ. Morphol., xii. (1897) pp. 455–84 (3 pls.).

segments of the neighbouring axial area. Variations in the pectoral arch and in other parts of the skeleton are associated with the pelvic variations. The pelvic variations were commoner in the females. Intercalation, in the sense of the introduction of new segments, does not take place.

Problems of Heredity.*—Herr G. Schlater has published a lecture on the problems of heredity. These, he says, must first be solved in the domain of the single cell, wherein, like many others, he finds an array of structural units or cytoblasts—five different kinds in the nucleus, three in the body of the cell.

There are three large questions:—The structure of the hereditary substance; the individuality or specific nature of this in different organisms; and the mechanism of transmission.

In discussing Weismann's position, the author notes the difficulty involved in the fact that the hereditary substance in the germ-cell is to that in the adult (in man) as 1 : 25,000,000,000. During this increase there is opportunity for change or specialisation under the influence of the "chief factors of development."

The chief factors in ontogeny include (1) the sum of external conditions; (2) the organisation of the living matter; and (3) the conditions of co-ordination and co-operation dependent on these. The chief determinant of inheritance is to be found in the specific individuality of the cytoblasts of the germ-cells.

Experiments on Supposed Inheritance of Acquired Characters.†—Dr. L. Hill tested Brown-Sequard's conclusion that, after section of the cervical sympathetic nerve in guinea-pigs, a droop of the upper eyelid is acquired, and that this droop is transmitted. In March 1895, six normal guinea-pigs were operated on, a droop of the eyelid was established, and has persisted. They were allowed to interbreed, but in none of the young was a persistent droop of the eyelid observable. Further experiments have proved absolutely negative. The author suggests that the apparent transmission of a droop in Brown-Sequard's cases may have been due to individually acquired conjunctivitis, which seems common enough in young guinea-pigs.

Alleged Modification of Bird's Stomach.‡—Dr. G. Brandes finds a mare's nest in the reputed modification of the bird's stomach as the result of altered diet. His own experiments on pigeons, gulls, &c., yielded quite negative results. Holmgren's were much the same, showing at most a general degeneration in the muscularity of the gizzard in the pigeons which he fed on flesh. Sir Everard Home seems to be responsible for the familiar results usually attributed to Hunter, who seems to have said little on the matter, though he made a preparation showing unusually strong musculature in the stomach of a gull fed for a year on corn. The other records are equally unsatisfactory. The nature of the stomach is doubtless variable, but "there is not the slightest evidence" of a gizzard being modified into a soft stomach, or conversely. Brandes suggests scepticism as to some other cases of alleged direct modification.

* Biol. Centralbl., xvi. (1896) pp. 689–94, 732–41.
† Proc. Zool. Soc. London (1896, published 1897), part 4, pp. 785–6.
‡ Biol. Centralbl., xvi. (1896) pp. 825–38 (7 figs.).

Influence of Heat and Light on Pigmentation of Salamander Larvæ.*—Professor W. Flemming finds that lighter pigmentation of salamander larvæ may be induced by increased temperature (Fischel), as well as by increased illumination (Flemming). The experiment was as follows:—

I. (*a*) A number of larvæ, in a cellar at 4°–5° C., in a white vessel in the window. Result in 8 days—light brownish colour.
(*b*) In a grey, covered vessel, in same cellar in the dark. Result in 8 days—as dark as usual.

II. (*a*) A number in a warm room (19°–20° C.), in a white vessel in the window. Result in 8 days—the lightest larvæ.
(*b*) In a brown, half-covered stoneware vessel, in the same room. Result in 8 days—light-brownish colour as in I (*a*).

Hypertrichosis.†—Prof. A. Brandt has written an interesting essay on so-called dog-men, or more technically on *hypertrichosis universalis*. We refer to it merely in respect of its ætiological interest. The abnormal hairiness is regarded by some, e.g. Virchow, Bartels, and Waldeyer, as a post-embryonic growth; it is regarded by others, e.g. Darwin, von Siebold, Ecker, Unna, as a persistence and exaggeration of the *lanugo fœtalis*. Brandt's view is that an inhibitory influence, weakening the integumentary system, results in a *hypertrichosis lanuginosa fœtalis*, the primitive hairs remaining, like the antlers on a castrated stag. The same weakness which caused the retention of the primitive hair may also express itself in defective dentition. Brandt recognises, however, that another kind of hypertrichosis may result from an *exaggerated* formative activity in the skin. But the two states are quite distinct.

Viragines.‡—Prof. A. Brandt discusses the ætiological significance of the beard in Viragines, which some—e.g. Kennel—interpret as a reversion-phenomenon, which the author, on the other hand, regards as a prophetic variation, expressing a tendency on the female's part to gain a characteristic which many males have long since acquired.

Epidermis Folds on Palms and Soles of Primates.§—Dr. H. H. Wilder concludes that the callous pads on the feet of walking pentadactylous mammals become reduced in certain monkeys to fleshy mounds without definite boundaries. Over these mounds the folds, which are elsewhere approximately parallel, are distorted (from this primitive pattern) into whorls, spirals, or loops. In some Primates, including man, the mounds are reduced, so that only the epidermic figure or centre is left, or even that may disappear. In man the apical centres on the finger tips are fairly constant, Galton's "simple arch" being the most reduced form. The palmar, thenar, and hypothenar centres are of uncertain occurrence.

As a working hypothesis, Wilder suggests that the epidermic ridges were primitively even and parallel; that pads evoked by pressure caused divergence of the primary ridges and the formation of secondary ridges; and that in modern walking forms the hypertrophy of the epidermis has obliterated the markings, which arboreal life has retained in the Primates.

* Arch. f. Mikr. Anat., xlviii. (1897) pp. 690–2.
† Biol. Centralbl., xvii. (1897) pp. 161–79.
‡ Tom. cit., pp. 226–39.
§ Anat. Anzeig., xiii. (1897) pp. 250–56.

He does not mean, however, to commit himself to a Lamarckian theory, believing that the facts may be equally well interpreted in terms of selection. There is no reference in the paper to Dr. D. Hepburn's work on the papillary ridges of monkeys and men (1895)—an omission which is surely inadvertent.

β. Histology.

Text-Book on the Cell.*—M. L. F. Henneguy has published a series of lectures on the cell, the result being a volume which must take its place beside the similar works of Hertwig, Bergh, and Wilson.

Giant Ganglion-Cells in Spinal Cord of Flat-Fishes.†—Mr. U. Dahlgren finds a system of giant ganglion-cells in the spinal cord of *Paralichthys dentatus*, *P. oblongus*, *Bothus maculatus*, *Pleuronectes americanus*, and other flat-fishes. It consists of a row of very large nerve-cells in the median dorsal fissure and of their processes, which pass backwards and form an isolated fibre tract on the mesial side of each dorsal horn. They are the first ganglion-cells to become differentiated in the embryo flat-fish; they are not preceded or accompanied by a really transient apparatus, and are the only large nerve-cells that appear in the dorsal median fissure. It is suggested that these cells are connected with the sense-organs of the dorsal fin, and that they may be the same as the transient ganglion-cells in the embryos of *Salmo*, *Raja*, &c.

Structure of Cerebral Cortex and Function of Nerve-Cell Processes.‡—Dr. K. Schaffer describes the superficial nerve-cells in the brain, and the relations of the axons and their collaterals. He maintains —(1) that nervous stimulus is always propagated only through the axons and their collaterals, the dendrites being nutritive; and (2) that impulse *from* a cell passes by the axons, while stimulus *to* a cell passes by those collaterals whose contact-relations enable them to function as receptive structures.

A Centrosome Artifact in Nerve-Cells.§—Dr. U. Dahlgren describes certain appearances in the spinal ganglion-cells of the dog, which looked exceedingly like centrospheres and centrosomes, but which candid examination showed to be artificial and due to some structural change produced by crystals of sublimate.

Sensory Organs of the Lateral Line.‖—Dr. F. S. Bunker has studied these in the bull-head, *Ameiurus nebulosus* Le Sueur. At the base of the sensory organs, outside the basement membrane, the nerve-fibres lose their medullary sheath, branch repeatedly, and spread out over the whole bottom and sides of the organ. They pierce the basement membrane in many places, and rise, still branching, to the bases of the sensory cells, around which they intertwine in a basket-like network, from which fibrillations rise still higher, nearly to the free border of the organ. Other fibres take no part in this basket-like plexus, but extend upwards, still branching, in close apposition to the sensory cells. The latter end in bristles, and are in the strictest sense nerve-elements conforming to the type of anaxionic neurons.

* 'Leçons sur la cellule, morphologie et reproduction,' 8vo, Paris, 541 pp., 362 figs.
† Anat. Anzeig., xiii. (1897) pp. 281–93 (4 figs.).
‡ Arch. f. Mikr. Anat., xlviii. (1897) pp. 550–72 (2 pls.).
§ Anat. Anzeig., xiii. (1897) pp. 149–51 (2 figs.). ‖ Tom. cit., pp. 256–60.

Red Blood-Corpuscles.*—Dr. E. Giglio-Tos distinguishes four kinds of red blood-corpuscles in Vertebrates:—

(1) *Primitive erythrocytes*, as seen in earliest development.

(2) *Granular erythrocytes*, as seen in the lamprey throughout life, and in embryonic or larval life in other Vertebrates. These are spherical cells with membrane and nucleus, with protoplasm rich in hæmoglobin, and with a certain number of granules or drops of hæmoglobigenous substance (of nuclear origin).

(3) *Nucleated ringed erythrocytes*; lenticular elliptical biconvex cells, with a median nucleus surrounded by a stratum of hæmoglobigenous substance. Around this central mass is a ring of elastic substance containing the hæmoglobin. These occur in Sauropsida and Ichthyopsida, except in the lamprey.

(4) *Non-nucleated ringed erythrocytes*; circular or elliptical discs, in which the hæmoglobigenous substance forms a single central mass, around which there is a ring of elastic substance containing the hæmoglobin.

Behaviour of Leucocytes in Injured Cornea.†—Prof. L. Ranvier describes the rôle of the leucocytes in the reparation of an injured cornea. As he says, he has previously discussed the migration, nutrition, transporting power, and dissolution of these cells; as indeed others have done. He objects to the term phagocytes, for that is only a new name for familiar elements, and he objects to that emphasis on phagocytosis which loses sight of the fact that all cells may in certain conditions take in solid particles. He insists on the important rôle which the leucocytes play in supplying nutritive material to the tissues, and on the view that inflammation is a return to embryonic conditions.

Muscle-Fibres.‡—Prof. R. Marchesini discusses the structure and development of muscle-fibres in a variety of types. Whether smooth or striped, the muscle-fibre results from the union of embryonic cells (caroblasts), which remain in their primitive state in the smooth fibres, and are transformed into fibrils in the striped. The difference in the structure of the so-called two kinds is wholly due to the degree of development.

Peritoneal Ostioles.§—M. J. J. Andeer maintains that the peritoneum of the frog, &c., has a fine gauze-like structure, being studded with minute pores or ostioles, which are important both physiologically and pathologically. As he says, they have hitherto escaped the observation of histologists.

Suprarenal Capsules.‖—Mr. Swale Vincent concludes that the suprarenal capsule of Mammals corresponds to two distinct glands in Elasmobranchs, the medulla corresponding in structure and function to the "paired segmental" suprarenal bodies, while the cortex corresponds to the interrenal body. In Teleosteans, and probably in Ganoids, the suprarenal bodies ("corpuscles of Stannius") consist entirely of cortical substance, and correspond to the interrenal of Elasmobranchs.

* Anat. Anzeig., xiii. (1897) pp. 97–109. Atti R. Accad. Sci. Torino, xxxii. (1897) pp. 237–9.
† Comptes Rendus, cxxiv. (1897) pp. 386–91.
‡ Boll. Soc. Rom. Stud. Zool., v. (1896) pp. 198–210.
§ Comptes Rendus, cxxiv. (1897) pp. 577–80.
‖ Proc. Roy. Soc., lxi. (1897) pp. 64–73.

γ. General.

Experimental Morphology.*—Mr. C. B. Davenport has published the first of four volumes which are to bear this title, and which have for their aim to explain what may be called the physiology of growth and development. The present volume deals in a careful and scholarly manner with the reactions of protoplasm to external influences, chemical, mechanical, and dynamic, and with the modifications which these influences sometimes induce. In spite of the author's preface, we cannot agree that he has found the correct title for his book, which, however, promises to be a very useful one.

Problems of Biology.†—Mr. G. Sandeman has published a book which may be called a criticism of some of the categories of biology. After a chapter on biological method, the author criticises three familiar postulates:—(1) That the qualities of the individual are discrete, numerable, constituent elements, of which the organism is the total sum; (2) that all the qualities of the organism and all its stages are the manifestation of, and are related to one another only through an agent or system of agents within the known body; (3) that everything organic exists only by reason of, and is to be explained only in relation to, some special external use which it now has, or which a similar structure has had in former times. The fifth and last chapter discusses the unity of the organism, which is the central idea of the book. Even by those who maintain that biology has nothing to do with philosophy, and *vice versâ*, Mr. Sandeman's book will be found stimulating; while those who believe that to science without philosophy the world remains a broken mirror, will welcome it warmly. And even the least ambitious of biologists may realise from this little book that in his use of the most familiar words, such as "organism," "function," "development," "evolution," he is dealing with big and difficult concepts of which progress demands an ever-recurrent criticism.

Bionomics of Australasian Animals.‡—Dr. R. Semon has given a popular account of the journeyings which he undertook in order to obtain the young stages of *Ceratodus*, *Echidna*, &c. From a review § of the book we select a few illustrations. The chief food of *Ornithorhynchus* consists of a bivalve, *Corbicula nepeanensis*. The Monotremes reproduce once a year. Ripe and fertilised eggs are found only in the *left* oviduct. When the egg of *Echidna* is placed in the pouch it measures 5 mm. in length, the newly hatched embryo measures 15 mm., the young one remains in the pouch until about 80–90 mm. in length. It is probable that the dingo is responsible for the disappearance of *Thylacinus* and *Sarcophilus*. A remarkable circular nest of stones is made by *Arius australis*. The importance of drift wood in distribution is very great. In many west-Javanese animals (e.g. *Manis javanica*, *Ptychozoon homalocephalum*) there seems to be no special reproductive season. Under the

* 'Experimental Morphology,' The Macmillan Co., New York, 8vo, 1896, xiv. and 280 pp., 74 figs. † 'Problems of Biology,' 8vo, London, 1896, 213 pp.

‡ 'Im Australischen Busch und an der Küste des Korallenmeeres. Reise-Ergebnisse und Beobachtungen eines Naturforschers in Australien, Neu-Guinea und den Molukken,' 8vo, Leipzig, 569 pp., 85 illustr., and 4 maps.

§ Zool. Centralbl., iv. (1897) pp. 84–8.

umbrella of a Rhizostomid the fish *Caranx auratus* was found; other small fishes seek shelter among the extraordinarily long spines of *Diadema setosum.*

The Plankton Pump.*—Prof. J. Frenzel describes the use (in lakes) of the Plankton pump, which has proved itself advantageous on ice-covered waters, and is probably capable of much wider utilisation. For slight depths it is both cheap and practicable; but the cost of the india-rubber tube mounts up with every yard, and what the pump can do in deep water explorations remains to be seen. So far as it has been used, it compares favourably with even Hensen's net.

Plankton of Faeroe Channel.†—Dr. G. H. Fowler, in the first of a series of notes on the Plankton of the Faeroe Channel, describes *Sagitta Whartoni* sp. n., which differs from all other species yet described in the approximation, almost fusion, of the paired lateral fins; *Spadella (Krohnia) hamata* Möbius, of which a better outline figure than has hitherto been given is furnished; and *Salpa asymmetrica* sp. n., the eighteenth now recorded from the N. Atlantic.

Variation of the Plankton.‡—Dr. J. Hjort has published a very interesting memoir describing his hydrographic-biological studies off the Norwegian coast. He has much to say in regard to the diversity of the Plankton at different seasons. The conditions on which the periodically diverse appearance of the Plankton depends are many and various. Of greatest importance are (1) the ocean currents and the variations in salinity; (2) the propagating period of the various organisms concerned; and (3) the variations of wind and light.

Physical Basis of Animal Phosphorescence.§—Mr. S. Watasé has published an entertaining lecture on this subject, and promises a monograph. In some historical notes he quotes largely from Faraday, who surmised the results of later workers, showing that a chemical substance, probably a secretion, in the glow-worm and the firefly, shines when exposed to air, independently of the insect's life, though the insect does in some way control its luminosity. Mr. Watasé clears the ground by insisting on the continuity of heat and light phenomena, which differ subjectively rather than objectively. Usually the organism produces heat without light, the firefly produces light without heat.

The proximate cause of luminosity in the animal kingdom may be due to a variety of secondary circumstances:—(1) there may be luminous bacteria present pathologically; (2) there may be symbiotic luminous bacteria; (3) the food may be phosphorescent.

In fireflies, the luminous cells contain granules, secretions of a fatty nature, which oxidise readily in alkaline media. Phosphorus has nothing to do with the phenomenon. The product of cell-metabolism is oxidised *in situ* and independently of the cell-life, by the inspired oxygen. Through its respiratory mechanism the insect may and does control the process; but the last step is the oxidation of a dead substance. Watasé closes

* Biol. Centralbl., xvii. (1897) pp. 190-8.
† Proc. Zool. Soc. London, 1896 (published 1897), part 4, pp. 991-6 (1 pl.).
‡ Skrift. Videnskabs. Christiania, 1895, part 1, No. 9 (published 1896), pp. 76 and 75 (15 maps, &c.).
§ Wood's Holl Biological Lectures, 1896, pp. 101-18 (1 fig.).

with the question whether the relation of oxygen to life may not always be of this nature.

Fauna of Alpine Lakes.*—M. Otto Fuhrmann gives faunistic lists, which represent a vast amount of work, relating to the Alpine lakes of Tessin. He has discovered numerous forms hitherto recorded only in the plains; indeed, out of 67 forms, 34 have not been noticed hitherto in these high-lying waters. In short, the Alpine lake fauna is less peculiar than was supposed. Fuhrmann gives an interesting illustration of the diversity that may exist in adjacent lakes. The Lago Punta Nera (2456 m.) and the Lago Scuro (2453 m.), are separated by 100 m. and united by a stream. The former is small and not deep, the latter is large and deep, otherwise they are much alike. From the former 33 species were obtained, from the latter 17, only 9 common to the two. Of the pelagic forms, only *Cyclops strenuus* and *Diaptomus* were common to the two lakes. The littoral forms were even more distinct.

INVERTEBRATA.

Mollusca.

a. Cephalopoda.

Oviposition of Nautilus.†—Dr. A. Willey describes the oviposition of *Nautilus macromphalus*, the species characteristic of the New Caledonian Archipelago, differing from *N. pompilius* in the umbilical region of the shell. The eggs are laid singly and at night, in concealed situations, and are firmly attached to a suitable surface by a sponge-like reticulate area of attachment placed towards their hinder inflated extremity, usually on one face of the egg-case, but sometimes quite posteriorly. The ovum is enclosed within a double casing, an inner closed capsule, and an outer capsule more or less freely open in front. These capsules are formed of a bright milk-white material, of firm cartilage-like consistency. The egg with outer covering complete is of remarkably large size, attaining a length of 45 mm. and a maximum height of 16·25 mm. The vitellus does not fill the entire cavity of the inner capsule, but is surmounted by a layer of cloudy viscid albumen. The yolk is of a rich brown colour, very fluid and sub-translucent. The breeding seems to be periodic.

Arthropoda.

a. Insecta.

Means of Defence in Insects.‡—Prof. L. Cuénot gives a detailed account of reflex bleeding in insects, e.g. in *Timarcha*, *Galeruca*, *Megalopus*, *Eugaster*, and *Ephippiger*. A preliminary note was previously summarised. When disturbed these insects emit drops of blood from the mouth, or from the femoro-tibial articulations, or from the attachment of the elytra. The blood contains toxic, caustic, or repellent substances, such as cantharidin, and is effectively protective against lizards and amphibians. A flow may be induced by slight chloroforming or other excitation. Compressed by the contraction of the abdomen the blood bursts through the cuticle at the points of least resistance. There is

* Rev. Suisse Zool., iv. (1897) pp. 489–543.
† Proc. Roy. Soc., lx. (1897) pp. 467–71 (4 figs.).
‡ Arch. Zool. Expér., iv. (1896) pp. 655–80 (4 figs.).

some interesting variability:—Thus the place of rupture may be different in the same species (*Timarcha*); some individuals do not show any bleeding; it seems to occur in specimens of *Melasoma* at Halle, but not in those of France.

Labium of Hemiptera.*—Dr. N. Leon confirms what he discovered in 1887 and in 1892, that the Hemiptera have not only labial palps, but also rudiments of the external and internal lobes. He has investigated *Benacus griseus* Say, *Zaitha anura*, *Gerris Najas*, *Velia rivulorum*, &c., and maintains the complete homology between the labium of Hemiptera and that of biting insects. The first joint corresponds to submentum and cardines, the second to mentum and stipites; the third and fourth joints represent paraglossæ or ligulæ, or, more probably, both united.

Evolution of Lepidoptera.†—Dr. Gräfin Maria von Linden discusses Prof. Eimer's work on the origin of species in Lepidoptera, and especially of the lines of evolution disclosed by a study of the markings. "It has been shown," she says, "that a large number of changes in the individual animal arise from the operation of external influences, that these variations are similar to those observed in nature, and occur likewise in definite directions. It is also shown that the variations which arise by organic growth are transmitted to descendants, and that the different stages of variation which are exhibited in the phylogeny as specific characters are recapitulated as transient stages in the ontogeny." "If Prof. Eimer's claims are correct," says Minot, "his researches mark one of the great epochs of biological discovery."

Growth of Silkworms.‡—Sigg. Luciani and Lo Monaco have investigated the progressive increase in the weight and nitrogenous content of silkworms, considered in relation to the nutrition at successive stages.

Unusual Case of Myiasis.§—Dr. G. Alexandrini reports an unusual case of myiasis due to the larvæ of *Sarcophaga carnaria* Meig. in the nasal cavity of man. After describing the case and the treatment, he notes some similar occurrences.

Larva of Thrixion Halidayanum.‖—M. J. Pantel describes some of the structural peculiarities of this Dipterous larva. The gut is simplified in adaptation to parasitism; thus the œsophagus and the hind-gut are short, the stomach and gastric appendages are suppressed, and the place of the proventriculus is taken by a hard cushion (with associated musculature) on the upper wall of the œsophagus. The heart—a muscular tube closed behind—is also described. More interesting, perhaps, is a metameric organ in the seven abdominal segments. It is formed in each side of a somite by a twin group of giant-cells, and possibly represents a closed excretory organ.

Notes on Strepsiptera.¶—Prof. N. Nassonow criticises Prof. F. Meinert's recent denial of the existence of a cephalothorax in Strepsiptera, and his identification of the cephalothorax as the posterior end. The

* Zool. Anzeig., xx. (1897) pp. 73–7 (5 figs.).
† Biol. Centralbl., xvii. (1897) pp. 179–90, 213–26.
‡ Atti (Rend.) R. Accad. Lincei, vi. (1897) pp. 155–32.
§ Boll. Soc. Rom. Stud. Zool., v. (1896) pp. 194–7.
‖ Comptes Rendus, cxxiv. (1897) pp. 580–2.
¶ Zool. Anzeig., xx. (1897) pp. 65–6.

author has confirmed the conclusions of Erichson and Siebold as to the presence of a true cephalothorax. He gives a figure of *Xenos Rossii*, showing (*a*) the supra-œsophageal ganglion with its optic lobes, (*b*) the œsophageal nerve-ring, (*c*) the sub-œsophageal ganglion, and (*d*) the abdominal ganglion, which is fused with (*c*) in the larvæ, but connected with it by a commissure in the adult female.

Second Abdominal Segment in Libellulidæ.*—Miss M. F. Goddard describes the second abdominal segment and the penis in a few male Libellulinæ, species of *Diplax*, *Celithemis*, *Libellula*, and *Plathemis*. Some general suggestions are offered—e.g. that the hamules may be homologues of abdominal appendages; and that the bifid condition of the hamules in Libellulinæ is secondary, transitions occurring towards the uniramous condition in the other sub-families.

Larvæ of British Lepidoptera.†—The seventh volume of 'The Larvæ of the British Butterflies and Moths,' by (the late) Mr. W. Buckler, published under the editorship of Mr. G. T. Porritt, deals with the first portion of the Geometræ. Mr. G. C. Bignell supplies a list of parasites known to affect the species treated of. It is needless to say more in regard to this well-known work.

β. Myriopoda.

Investigations on Diplopoda.‡—Dr. C. Verhoeff discusses—(1) the comparative morphology of the first pair of appendages in male Iulidæ; (2) the well-marked differences of coloration in the sexes of *Brachyiulus projectus* Verh., *B. projectus* var. *alticolus* Verh., and *B. rosenauensis* Verh., the males being the darker in all three cases; (3) the occurrence of *Schalt*-males in *Pachyiulus hungaricus* Karsch and in *Brachyiulus projectus* Verh.; and (4) three new forms from Siebenbürgen, viz. *Polydesmus hamatus* Verh., *P. illyricus montanus* Daday, and *P. illyricus* Verh. [= *complanatus* Daday].

Ovum of Diplopoda.§—Dr. B. Němec has investigated the structure of the ovum of *Polyzonium germanicum* Brdt., *Blaniulus guttulatus* Bosc, and some other Diplopoda. A medium-sized ovum contains a large well-defined cap-like body, on the concave side of which lies the nucleus. The latter shows an achromatic reticulum, and a large round nucleus including a still smaller body. Beside the cap there is also a much smaller corpuscle, around which the plasma is radially disposed (the attraction-sphere). The cap in question arises from one of two corpuscles which lie near the nucleus in the young ovum; it becomes very definite, and embraces the nucleus; thereafter it becomes vacuolated and breaks up. It is possible that cap and sphere are both differentiations of an originally single corpuscle which divides.

δ. Arachnida.

New Spiders.‖—The Rev. O. Pickard Cambridge describes two new spiders, both of which require new genera. The first, *Aetius decollatus*

* Proc. Am. Philos. Soc. Philadelphia, xxxv. (1896) pp. 205–12 (2 pls.).

† Ray Society, London, 8vo, pp. xv. and 176, pls. cvi–cxxvii. (1897), volume for 1894.

‡ Zool. Anzeig., xx. (1897) pp. 78–88.

§ Anat. Anzeig., xiii. (1897) pp. 309–12 (15 figs.).

‖ Proc. Zool. Soc., part 3, 1896 (published 1897), pp. 1006–12 (1 pl.).

(fam. Myrmecidæ), is from Ceylon; the second, *Friula Wallacii* (fam. Gasteracanthidæ), was found by Dr. A. R. Wallace at Sarawak many years ago. It is a remarkable form, the exterior angle of the diamond-shaped abdomen being prolonged on each side (for more than the width of the abdomen) into a strong cylindrical spine-like projection, directed rather backwards, and enlarged or clavate at the extremity, ending in a group of six or seven small conical prominences. The author also gives an account of the males of *Labdacus monastoides* Cambr. and *Stephanopoides brasiliana* Keys, the females only having been hitherto described.

Epizoic Mite on an Ant.*—M. Ch. Janet describes the occurrence of a mite, *Antennophorus Uhlmanni* Haller, beneath the head and on the sides of the abdomen of *Lasius mixtus* Nyl. It feeds on nutritive fluid disgorged—willingly it would seem—by the ant.

ε. Crustacea.

Notes on Crabs.†—Mr. W. Garstang discusses the function of the antero-lateral denticulations of the carapace in sand-burrowing crabs, such as *Bathynectes longipes* and *Atelecyclus heterodon*. They subserve a sieve-like function, and the extent of the denticulated area corresponds with the extent of the inhalant gap between the carapace and the cheliped, when the latter appendage is approximated to it in the flexed position. In the sand-burrowing crabs with these denticulations, the chelipeds act as organs temporarily subservient to the respiratory process by providing a broad operculum to the exostegal channel.

Mr. Garstang also describes the systematic features, habits, and respiratory phenomena of *Portumnus nasutus* Latreille, which has not been previously recorded as an inhabitant of British seas. Again he shows the utility of apparently trivial specific characters.

Development and Species of Sergestes.‡—Dr. H. J. Hansen gives a brief account of this genus, in regard to which more complete observations are much to be desired. Of the 50 (or 60) hitherto described species, only about 20 have been established on sexually mature forms, and almost all the other species are larval stages, some of them of species previously established on adult specimens. Of the 20 species founded on adult specimens, 2 are excluded for good reasons, and 4 are cancelled as synonyms.

When a species is mature, the male always possesses a large petasma, and—so far as we know—a peculiar development of the exterior flagellum of the antennulæ. In all larvæ (*Mastigopus*) the eyes are yellowish or whitish, and black pigment, when present, is found only in the interior, and very remote from the cornea; while in the adults the eyes are totally black.

With one exception (*S. arcticus*) all the species are found in tropical and sub-tropical seas, to lat. 42°–43° N. in the Atlantic. All the larvæ are essentially surface forms, but at least two-thirds of the species inhabit the depths of the sea when mature.

* Comptes Rendus, cxxix. (1897) pp. 583–5 (1 fig.).
† Journ. Marine Biol. Ass., iv. (1897) pp. 396–407 (2 figs.).
‡ Proc. Zool. Soc. London, 1896, part 4 (published 1897) pp. 936–70.

Malayan Decapods and Stomatopods.* — Dr. J. G. de Man continues his report on a collection from Malacca, Borneo, Celebes, and the Java Sea. He describes several new species.

Notes on Distribution of Amphipoda.†—Mr. A. O. Walker has made some studies on the proportion of species to genera in small and large areas, and on the distribution of species at various depths. He finds that the proportion of species to genera increases with the area, and that a far greater number of species are found at depths less than 100 fathoms, than at that or a greater depth. From below 50 fathoms, 208 species were recorded, against 74 between 50 and 100 fathoms; and 57 above 100 fathoms.

Sarcotaces arcticus.‡—Dr. J. Hjort discusses this strange parasite —perhaps a new type of Cirripedia—which was discovered by Collett (1873), in the flesh of *Molva abyssorum*, and referred by him to the genus *Sarcotaces* established by Olsson (1872). The life-history is probably somewhat as follows:—The small ova give rise to nauplius larvæ which swim about at a depth of over 100 fathoms; they perhaps attain to a metanauplius stage, and then fasten themselves to *Molva*; after a period of growth they begin to be encapsuled by connective tissue strands developed in the musculature of their host; this capsule cuts off nutrition, and the parasite lives on the store of blood accumulated in its large digestive cavity; the ovaries, however, ripen, and the eggs are fertilised, perhaps by a rudimentary male; degeneration sets in, an opening to the surface of the host is formed, and nauplius-larvæ escape. But much remains quite uncertain as regards both structure and development.

New Epicarid Parasite.§—M. Maurice Caullery describes *Branchiophryxus nyctiphanæ* g. et sp. n., one of the Dajidæ, which he found on the last gill of *Nyctiphanes norvegica*. In the female, the number of thoracic appendages is reduced to eight (ten being the usual number), and the pleural plates have disappeared; in both sexes the abdomen is atrophied. The type is thus more degraded than *Aspidophryxus*, *Dajus*, or *Notophryxus*. It shows most resemblance, in part perhaps the result of convergence, to *Notophryxus lateralis* G. O. Sars.

Development of Monstrillidæ.‖—Dr. W. Giesbrecht calls attention to Giard's ¶ solution of the riddle involved in the fact that these Copepods do not feed during their mature pelagic life, when, however, they are very active and very productive. The solution is found in the earlier life of these animals, when they are entoparasites in Annelids (*Polydora*), and accumulate material for future use. Malaquin ** has recently confirmed this, but states that the young are found in *Filigrana* and *Salmacyna* in a *blastula-like stage*. Giesbrecht, on the other hand, finds that the young of Monstrillidæ, like other Copepods, leave the egg as nauplii. It is possible, however, that after the nauplius stage they lose their

* Zool. Jahrb. (Abth. Syst.), ix. (1897) pp. 725–90 (3 pls.).
† Proc. and Trans. Liverpool Biol. Soc., x. (1896) pp. 178–80.
‡ Skrift. Videnskab. Christiania, 1895, i. (published 1896) 14 pp. (2 pls.).
§ Zool. Anzeig., xx. (1897) pp. 88–92 (2 figs.). ‖ Tom. cit., pp. 70–2.
¶ Comptes Rendus, cxx. p. 937; cxxiii. p. 836.
** Op. cit., cxxiii. p. 1316; cxxiv. p. 99.

appendages, undergo histolysis, and become the ellipsoid bodies which Malaquin has described.

Free-Swimming Copepods from West Coast of Ireland.*—Mr. I. C. Thompson describes the Copepods of some tow-net material from off Valencia. Of 22 species, 6 were rare, viz. *Metridia armata*, *Candace pectinata*, *Pseudocalanus armatus*, *Monstrilla rigida*, *Corycæus speciosus*, and *Oncæa mediterranea*. The occurrence of the two last, which are southern species, may indicate Gulf Stream influence. The collection, like another made by Prof. Herdman, illustrates the relatively large number of different genera, for the 22 species represent 18 genera.

Brain and Optic Ganglion of Leptodora hyalina.†—Mr. E. P. Carlton has made a study of the minute structure of these parts. The brain is covered with cortical cells, except at the superficial origin of the nerves and over an area located dorsolaterally. The interior is composed of the medulla, or *Punktsubstanz*, which is divided by commissures and cells into distinct subdivisions, and of three groups of nerve-cells. In the optic ganglion, likewise, there is a superficial layer of cortical cells and a central medulla. The author describes the various parts in detail.

South African Entomostraca.‡—Prof. G. O. Sars reared 20 species of Entomostraca from some dried mud obtained from a swamp at Knysna, some distance east of the Cape of Good Hope. Nothing has been hitherto published about the freshwater Entomostraca of that remote region, hence the special interest of this paper. The mud yielded 9 Cladocera, 10 Ostracoda, and 1 Copepod, of which 11 species were apparently new to science.

Classification of Trilobites.§—Mr. C. E. Beecher completes his outline of a natural classification of the Trilobites.

Order A. Hypoparia ord. n. Free cheeks forming a continuous marginal ventral plate of the cephalon, and in some forms also extending over the dorsal side at the genal angles. Suture ventral, marginal, or sub-marginal. Compound paired eyes absent; simple eyes may occur on each fixed cheek, singly or in pairs. Includes the families Agnostidæ, Harpedidæ, and Trinucleidæ.

Order B. Opisthoparia ord. n. Free cheeks generally separate, always bearing the genal angles. Facial sutures extending forwards from the posterior part of the cephalon within the genal angles, and cutting the anterior margin separately, or rarely uniting in front of the glabella. Compound paired holochroal eyes on free cheeks, and well developed in all but the most primitive family. Includes the families Conocoryphidæ, Olenidæ, Asaphidæ, Proëtidæ, Bronteidæ, Lichadidæ, and Acidaspidæ.

Order C. Proparia ord. n. Free cheeks not bearing the genal angles. Facial sutures extending from the lateral margins of the cephalon in front of the genal angles, inward and forward, cutting the anterior margin separately or uniting in front of the glabella. Compound

* Proc. and Trans. Liverpool Biol. Soc., x. (1896) pp. 92–102.
† Anat. Anzeig., xiii. (1897) pp. 293–304 (28 figs.).
‡ Skrift. Videnskabs. Christiania, 1895, part i, No. 8 (published 1896), 56 pp., 8 pls.
§ Amer. Journ. Sci., iii. (1897) pp. 181–207.

paired eyes scarcely developed or sometimes absent in the most primitive family, well-developed and schizochroal in the last family. Includes the families Encrinuridæ, Calymenidæ, Cheiruridæ, and Phacopidæ.

The Hypoparia probably culminated in the pre-Cambrian times, the Opisthoparia during the Cambrian, and the Proparia during the Ordovician. The Opisthoparia are represented by about 85 genera in the Cambrian, 45 in the Ordovician, 19 in the Silurian, 10 in the Devonian, 4 in the Carboniferous, and 1 in the Permian.

Annulata.

Pelagic Larvæ of Polychæta.*—Dr. V. Haecker describes many of the pelagic larvæ of Polychæta which are to be found in spring in the Gulf of Naples. He distinguishes the trochophore (without hint of metameres), the metatrochophore (in which segments are beginning to be defined), the nectochæta (with reduced ciliation, but with strong setose natatory appendages), and the protrochophore (without mouth or anus, with broad pre-oral zone bearing short cilia), a stage antecedent to or replacing the trochophore.

After defining the various regions of the larval body, the author describes the larvæ of the different families.

The assumption of a pelagic stage is interpreted as an alternative to the acquisition of a store of yolk. Both are adaptations to secure the nutrition of the young. All possible transitions occur between those forms which become sedentary immediately after being hatched, and those which are from the first pelagic.

The author distinguishes four groups:—I. Tubicolous forms with non-pelagic larvæ (Terebellidæ, Ariciidæ, Arenicolidæ (?); II. Tubicolous forms with strictly pelagic larvæ (Chætopteridæ, Spionidæ, Serpulidæ, Archiannelidæ); III. Errantia without pelagic larvæ (some Eunicidæ and Syllidæ); IV. Errantia with strictly pelagic larvæ (Nephthyidæ, Nereidæ, Phyllodocidæ, and Aphroditidæ).

Not the least important part of this valuable memoir is the third chapter, in which the author discusses the comparative histology and physiology of the integument—the pigmentation, the primary sense-organs, the locomotor apparatus, the primary glandular and skeletal tissue.

Asymmetry of Spirorbis.†—MM. Maurice Caullery and F. Mesnil describe the asymmetry of *Spirorbis* induced by its habitat in the interior of a spiral tube. The direction of the turn of the spire is constant for a given species; the operculum is always on the concave side; the longitudinal muscle-fibres are strongest on the same concave side; the viscera are thrown towards the same side; the uncini on the thorax and abdomen are larger and more numerous on the concave side; the ovules in course of maturation are always on the convex side; and so on. All can be explained by the movements made by the animal within the tube. The authors distinguish right-handed and left-handed species, and in a detailed memoir (referred to) have applied the facts to a phylogenetic consideration of the group. In a note on the above, Prof. E. Perrier‡ directs attention to some previous observations which he made bearing

* Zeitschr. f. wiss. Zool., lxii. (1896) pp. 74-168 (3 pls., 8 figs.).

† Ann. and Mag. Nat. Hist., xix. (1897) pp. 411-3. Comptes Rendus, cxxiv. pp. 48, 50.

‡ Tom. cit., pp. 50-1.

on the question of asymmetry, and on the resemblance between Cephalobranchiate Annelids and Gasteropods. "The initial asymmetry is no doubt due to an active cause like that which shows itself in Molluscs; when once the tube is formed, it can accentuate itself by reason of the special conditions of existence it imposes on the animal."

New American Species of Megascolides.*—Mr. F. Smith gives a brief description of *Megascolides americanus* sp. n., from Pullman, Washington. It is said to be very abundant, and to make burrows sometimes over fifteen feet deep. It differs from its North American relatives in the presence of numerous small nephridia in each somite instead of two large ones, in the extent of the clitellum, and in several other characters.

Regeneration of Fore-gut in Lumbriculus.†—Dr. F. von Wagner described this in 1893 as occurring without the help of the ectoderm. He finds, however, that an unmistakable invagination of ectoderm occurs. At the point where the endoderm of the gut is for a time in contact with the superficial ectoderm, forming a provisional mouth, a true stomodæal insinking develops.

Species of Acanthobdella.‡—Prof. Al. Kowalevski has studied the structure of *Acanthobdella peledina* Grube, found by Middendorf as a parasite on the fishes of the Jenissei, and *Acanthobdella Esmontii*, found by O. Grimm in the Caspian. The chief interest of the first species is its likeness to Chætopods; it may be considered as a transitional form. It has setæ and a body-cavity. The second species is much more like *Nephelis*.

Rotatoria.

New Species of Rotifers from the Illinois River.§ — Mr. Adolph Hempel gives a short description, with figures, of three new species of *Brachionus*:—*B. variabilis*, *B. mollis*, and *B. punctatus*. The first is rather a bad name, since all Rotifers vary, and none more so than the different species of *Brachionus*. *B. mollis* is peculiar in having a very thin soft glassy transparent lorica, with no spines at all, either anteriorly or posteriorly. *B. punctatus* has, since its discovery in America, been found near London by members of the Quekett Club, and also in Russia by Mr. A. S. Scorikow.

Trochosphæra solstitialis.‖—Dr. C. A. Kofoid reports the finding in the Illinois River and adjacent swamps of this rare and peculiar rotifer, first discovered by Surgeon V. Gunson Thorpe, R.N., in China, and described in this Journal in 1893 (p. 147).

Rotifera of Sandusky Bay.¶—Dr. D. S. Kellicott gives a preliminary list of rotifers observed at the lake laboratory provided for him by the Trustees of the Ohio State University on Lake Erie. Sixty-seven species are enumerated, with notes of their occurrence. One species, *Melicerta flocculosa*, is described as new, but no figure is given, which is always a great drawback to future identification.

* Amer. Nat., xxxi. (1897) pp. 202–4.
† Zool. Anzeig., xx. (1897) pp. 69–70 (1 pl.).
‡ Bull. Acad. Sci. St. Pétersbourg, v. (1896) pp. 1–4.
§ Bull. Illinois State Laboratory Nat. Hist., iv. 1896.
‖ Science, iv., Dec. 1896, pp. 935–6.
¶ Proc. Amer. Micr. Soc., 1896, pp. 155–64.

Rotatoria from East Africa.*—Dr. Anton Collin gives an account of some Rotifers observed in East Africa by Dr. Stuhlmann during his journey with Emin Pasha. The account is based on short notes and drawings, and a very few specimens preserved in spirit, and is therefore very fragmentary, and in many cases the animals cannot be identified. Sixteen species are enumerated, four of which are considered to be new:—*Philodina* (?) *emini*, *Euchlanis longicaudata*, *Brachionus tetracanthus*, and *Noteus Stuhlmanni*.

Rotatoria of the Neighbourhood of Kharkow.†—In this pretentious memoir, entirely in the Russian language, Mr. A. S. Scorikow enumerates and describes 140 Rotifers found in his neighbourhood, of which the following six are considered new species and varieties:—*Polyarthra platyptera* var. *remata*, *Triarthra thranites*, *Pleurotrocha sigmoidea*, *Rattulus bicornis*, *Brachionus cluniorbicularis*, and *Brachionus lineatus*. The claim to specific rank appears very slight with most of these, and *B. lineatus* is certainly identical with Hempel's *B. punctatus* mentioned above.

Nematohelminthes.

Life-History of Trichina.‡—Herr Geisse finds, by means of feeding experiments, that the impregnated females bring forth their embryos in the tubular glands of the small intestine, and that the embryos pass into the body more by the vascular system than by active migration.

Herren R. Hertwig and Graham § find that embryos reach the intramuscular connective tissue eight days after infection. When the Trichina enters the muscle-fibre, the striping disappears, and the nuclei multiply and grow. The worm is surrounded by a gelatinous modification of the sarcolemma, proliferating connective tissue, and leucocytes. As the capsule is formed the muscle-fibre disappears at that place.

Filaroides in Frontal Sinuses of Skunks.‖—Mr. W. McM. Woodworth calls attention to the occurrence in America of *Filaroides mustelarum* van Ben., which is common in martens and weasels in Europe. It causes swellings of the frontal bones of skunks, and probably in other Mustelidæ.

Platyhelminthes.

Fragmentation in Lineus gesserensis.¶—Dr. A. Brown finds that the zones of fission in *Lineus gesserensis* coincide with the transverse markings; that the fission is a process of digestive solution (by the fluids of the gut), and proceeds from within outwards; that there are circular outgrowths of intestinal epithelium corresponding to external grooves; that, as the result of opposing pressures outwards and inwards, atrophy, disintegration, and disappearance of the outermost cells of the intestinal outgrowth take place, bringing the body-wall into contact with the digestive cavity; that the ruptured surfaces are at once covered up by the intestinal outgrowth, and by proliferation of the subjacent

* 'Rotatorien, Gastrotrichen und Entozoen Ost-Afrikas, von Ant. Collin,' 14 figs.
† 'Rotatoria of the Neighbourhood of Kharkow,' 1896, 168 pp., 3 pls. (in Russian).
‡ Münchener med. Wochenschr., xlii. (1895) p. 655. Zool. Centralbl., iv. (1897) pp. 96–7.
§ Münchener med. Wochenschr., xlii. (1895) pp. 504–5 (4 figs.). Zool. Centralbl., iv. (1897) p. 97.
‖ Amer. Nat., xxxi. (1897) pp. 231–5.
¶ Proc. Roy. Soc., lxi. (1897) pp. 28–9.

connective tissue which aids in healing the fragments. The intestinal epithelium changes in character as it takes up its new external position. The whole process of fission has evident relationships to the process of reproduction.

Connective-Tissues and Body-Cavities of Nemerteans.*—Dr. T. H. Montgomery, jun., has investigated species of *Carinella*, *Cerebratulus*, *Lineus*, *Amphiporus*, *Tetrastemma*, and *Stichostemma*, and draws the following general conclusions:—

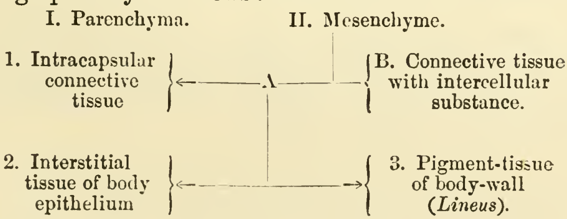
The connective tissue with dense intercellular substance, the parenchyma, and the intracapsular tissue of the nervous system, occur in all these genera. A true mesenchyme tissue was found only where there was an evident perivisceral body-cavity. A pigmented connective tissue without intercellular substance, situated in the muscular body wall, is possessed only by *Lineus*. The branched connective tissue cells with a more or less dense intercellular substance form the basal membranes of the epithelia and endothelia, the elements between the muscle-fibres or bundles, the nerve-sheaths, &c. True parenchymatous tissue with walled cells, without intercellular substance and extraneous cell-fibres, reaches its greatest quantitative development in *Carinella* and *Cerebratulus*, and is least in *Stichostemma*; it is absent on the lateral blood-vessels in *Lineus* and the Metanemertini, and in the head and œsophageal regions in all the species. It probably functions as a layer for the mutual transfusion of the rhynchocœlomic and blood fluids. The cells of the intracapsular connective tissue of the nervous system are, in all species except perhaps *Stichostemma*, divisible into two categories:—(*a*) those between the outer and inner neurilemma; and (*b*) those around and within the fibrous core.

A noticeable body-cavity is undoubtedly present in *Carinella* and *Cerebratulus*, and in a more reduced state in *Lineus gesserensis*, *Amphiporus*, and *Stichostemma*. It consists of a slit between the intestine and proboscis-sheath, and the body-wall; in *Cerebratulus* it is a very evident cavity, with both fixed and free mesenchyme cells. There is none in Metanemertini.

The gonadal membrane is apparently always a product of the connective tissue cells, with dense intercellular substance; the genital cells are either derivatives of cells of this tissue (in *Lineus* and the Metanemertini), or of mesenchyme cells (in *Carinella* and perhaps *Cerebratulus*).

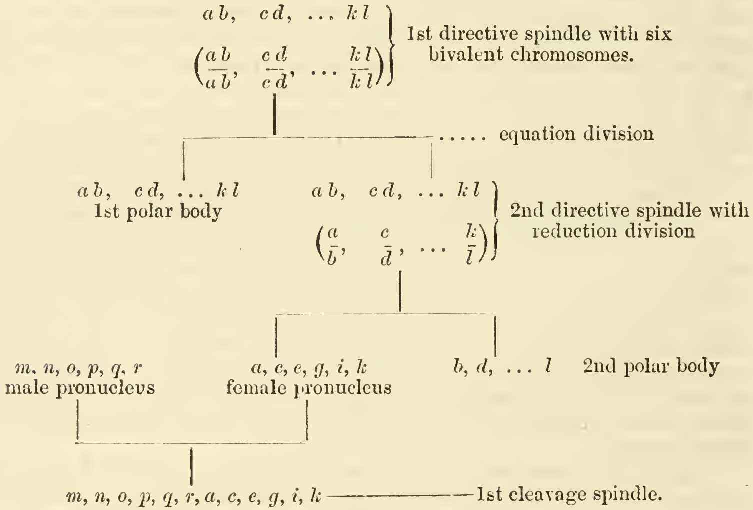
In the adult Nemertean, amitotic division is seen in the mesenchyme cells; but no cell-divisions occur in the other connective tissues, except those true mitotic divisions (in the tissue with intercellular substance) which give rise to the genital cells.

The relationships of the various Nemertean connective tissues may be illustrated graphically as follows:—



* Zool. Jahrb. Abth. Anat., x. (1897) pp. 1–46 (4 pls.).

Maturation and Fertilisation in Prostheceræus vittatus.*—Dr. A. von Klinckowström describes these processes in the ova of this large marine Planarian, which appears to afford very excellent material for such studies. About half an hour after oviposition the first polar body is given off. It shows active amœboid movements for four or five hours. Two or three hours after the first the second polar body is given off. In an hour or two the cleavage is in active progress; in 15–20 hours the 16-cell stage has been reached. The peculiar nuclear metamorphosis which Selenka described in *Thysanozoon* does not occur in *Prostheceræus*; the division-figure in the uterine ovum is simply the first directive spindle. The author gives the following scheme of the maturation-process, the letters meaning chromosomes, of which there are typically twelve, admitting of 853,776 possible combinations in fertilisation:—



Male Organs of Stenostoma leucops O. Schm.†—Herr H. Sabussow points out the defectiveness of our knowledge in regard to the reproductive organs of Turbellarians. He sets himself to remedy this by a careful description of the male organs of *Stenostoma leucops* O. Schm., which consist of five parts—an unpaired testis, an almost spherical vesicula seminalis, a tubular penis without chitinous parts, a penis-sheath, and a small antrum masculinum.

New Ectoparasitic Triclad.‡—Herr L. A. Jägerskiöld describes *Micropharynx parasitica*, found on *Raja clavata* and *R. batis*. It is a quite typical Triclad, without marked adaptation to ectoparasitic life, except that it has no eyes, thus differing, *inter alia*, from the other parasitic Triclad *Bdelloura limuli* v. Graff.

* Arch. f. Mikr. Anat., xlviii. (1897) pp. 587–605 (2 pls., 3 figs.).
† Zool. Jahrb. (Abth. Syst.), x. (1897) pp. 47–54 (1 pl.).
‡ Öfversigt K. Vetensk. Akad. Förhandl., 1896, pp. 707–14 (3 figs.).

Echinoderma.

Pseudopodia in Echinoderm Ova and Embryonic Cells.*—Gwendolen F. Andrews observes that the ova, polar bodies, blastomeres, and even later embryonic cells, of starfish and sea-urchins, give off delicate anastomosing pseudopodial filaments like those of Rhizopods. It is claimed that these are concerned in the formation of the egg-membrane, that they connect the cells during cleavage and gastrulation so that the protoplasm is continuous, and that they may be the basis of cytotropism and of co-ordinating communication in embryonic cell-aggregates. The observations are described under the title, "Spinning powers of certain eggs."

Palæozoic Ophiuroids.†—Dr. J. W. Gregory gives a synopsis of a classification with diagnoses of some of the genera. He recognises two orders:—(1) Lysophiuræ (ambulacral ossicles alternate, free; no ventral arm-plates); (2) Streptophiuræ Bell (vertebral ossicles present with more or less Streptospondyline articulations). The first order includes Protasteridæ and Palæophiuridæ; the second includes Ophiurinidæ, Lapworthuridæ, Eoluidæ, Onychasteridæ, and Eucladiidæ.

Muscle-Fibres of Holothurians.‡—Dr. N. Iwanzoff finds that if the internal organs of *Holothuria tubulosa* and *Stichopus regalis* be treated *intra vitam* with methylen-blue, by injection or otherwise, certain muscle-elements react like nervous elements. It seems as if those elements which behave in this way were in a normal state of exhaustion, marked by the presence of a granular product of metabolism, which has a strong affinity for methylen-blue. Perhaps the same is true of nervous elements.

Cœlentera.

Diversity of Structure in Metridium.§—Prof. G. H. Parker shows that uniformity of structure is by no means a general characteristic of *Metridium marginatum* Milne Edw. As in some other Actinians, there are variations in the number of siphonoglyphs and in the number and relations of the mesenteries. The author distinguishes monoglyphic and diglyphic types; but it is uncertain whether these are varieties or whether the species is dimorphic. It is possible that the two forms may be associated with sexual and asexual reproduction.

Porifera.

Sponges of Amboina.‖—Dr. E. Topsent describes a collection from the Bay of Amboina. It included more than 80 species, of which 27 were new species or varieties. The collection was made in the Madrepore zone, and was characterised by the absence of Hexactinellida, the abundance of Monaxonida (especially Haplosceridæ), a sparse representation of Calcarea, a notable proportion of Tetractinellida and Monoceratina. The Carnosa were represented by three interesting forms:—

* Journ. Morphol., 1897, pp. 367–89. See Amer. Nat., xxxi. (1897) pp. 242–5.
† Proc. Zool. Soc., part 3, 1896 (published 1897), pp. 1028–44.
‡ Arch. f. Mikr. Anat., xlix. (1897) pp. 103–13 (1 pl.).
§ Bull. Mus. Comp. Zool. Harvard, xxx. (1897) pp. 259–73 (1 pl.).
‖ Rev. Suisse Zool., iv. (1897) pp. 421–87 (4 pls.).

Chondrosia reniformis, not hitherto recorded from the Far East, *Placortis simplex*, hitherto known only from the Mediterranean, and *Placinolopha Bedoti* g. et sp. n.

Protozoa.

Monograph on Coccidia.*—M. A. Labbé completes his systematic account of the various species of Coccidia, and gives a diagnostic key, with a list of their hosts. The second part of the memoir is devoted to a discussion of the structure—the areolar cytoplasm, the reserve-granules in the meshes, the nucleus, and the centrosome. In the next chapter the author describes the life-history of these parasites, (*a*) the penetration of the sporozoite into a cell; (*b*) its transformation into a spherical Coccidium; (*c*) the nutrition and growth of this phase; and (*d*) its encystation and reproduction by internal division or by sporulation. In the sporulation there is a distinct chromatin reduction, comparable to the expulsion of a polar body. No conjugation has been observed, though its occurrence is suggested by the dimorphism of the spores in *Pfeifferia.* The last chapter discusses some general features of the life of Coccidia:—their habitat in Vertebrates rather than Invertebrates, their restriction to epithelia, the manner of infection, the adaptation of parasite to host, individual and phylogenetic variations, relationship with Gregarines, and so on.

* Arch. Zool. Expér., iv. (1896) pp. 549-654 (7 pls., 19 figs.).

BOTANY.

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

α. Anatomy.

(1) Cell-Structure and Protoplasm.

Influence of Light on Cell-Division.*—Herr W. Lohmann has made experiments relative to the influence of intense light on *Saccharomyces cerevisiæ* and other yeasts. As source of light, a 15-ampère arc lamp and direct sunlight were used. Pure cultivations equally disseminated in wort-gelatin were exposed to the light, and after a certain exposure the newly formed cells were counted. From a great number of countings it was found that strong electric light exerted an inhibitory influence on cell-division in *S. cerevisiæ*. Direct sunlight acted in a similar way.

Heterotype Divisions in Lilium Martagon.†—According to Miss E. Sargant, there are two series of nuclear divisions in the life-history of *Lilium Martagon* which exhibit 12 chromosomes instead of 24, viz.:—I. Spermatogenesis. (1) First division of pollen-mother-cell nucleus; (2) second division of pollen-mother-cell nucleus; (3) division of pollen-grain nucleus into vegetative and generative nuclei; (4) division of generative nucleus in pollen-tube. II. Oogenesis. (1) Division of primary embryo-sac nucleus into micropylar and chalazal nuclei; (2) division of micropylar daughter-nucleus; (3) division of both daughter-nuclei of micropylar nucleus. The second and third divisions in both series are precisely similar to vegetative nuclear divisions, except in possessing only half the number of chromosomes; they are called *homotype*. The first nuclear division on either side is termed *heterotype*, because the process of karyokinesis differs from that of the vegetative nucleus. The chief points which distinguish it are:—(1) The resting nucleus, after some increase in size, passes into a contracted state called synapsis; (2) the chromatic ribbon of the spirem is not homogeneous, but is composed of an erythrophilous ribbon bearing a double row of cyanophilous dots; (3) longitudinal fission appears in the spirem ribbon before its division into chromosomes; (4) a second longitudinal fission appears in each segment of the immature chromosomes; (5) the segments of each chromosome are tightly twisted on each other, and separate from near the middle or from either end; the chromosomes of the diaster stage are usually V-shaped.

Formation of the Endosperm in Leucojum.‡—Dr. L. Buscalioni records some anomalous instances of karyokinetic division of the nucleus in the formation of the endosperm in *Leucojum vernum*. During mitosis he has constantly observed, at the poles of the secondary nuclei or at the sides of the equatorial disc, a protoplasmic cord strongly stainable by hæmatoxylin, which advances more or less towards the periphery of the

* Inaug.-Diss. Rostock, 1896. See Centralbl. Bakt. u. Par., 2te Abt., ii. (1896) pp. 797–8.
† Rep. 66th Meeting Brit. Ass., 1896, p. 1021. Cf. this Journal, 1896, p. 640.
‡ Atti R. Accad. Lincei, vi. (1897) pp. 187–8.

cell, sometimes finally reaching the cell-wall. Another anomalous process is termed by the author gemmation. The nucleus puts forth emergences, which subsequently become detached. This was observed especially with nuclei of very large size, and sometimes all stages of the process were met with in the same cell. It is probably a process of degeneration.

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

Pigments of Plants.*—Miss M. J. Newbigin gives a detailed account of the various colouring matters of plants, dividing them into lipochromes, which are insoluble, and anthocyans, which are soluble in water. There is no evidence that lipochromes are in any way derivatives of chlorophyll. The authoress groups them in two classes—eucarotins and carotinins. Anthocyans are probably derivatives of tannins. The usual theory, that their purpose is to prevent the decomposition of chlorophyll in a strong light, is scarcely in harmony with some of the conditions under which they are commonly formed, as, for instance, in young shoots in spring and in autumn leaves. Etiolin is probably nearly allied to chlorophyll, which it resembles in containing nitrogen, while most other plant-pigments are non-nitrogenous.

Formation of Gum by Aralia spinosa.†—M. L. Lutz finds the seat of formation of gum in this species to be almost exclusively the phloem of the vascular bundles; the cortex, pericycle, xylem, and pith are almost unaffected by it. It is formed alike in the root, the stem, and the leaves. The process goes through two stages; the first is very rapid, resembling the formation of mucilages; the second is much slower, partaking more of the character of the production of a true gum.

Colouring-Matter of the Tomato.‡—Herr C. Ehring finds the pigment of the tomato to be a cholesterin closely allied to the carotin of the petals of *Calendula*.

(4) Structure of Organs.

Young Form of Plants.§—Prof. K. Goebel adduces a variety of instances, chiefly belonging to the Muscineæ and Pteridophyta, in which the young form—protoneme, prothallium—is more or less retained in later life, or in which it can be again called into existence, especially by placing the plant in unfavourable vital conditions. This is especially well seen in *Funaria hygrometrica*. If the rudimentary buds are cultivated in the dark, they revert to a protoneme condition, even after the wedge-shaped apical cell has already been formed, the cells growing out into filaments. In *Schizostega osmundacea* a similar process takes place in nature, shoots of limited growth being formed, the rudimentary leaves of which, together with their apical cell, are of only temporary duration. In Ferns, shutting off the light will cause the prothallium to revert to

* Trans. Bot. Soc. Edinburgh, xx. (1896) pp. 534–50.

† Bull. Soc. Bot. France, xliii. (1896) pp. 513–6; Journ. de Bot. (Morot), xi. (1897) pp. 91–5 (2 figs.). Cf. this Journal, 1896, p. 81.

‡ 'Ueb. d. Farbstoff d. Tomate,' Münster, 1896, 35 pp. See Bot. Centralbl., lxix. (1897) p. 154.

§ SB. K. Bayer. Akad. Wiss. München, 1896 (97), pp. 447–97 (16 figs.). Cf. this Journal, 1889, p. 550.

a filamentous form. Analogous results were obtained with flowering plants (Monocotyledones and Dicotyledones), a reversion to the early form of leaf being brought about by unfavourable conditions of air or soil. In some Gymnosperms (*Biota*, *Chamæcyparis*) the young form appears to have become fixed.

Geophilous Plants.*—Herr A. Rimbach has studied the structure and biological phenomena of geophilous plants, i.e. of those in which stem-structures penetrate the soil for the purpose of assisting in the nutrition of the plant, or for purposes of propagation. These differ from one another in a variety of ways. Thus the main underground cauline axis may be vertical or horizontal; it may be persistent or may die at an early period; the roots may be contractile or not, and may break up into fragments or not; the accumulation of reserve-material may be chiefly in the stem, the leaves (bulbs), or the root. Nearly allied species may differ widely in these respects; while, on the other hand, similar biological characters may be exhibited by species in no way related to one another. Thus *Ranunculus bulbosus* and *Gladiolus communis* closely resemble one another in these respects; also *Anemone nemorosa* and *Paris quadrifolia;* and again, *Oxalis elegans* and *Tigridia pavonia.*

Opening of the Flower of Œnothera.†—M. L. Planchon has investigated the phenomena connected with the sudden opening in the evening of the flowers of *Œnothera Lamarckiana*, and suggests the following interpretation:—At sunset the afflux of sap and decrease of transpiration cause a general swelling of the bud, and especially of the corolla. This accounts for all the phenomena of opening. By their swelling the petals detach the calyx, and the reflex of the sepals is the result of a swelling of their upper surface in consequence of a special anatomical arrangement. The opening and unfolding of the petals is then effected by further swelling of their lamina, accompanied by enlargment of the disc. The fall of the flower the next day is the result of dissociation of the cells which unite the calycine tube with the ovary.

Deviations in the Flower of Polygonum.‡—Prof. J. W. H. Trail gives a description of the variations in the flower of several species of *Polygonum*, especially in *P. Persicaria* and *aviculare.* These include suppression of one or more of the segments of both perianth-whorls; cohesion of two or more segments; chorisis of segments; cohesion, chorisis, and abortion of stamens; adhesion of stamens to perianth; and petalody of stamens. The variability appears to express the result of an innate tendency to vary where not subject to the check of loss of fertility. The pistil frequently exhibits reduction to two carpels; the single ovule in the ovary appears to be a constant character.

Flower and "Nipples" of Salisburia.§—Prof. K. Fujii has studied the nature of the excrescences known as "nipples" (chichi) on the stem and branches of *Salisburia adiantifolia* (*Gingko biloba*). They form pendent cylindrical or conical bodies on the under side of the branches, occurring also on the root. They are apparently formed from the coali-

* Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 92–100.
† Bull. Soc. Bot. France, xliii. (1896) pp. 455–76 (10 figs.). Cf. this Journal, 1896, p. 330.
‡ Rep. 66th Meeting. Brit. Ass., 1896, pp. 1016–7.
§ Bot. Mag. (Tokio), ix. (1895) pp. 440–4 (1 pl.).

tion of a number of adventitious buds, and are probably of a purely pathological character.

The same author * gives an account of the different views hitherto held regarding the morphology of the flower in the same species.

Hairs on the Sepals of the Santalaceæ.†—M. P. van Tieghem calls attention to the remarkable fact that the tuft of hairs which springs from the sepals behind the stamens in plants belonging to this order, is not trichomic, but is of endogenous origin, springing from large exodermal cells. This is well seen in *Thesium humifusum*, and is general throughout the order ; but in the allied families, Arionaceæ and Schœpfiaceæ, the hairs, though occupying the same position, have an ordinary epidermal origin.

Phanerogams with an Ovule destitute of Nucellus.‡ — M. P. van Tieghem gives further details of this group of Phanerogams (or of Dicotyledones), the INOVULATÆ or Loranthineæ, characterised by the absence of any true ovule, and composed of ten orders, the Nuytsiaceæ, Elytranthaceæ, Dendrophthoaceæ, Treubellaceæ, Loranthaceæ, Arceuthobiaceæ, Helosaceæ, Ginalloaceæ, Viscaceæ, and Balanophoraceæ. Of these orders the first five, comprising the LORANTHALES, have hermaphrodite and dichlamydeous, the remaining five, the VISCALES, unisexual and apetalous flowers. The greater number are chlorophyllaceous parasites; the Helosaceæ and Balanophoraceæ are non-chlorophyllaceous root-parasites.

Closely related to the Inovulatæ, and forming a border-land between them and those endowed with perfect ovules, are a group of orders which the author names the INNUCELLATÆ, or *Santalineæ*, in which the ovule is reduced, not to a nucellus, as stated by previous authors, but to the funicle or ovular leaf not differentiated into petiole and lamina; the nucellus and the integument being both entirely wanting. To this group belong nine orders, viz. :—the Santalaceæ, Arionaceæ, Schœpfiaceæ, Sarcophytaceæ, Myzodendraceæ, Opiliaceæ, Olacaceæ, Aptandraceæ, and Harmandiaceæ, the characters of each of which are described in detail. In all of them the mother-cell of the endosperm and of the oosphere (improperly called the embryo-sac), originates directly beneath the epiderm in the cortex of the foliar leaf, without this cortex becoming elevated above the surface and forming the emergence known as the nucellus. These nine orders comprise about fifty genera, five of them new. The last-named three orders possess a corolla, and constitute the alliance of the OLACALES ; the remaining seven, which are apetalous, make up the alliance of the SANTALALES. They all agree with the Loranthineæ in the ripe fruit containing no true seed.

The Anthobolaceæ, comprising four genera, are distinguished from the above-named orders in possessing a nucellus, but no integument ; they constitute a new group, the INTEGMINATÆ or ANTHOBOLINEÆ.

Winged Fruits and Seeds.§—Dr. C. von Wahl classifies the contrivances for assisting in the carriage of seeds or fruits through the air by

* Op. cit., x. (1896) pp. 7–8, 13–5 (1 pl.).

† Journ. de Bot. (Morot), xi. (1897) pp. 41–5.

‡ Bull. Soc. Bot. France, xliii. (1896) pp. 543–77 ; Comptes Rendus, cxxiv. (1897) pp. 655–60, 723–8, 803–5. Cf. this Journal, 1896, p. 206.

§ Biblioth. Bot., Heft 40, 1897, 25 pp. and 5 pls.

the agency of the wind under six types, viz. :—(1) The *Acer*-type ; (2) the *Fraxinus*-type ; (3) the *Dipterocarpus*-type ; (4) the *Halesia*-type ; (5) the *Ulmus*-type ; (6) the *Bignoniaceæ* type. The nature of the mechanical contrivance is uniform in each type, whether it belong to the fruit or the seed, and is often entirely independent of the systematic affinities of the species. To the first type, which the author regards as presenting the most perfect construction for attaining the desired end, belong the samaræ of the various species of *Acer* ; those of a number of species of Malpighiaceæ ; of *Securidaca* among Polygalaceæ ; of several species of Leguminosæ and Sapindaceæ ; of *Rajania* among Dioscoreaceæ ; and the seeds of many Coniferæ, such as *Pinus* and *Larix* ; and of many Cedrelaceæ and Meliaceæ. The second type occurs in *Fraxinus* and *Liriodendron*. The third, which bears a strong resemblance to a shuttlecock, is generally diffused through the Dipterocarpaceæ. The fourth occurs in *Halesia* and *Combretum*. The *Ulmus* type occurs also in *Pterocarpus* and *Paliurus*. To the sixth type, which is represented chiefly by the seeds of the different genera of Bignoniaceæ, belongs also the fruit of *Welwitschia*.

Septal Nectaries.*—Herr J. Schniewind-Thies treats of the nectaries situated in the septa of the ovary which are peculiar to certain orders belonging to the Liliifloræ and Scitamineæ. The author classifies them under a number of different groups ; the simplest form occurring in *Tofieldia palustris*, where the nectar is excreted from the entire outer wall of the ovary ; while in *T. calyculata* the secretion is limited to the furrows in the ovary which correspond to septa. The nuclei of the secreting tissue are distinguished from those of the parenchyme by the large amount of chromatin which they contain, and usually by the greater number of nucleoles. In most nectaries the nuclei are erythrophilous. Unusual positions of the nectaries occur ;—in the apex of the style of *Leucojum vernum* ; in the apex of the ovary of *Galanthus nivalis* ; and as club-shaped, or some other form of outgrowth on the ovary of the Zingiberaceæ.

Leaves of Ranunculaceæ and Umbelliferæ.†—Herr G. Bitter points out, in a great number of examples, the remarkable similarity in the types of leaves in these two families. In both orders the phyllotaxis is, with very few exceptions, alternate (spiral) ; stipules are almost invariably wanting, and the petiole is commonly expanded laterally. A very deep and complicated division of the lamina is common ; but in both orders we have species with narrow undivided lamina, and nearly parallel venation (*Ranunculus gramineus*, *Bupleurum*). On the other hand a heath-like foliage occurs in a large group of Umbelliferæ in the Cape and Australia, but is altogether wanting in the Ranunculaceæ ; while pedate leaves occur in the latter, but not in the former family.

Leaves of Arum italicum.‡—Prof. G. Arcangeli discusses the cause of the variability in the leaves of this plant, which are sometimes furnished with a number of white or yellow spots, sometimes entirely

* 'Beitr. z. Kenntn. d. Septalnektarien,' Jena, 1897, 88 pp. and 12 pls. See Bot. Centralbl., lxix. (1897) p. 216.

† Flora, lxxxiii. (1897) pp. 223–303 (31 figs.).

‡ Bull. Soc. Bot. Ital., 1896, pp. 321–4 ; 1897, pp. 46–8.

without spots; and suggests that it may be connected with the attraction of insects for the purpose of pollination.

β. Physiology.

(1) Reproduction and Embryology.

Fertilisation of the Bromeliaceæ.*—Herr E. Ule has examined the structure of the flower in connection with fertilisation in several species of Brazilian Bromeliaceæ belonging to the genera *Nidularium*, *Quesnelia*, *Æchmea*, and *Chevallieria*. They frequently exhibit the phenomenon of cleistopetaly or *pseudo-cleistogamy*, i.e. the corolla is nearly or quite closed, and the flowers are nevertheless habitually cross-pollinated, usually by humming-birds, which open the corolla by their beaks, being attracted either by the scent, or by the bright colour of the corolla or of the bracts. Self-pollination is, however, not impossible; and cleistopetaly may often be a step towards cleistogamy. With the Bromeliaceæ these flowers pass gradually into ordinary open flowers.

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

Organic Nourishment of Green Plants.†—Dr. T. Bokorny discusses the reason why chlorophyllaceous plants are able to assimilate certain organic compounds, while others are useless to them. Thus CO_2 is readily converted into $C_6H_{12}O_6$; while plants cannot form any carbohydrate out of $C_3H_8O_3$ (glycerin). As a general rule, compounds with one atom of C are readily assimilable, the difficulty increasing with the increase in the atoms of C; those which contain C and H only are not so favourable as those which consist of C and O only, or of C, H, and O. Pepton is a peculiarly excellent food-material for Fungi, and probably also for Algæ. Starch can often be formed from grape-sugar or cane-sugar only through the influence of light. Free acids are always injurious to the protoplasm. Asparagin is readily converted into proteids in the dark. CH_2O (formic aldehyd) is probably always the first product of assimilation.

Influence of Light on the Growth of Plants.‡—A series of experiments on this subject by Herr K. Stameroff leads him to the following conclusions:—The vegetative hyphæ of *Mucor* and *Saprolegnia* grow with equal rapidity in light and in dark. Light has a retarding effect on the growth of the reproductive hyphæ of *Mucor*. The rhizoids of the bulbils of *Marchantia polymorpha* grow more slowly in the light than in the dark. Light has no effect on the rapidity of growth of the pollen-tubes of *Colutea arborescens* or *Robinia pseud-acacia*. The vegetative hyphæ of *Mucor* and *Saprolegnia* and the rhizoids of the bulbils of *Marchantia* grow entirely at the apex. The pollen-tubes of *Colutea* and *Robinia* exhibit irregularities in their growth, the variations following the law of the great period. The rate of development of the pollen-tubes, and their size, depend on the supply of sugar.

* Ber. Deutsch. Bot. Gesell., xiv. (1896) pp. 407–22 (1 pl.).
† Biol. Centralbl., xvii. (1897) pp. 1–20, 33–48.
‡ Flora, lxxxiii. (1897) pp. 135–50. Cf. this Journal, 1896, p. 540.

Assimilation of Ammoniacal Nitrogen and Nitric Nitrogen.*—MM. E. Laurent, E. Marchal, and E. Carpiaux report the results of a series of observations on the assimilation of ammoniacal nitrogen and nitric nitrogen by the higher plants. The general conclusions are that, in the higher plants, the assimilation of nitrates does not take place in the dark; the action of the ultra-violet rays is necessary for it. For the assimilation of ammoniacal salts, the action of the same rays is predominant, but the luminous rays may incite a feeble assimilation of ammonia in etiolated leaves. The action of chlorophyll is not necessary; etiolated leaves assimilate ammoniacal nitrogen even better than green leaves. The assimilation of nitric nitrogen gives rise to a temporary production of ammonia.

Function of Calcium Oxalate.†—From a series of observations, made chiefly on the rhizome of *Rumex obtusifolius*, grown in various soils and in the dark, Herr G. Kraus has arrived at the conclusion that calcium oxalate is by no means invariably an excretory product, but that it performs the function of supplying the necessary lime for the aerial portions of the plant. Similar results were obtained as to the function of this substance in the bark of various trees and shrubs. With the Cactaceæ the results were mainly negative, though not conclusive. The only possible solvent for calcium oxalate in the cell-sap is a free acid.

Germination of Barley.‡—Mr. T. C. Day publishes a series of observations on the germination of barley with restricted moisture, the results being shown in a number of tables. An increase of moisture during germination always induces a corresponding increase in the carbon dioxide produced. Taking the production of carbon dioxide as the measure of growth during germination, the period of greatest activity, with varying quantities of moisture, is generally about the third or fourth day.

Influence of the Stock on the Graft.§—By grafting the same variety of the pear on two different stocks, the wild pear and the quince, MM. G. Rivière and G. Bailbache have attempted to determine the question of the influence exercised by the stock on the graft. They find, as a general result, that the mean weight of the fruit produced is considerably greater in the plants grafted on the quince; that the density of the fruit is also greater, and that the amount of free acid and of sugar is also larger.

Vitality of Seeds.‖—As the result of further observations on this subject, Dr. A. J. Ewart states that the resistant power of a seed to desiccation is partly dependent on the nature and thickness of the seed-coats, partly on the form in which the reserve food-material is stored. Other conditions being similar, albuminous seeds are the least resistant to desiccation, oily seeds next, and starchy seeds most resistant.

* Bull. Acad. Roy. Sci. Belgique, xxxii. (1896) pp. 815–65.
† Flora, lxxxiii. (1897) pp. 54–73 (2 figs.).
‡ Trans. Bot. Soc. Edinburgh, xx. (1896) pp. 492–501 (2 figs.).
§ Comptes Rendus, cxxiv. (1897) pp. 477–80.
‖ Proc. Liverpool Biol. Soc., x. (1896) pp. 185–90. Cf. this Journal, 1895, p. 72.

Latent Life of Seeds.*—Pursuing his experiments on this subject, M. C. de Candolle finds that if seeds of maize, oat, fennel, *Mimosa pudica*, *Gloxinia*, and other plants, are exposed for 118 days to a temperature of $-40°$ F., the majority will still germinate. The protoplasm of the seeds is described as not actually living, but as having reached a stage of inaction in which it is still endowed with potential life.

Changes in the Tentacles of Drosera produced by Feeding.†—Miss L. Huie describes the remarkable changes produced in the cells of the tentacles of *Drosera rotundifolia* by feeding the leaves with white of egg. As the result of this stimulation the basophile cytoplasm is used up, and is represented ultimately by a very scanty eosinophilous plasm. The restoration of the cytoplasm is brought about by the nucleus absorbing food-material, and then excreting it into the protoplasm.

Temporary Suspension of the Action of Chlorophyll.‡—Prof. W. Pfeffer calls attention to the arrest of the assimilating function of chlorophyll-grains under unfavourable vital conditions, or through the action of reagents, which is only temporary, if these conditions last but for a short time. During this period they undergo no change of form or colour; respiration becomes feeble, but is not entirely suspended. Isolated chlorophyll-grains can assimilate for a time when exposed to light.

(3) Irritability.

Mechanism of the Phenomena of Sensitiveness.§—Prof. A. Borzì sums up as follows his conclusions as to the mechanism of the motile phenomena resulting from a blow or from sharp concussion.

The cause lies in special protoplasmic elements, differentiated physiologically as organs for the reception and transmission of the irritation. They consist of very delicate fibres, and in general of cells arranged in longitudinal rows in the direction followed by the irritation, and constitute definite anatomico-physiological plexi. The cells have a very thin membrane which is very contractile, and is endowed with well-marked osmotic properties. Minute perforations, adapted for the passage of very fine protoplasmic threads, often traverse their walls. The action of stimuli which induce variations in the state of imbibition of the protoplasm is followed by a rapid change in the turgor and tension of the cells, thus changing the position of the irritated organ. For the purpose of retaining temporarily the water expelled from the protoplasm during the variation in its osmotic condition, every sensitive plexus is traversed by intercellular spaces, which form a connected system, varying in its special character in different cases. Occasionally the median layer of the membrane of the sensitive cells is transformed into a semi-fluid substance, and forms a receptacle for water. The gelatinisation of this layer sometimes fills the spaces with an absorbent colloidal substance. The rapidity with which the sensitive plexi respond to the action of stimuli depends on the presence of this substance, and on its density. The water which fills the intercellular spaces contains various organic sub-

* Rep. 66th Meeting Brit. Ass., 1896, pp. 1023–4. Cf. this Journal, 1895, p. 655.
† Quart. Journ. Micr. Sci., xxxix. (1897) pp. 387–425 (2 pls. and 1 fig.).
‡ Ber. K. Sachs. Ges. Wiss. Leipzig, June 1st, 1896. See Bot. Centralbl., lxix. (1897) p. 72.
§ Il Naturalista Siciliano, i. (1897) pp. 168–90.

stances, mostly of the nature of glucose. Sometimes they contain air or some other gas.

The sensitive organs chiefly observed were :—The stigma of *Martynia*, *Mimulus*, *Bignonia*, *Tecoma*, &c.; the stamens of *Portulaca grandiflora*, of *Opuntia amyclea*, and other Cactaceæ, and of the Berberideæ; the leaves of *Mimosa*.

Positive and Negative Heliotropism.*—Herr F. Oltmanns confirms his previous statement of the existence of an optimum intensity of light for heliotropic curvatures for each species. With the fructification of *Phycomyces* he found the curvature to be negative, indifferent, or positive, according to the distance from the source of light; the former being the case when the distance is least, the latter when it is greatest. Green barley seedlings were more sensitive to light than etiolated ones. The horizontal position of many stems and aerial stolons is the result of purely geotropic causes, often entirely uninfluenced by light.

Aerotropism of Roots.†—Dr. A. J. Ewart gives further examples of the aerotropic, or, as he prefers to term it, the *oxytropic* irritability of the apices of roots. This property is especially well marked in seedlings of *Helianthus*, *Cucurbita*, and *Pisum*; but it is probably very general.

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

Formation of Proteids in Plants.‡—According to Herr T. Kosutany, leaves contain a somewhat larger amount of nitrogen by night than by day; there are then also more ammoniacal salts, and as large a proportion of proteids. There is, on the other hand, a larger amount of nitrates in the daytime; from which it would appear probable that the nitrogen of nitrates is converted into proteids more by night than by day. No asparagin could be detected in the night, being probably converted into proteids. The nett result is that the raw materials for the production of proteids are absorbed by the plant in greater quantities during the day, but that the final process takes place chiefly at night.

Formation of Non-nitrogenous Reserve-Substances in the Almond.§—From a series of analyses of almonds made at different stages of their ripening, M. Leclerc du Sablon draws the general conclusion that, as the amount of oil increases, that of the fatty acids diminishes, the former being apparently formed at the expense of the latter. Glucose is, in the same way, used up in the formation of the reserve food-materials; saccharose, on the other hand, being found only in the ripe seed; the same is the case also with the amyloses.

Evolution of Heat by Wounded Plants.‖—Mr. H. M. Richards gives further results of his experiments on the effects of mechanical injury on potatoes, onion bulbs, and other structures, with a description of the apparatus used to measure the rise in temperature. He finds invariably a rise in temperature of the adjacent tissue, which attains its

* Flora, lxxxiii. (1897) pp. 1–32. Cf. this Journal, 1892, p. 513.
† Proc. Liverpool Biol. Soc., x. (1896) pp. 190–3.
‡ Landwirthsch. Versuchs-Stat., xlviii. (1896) pp. 13–33. See Bot. Centralbl., 1896, Beih., p. 488.
§ Comptes Rendus, cxxiii. (1896) pp. 1084–6.
‖ Ann. Bot., xi. (1897) pp. 29–63 (2 figs.). Cf. this Journal, *ante*, p. 145.

maximum about 24 hours after injury. This maximum was always between two and three times the ordinary plus temperature of the plant. In tubers (potatoes) the effect is local; while in onion bulbs and other foliar tissues a much greater extent of tissue is affected.

Action of Light on Diastase.*—From a series of experiments on the action of light on various solutions containing diastase, Prof. J. R. Green comes to the conclusion that there exists in the leaf and in the various extracts examined, a certain amount of zymogen which is converted by the infra-red and the red, orange, and blue rays of the spectrum into active diastase. The violet and ultra-violet rays, on the other hand, cause a destruction of the diastase, or at least such a change in the configuration of its molecule that it is unable to effect the hydrolysis of starch. The enzyme is apparently not located in the chlorophyll grain, but in the protoplasm of the cell. The author advocates the theory that the red colouring of certain leaves is a material help to the translocation of starch in them by screening off the rays which destroy the diastase. There appears also to exist in plants a power of absorbing and utilising the radiant energy of light, sometimes to a considerable extent, without the presence of a chlorophyll apparatus.

Fermentative Power.†—Mr. A. J. Brown replies to Duclaux's criticisms of the author's views on Pasteur's theory of fermentation. Mr. Brown had brought forward evidence to show that the argument on which Pasteur rested his theory was unsound, and that consequently that theory was untrustworthy. Pasteur had omitted to take time into consideration; and as time enters into and governs the results from which the fermentative power was calculated, the calculation was therefore erroneous. The author would abolish the expression fermentative power or $\frac{S}{l}$ on the ground that it can never be applied to experimental work with living organisms, and would retain fermentative activity, $\frac{S}{lt}$, to express the fermentative power of an organism in a unit of time.

Alcoholic Fermentation without Yeast.‡— It seems probable that Herr E. Buchner has obtained an alcoholic diastase capable of converting sugar into alcohol and carbonic acid without the intervention of yeast. Yeast is pounded up with infusorial earth to break down the cell-walls, and then submitted to hydraulic pressure. In this way is obtained what may be called a solution of protoplasm, which, when mixed with a 20 to 40 per cent. sugar solution, causes the evolution of gas bubbles in a few minutes, accompanied by the presence of alcohol in the liquid.

Technical Mycology.§—Herr F. Lafar has just brought out the first volume of his handbook on the physiology of fermentation. The work appeals to the chemist, brewer, farmer, and pharmacist. The first volume, with a preface by E. C. Hansen, deals with Schizomycetes.

* Proc. Roy. Soc., lxi. (1897) pp. 25–8.
† Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 33–40.
‡ Ber. Deutsch. Chem. Gesell., xxx. (1897) p. 117. See Ann. Inst. Pasteur, xi. (1897) p. 287.
§ Jena, 1896. See Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 22–3.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Leaves of Selaginella.*—Prof. R. J. Harvey Gibson has made a careful study of the comparative anatomy of the leaf in the various species of *Selaginella*. The various forms may be arranged under four principal types, viz.:—(1) the *Martensii*-type (36 sp.); the epiderm is dissimilar on the ligular and aligular surfaces of the leaf; there is a mesophyll consisting of reticulate parenchyme; (2) *Braunii*-type (3 sp.); the epiderm of both surfaces consists of elongated sinuous cells, and has a distinct palisade layer as well as reticulate mesophyll; (3) *Galeottii*-type (9 sp.); the epiderm of both surfaces is composed of quite or nearly similar cells with wavy margins, and is much elongated in the long axis of the leaf; (4) *Spinosa*-type (3 sp.); resembles the last, but the leaves are similar and are arranged spirally. *S. Lyallii* forms an anomalous type.

The distribution of the stomates is very variable in the genus, but they are more abundant, as a rule on the aligular surface. The epidermal cells are of three types:—conical, elongated with square ends, and sclerotic warty elongated fibres. The mesophyll varies very greatly in amount and in the form of its cells. The vascular bundle is almost invariably of very simple structure. All the species which have the *Martensii*-type of leaf belong to the monostelic and tristelic series as regards stem-structure; while those in which the two epiderms are similar have two laterally placed steles.

Apogamous Reproduction in Ferns.†—Mr. W. H. Lang has endeavoured to determine the connection between apogamous reproduction in Ferns and the "cresting" of the frond. With *Nephrodium filix-mas* there appears to be no such necessary connection; with *Scolopendrium vulgare*, *Athyrium filix-femina*, and *Aspidium angulare*, the results were more variable. A prolongation of the mid-rib of the prothallium, similar to that described in a variety of *Scolopendrium vulgare*, was observed also in a variety of *Lastrea dilatata*; it also bore sporanges, isolated or collected into sorus-like groups, as well as archegones and antherids.

Opening of the Sporange of Ferns. — Herr C. Steinbrinck ‡ describes the phenomenon of the bursting of the sporange of ferns, by which the spores are scattered, as consisting of three processes, viz.—(1) the opening of the sporange by the folding of the membrane, the annulus first stretching and then bending outwards; (2) the return of the annulus to nearly its original form; (3) a final shrinking in consequence of the complete evaporation of the water contained in it.

By the use of the same apparatus § as that employed in the case of Mosses, Herr J. Schrodt ‖ shows that the bursting of the sporange cannot be due to the pressure of the air in the intercellular spaces, since it takes place equally under a receiver when the air has been almost entirely pumped out.

* Ann. Bot., xi. (1897) pp. 123–55 (1 pl.). Cf. this Journal, 1896, p. 331.
† Rep. 66th Meeting, Brit. Ass., 1896, pp. 1019–20. Cf. this Journal, *ante*, p. 56.
‡ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 86–90. Cf. this Journal, 1896, p. 538.
§ *Vide infra*, p. 224.
‖ Tom. cit., pp. 100–6.

Muscineæ.

Swelling of the Peristome of Mosses.*—Herr C. Steinbrinck contests Bütschli's theory that the shrinking of the teeth of the peristome of Mosses on drying is due mainly to the contraction of very small cavities which are emptied by the external pressure; their expansion on imbibition, to the meshes becoming again filled with water. His conclusion is based on the fact that the contraction takes place under the air-pump just as it does under the ordinary pressure of the air. He is disposed rather to revert to the micellar theory of Nägeli as an explanation of the phenomenon.

Herr R. Kolkwitz † describes the apparatus employed by Steinbrinck for his experiments.

Distribution of Spores in the Splachnaceæ.‡—Herr N. Bryhn calls attention to the part played by flies in the distribution of the spores of the Splachneæ (*Splachnum*, *Tetraplodon*). These mosses are saprophytes, growing on excrements or on decaying organic matter. The insects lay their eggs in the decaying or fœtid organic matter, and are apparently attracted by the bright colour of the hypophyse (apophyse) of the moss, carrying away the spores in large numbers. Without this agency germination does not appear to take place.

Œdipodium.§—Herr E. Nyman describes in detail the structure of the oophyte and sporophyte generations of *Œdipodium Griffithianum*. The cortical parenchyme of the stem is destitute of pores. The central bundle is only rudimentary, and is scarcely differentiated from the cortical parenchyme, and can have but little importance for the conduction of water. The rhizoids have sometimes a bulbous swelling at the apex. The great characteristic of the genus, and one quite peculiar to it among Mosses, is the presence of a spongy parenchyme and of stomates in the seta, which thus serves a very important function as an assimilating organ. As regards the systematic position of the genus, the author is disposed to agree with Lindberg in erecting it into a distinct family intermediate between the Splachnaceæ and Tortulaceæ.

Braithwaite's British Moss-Flora.‖—Part xvii. of this work commences the third and concluding volume, which is to include the Pleurocarpous Mosses and the Sphagna. The Pleurocarpous Mosses consist of three families, the Hypnaceæ, Pterygophyllaceæ, and Neckeraceæ. Of the Hypnaceæ the present part treats of the following genera:—*Thuidium* (6 sp.), *Leskea* (3 sp.), *Anomodon* (3 sp.), and *Amblystegium*, of which 19 species are included in the present part.

Genera and Species of Mosses.¶—Prof. C. R. Barnes and Mr. F. De F. Heald give a complete Analytic Key to the Genera and Species of North American Musci (including Sphagnaceæ). Descriptions are appended of

* Ber. Deutsch. Bot. Gesell., xiv. (1896) pp. 401–7; xv. (1897) pp. 29–33.
† Op. cit., xv. (1897) pp. 106–10 (2 figs.).
‡ Biol. Centralbl., xvii. (1897) pp. 48–55 (4 figs.).
§ 'Om byggnaden och utvecklingen af *Œdipodium Griffithianum*,' Upsala, 1896, 3 pp. and 2 pls. See Bot. Centralbl., lxix. (1897) p. 206.
‖ Pt. xvii., 1896, 36 pp. and 6 pls. Cf. this Journal, 1895, p. 457.
¶ Bull. Univ. Wisconsin, No. 5, 1897, x. and 211 pp.

all the species and varieties published between 1884 and 1896, 603 in number.

Dissemination of the Spores in Sphagnum.*—Herr S. Nawaschin describes the mode in which the spores escape from the sporange in *Sphagnum*, which he states to have features unknown elsewhere in the vegetable kingdom. The scattering of the spores is effected by the sudden expansion of the strongly compressed air within the sporange. Differences of tension in the upper parts of the wall of the sporange play a secondary part in the process, bringing about the detachment of the opercule. Connected with this process is the remarkable abortion of the stomates in the wall of the sporange, there being no actual fissure between the guard-cells.

Algæ.

Corallinaceæ.†—Herr F. Heydrich gives a detailed account of the structure and development of the Corallinaceæ, especially of the Melobesieæ. *Choreonema* differs from all the other genera in having no true attachment-disc, the rhizoids penetrating independently into the tissue of the host-plant. In *Melobesia* the entire thallus usually consists of a layer of rhizoids. The thallus displays no distinct differentiation of tissues, as is the case with the other Florideæ. Vegetative propagation takes place in the Melobesieæ by growths of various kinds at definite spots in the basal disc; but this is not the case with the Corallineæ. The sexual conceptacles are always diœcious, and consist of cystocarps and antherids. The tetrasporanges are produced (except in *Sporolithon*) in non-sexual conceptacles. The author regards the Cryptonemiaceæ as the family to which the Corallinaceæ are most nearly allied.

The species are arranged under nine genera, viz.:—*Choreonema* (1 sp.), *Melobesia* (12 sp.), *Mastophora* (5 sp.), *Lithophyllum* (12 sp.), *Lithothamnion* (60 sp.), *Sporolithon* g. n. (1 sp.), besides three genera of Corallineæ, *Amphiroa*, *Cheilosporum*, and *Corallina*. A number of new species of Melobesieæ are described. *Sporolithon* g. n. differs from *Lithothamnion* in the tetrasporanges not being formed in true conceptacles, but in layers which permeate the thallus.

Structure and Development of Grinnellia.‡—Mr. M. A. Brannon has made a detailed study of the life-history of *Grinnellia americana* belonging to the Delesseriaceæ. The cells, both vegetative and reproductive, are connected with one another by protoplasmic pits, or, in the case of those of the procarp, by open pores. The plant is very sensitive to light; mutilated plants proliferate readily. Plants may originate vegetatively by regeneration of the frond. Pollinoids are developed in enormous numbers by the abstriction of the terminal portion of the apical cells of the antherids. The three-celled procarp is developed from the supporting thallus-cell of the young cystocarp; its apical cell becomes the carpogone. Fusion of the pollinoid with the trichogyne results in great stimulation to the thallus-cell at the base of the procarp,

* Flora, lxxxiii. (1897) pp. 151–9 (1 pl.).
† Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 34–70 (1 pl. and 3 figs.).
‡ Ann. Bot., xi. (1897) pp. 1–28 (4 pls.).

and rapid disintegration of the trichogyne, which is a very evanescent organ, and is often branched. No fusion of cells takes place in the basal region of the cystocarp, as is the case in *Gracilaria* and other allied genera. The fertilised contents of the carpogone are transferred through the open pores, connecting the procarpic cells with the supporting thallus-cell, which becomes the central one of the five auxiliary cells.

Gloiopeltis.*—The late Prof. F. Schmitz has investigated the structure of this genus of Florideæ, and maintains that the alleged genus *Endotrichia* must be merged in it. *G. furcata* produces non-sexually bodies closely resembling cystocarps in appearance and structure; while *G. capillaris* bears normal sexual cystocarps. From the form and mode of development of the true cystocarps, *Gloiopeltis* must be placed among the Gloiosiphonaceæ.

Evolution of the Green Algæ.†—Prof. R. Chodat, dissenting from many of the views at present current respecting the genetic connection with one another of the various families of Chlorophyceæ, makes the following suggestions:—The principal groups may all be traced back to the Palmellaceæ, comprising the genera *Palmella, Tetraspora, Glœocystis,* and *Apiocystis.* The gelatinous general envelope of the Palmellaceæ is produced by the confluence of the special gelatinous cell-walls. Cell-division may take place in three different ways:—irregularly in all directions (*Palmella*-condition); in one plane only (*Tetraspora*-condition); or tetrahedrally (*Glœocystis*-condition). From these three principal conditions are derived the three important tendencies which govern the lower Chlorophyceæ:—(1) The zoospore-condition (Volvocineæ); (2) the sporange-condition (Pleurococcoideæ); (3) the *Tetraspora*-stage (Ulvaceæ and filamentous green algæ). The Volvocineæ are derived immediately from the unicellular species of *Chlamydomonas,* to which is nearly related *Gonium,* where the tetrasporoid-stage is undergone in a motile condition. In *Pandorina* the earliest stage is the larval condition; *Eudorina* and *Volvox* have a very similar origin. In the Protococcoideæ the motionless sporange-stage is the most important. All the genera, *Oocystis, Nephrocytium, Scenedesmus, Raphidium,* &c., can be reduced to globular unicellular colonies, which behave like the sporanges of *Palmella* or *Dactylococcus.* The Pediastreæ, *Cœlastrum, Sorastrum, Pediastrum, Hydrodictyon,* &c., constitute a parallel group, arranged in several series. The Ulvaceæ and Chætophoraceæ are united with the ancestral forms through *Monostroma* and *Pleurococcus.* The latter is a reduced type, existing as a lichen-gonid, and may develope branched filaments, zoosporanges, gametes, or spores. The highest development of the filamentous green algæ is reached in the Coleochæteæ.

Reproduction among the Phæosporeæ.‡—M. C. Sauvageau points out how many lacunæ there still are in our knowledge of the different modes of propagation, sexual and non-sexual, in this order of Algæ. Especially Berthold's observations of the conjugation of the zoospores in *Ectocarpus siliculosus* have not at present been confirmed by any other

* Trans. Bot. Soc. Edinburgh, xx. (1896) pp. 554–70.
† Ann. Bot., xi. (1897) pp. 97–121.
‡ Ann. Sci. Nat. (Bot), ii. (1896) pp. 223–74.

authority. The author classifies the numerous families in three groups, viz.:—(1) Unilocular sporanges only:—Laminariaceæ (except the Chordeæ), Sporochnaceæ, Spermatochnaceæ, Dictyosiphonaceæ, Desmarestiaceæ, Striariaceæ; 37 genera and 145 species. (2) Plurilocular sporanges only:—a portion of the Scytosiphonaceæ; 4 genera and 7 species. (3) Both unilocular and plurilocular sporanges:—Lithodermaceæ, Ralfsiaceæ, Stilophoraceæ, Chordariaceæ, Elachisteaceæ, Myriotrichiaceæ, Encœliaceæ (the greater part), Sphacelariaceæ, Choristocarpaceæ, Ectocarpaceæ, Tilopterideæ, Nemodermaceæ, Cutleriaceæ; 70 genera and 200 species. The last five families have also other reproductive organs, besides ordinary unilocular and plurilocular sporanges.

In another paper * the author confirms the observation of Berthold of the conjugation of the zoospores (gametes) formed in the plurilocular zoosporanges of *Ectocarpus siliculosus*, and gives further details respecting the heterogamous impregnation of *E. secundus*. *E. Lebelii* has both antherids and unilocular sporanges, which are probably oogones; the zoospores appear not to have completely lost their sexual character. *E. Padinæ* (*Giffordia Padinæ*) possesses antherids, and two kinds of sporange, meiosporanges and megasporanges. The author further calls attention to the fact that in *E. tomentosus*, and in some other species of the order, the zoospores of the unilocular sporanges are, in opposition to what is generally the case, larger than those of the plurilocular sporanges, and that their mode of germination differs from that of the latter.

Epiphyllous Algæ.†—Herr W. Schmidle gives a *clavis* of nine species of *Trentepohlia*, classified under the two subgenera Eu-Trentepohlia and Heterothallus. He regards the genus as strongly polymorphic; the following new species are described:—*T. ellipsicarpa*, *pinnata*, and *minima*. The author finds an epiphytic species of *Scytonema*, the only one at present known, which he names *S. tenuissima*, epiphytic on the upper surface of leaves.

A new species of *Pithophora*, *P. clavifera*, from New Guinea, is also described.

Nordstedt's Index of Desmids.‡—This most useful work consists of a Bibliography of the Desmidieæ down to the year 1896, and of an alphabetically arranged list of the genera and species. Under each specific name is a chronological series of records of the species and of all the well-marked varieties.

Characters of Vaucheria.§—Herr H. Götz describes the structure and various modes of reproduction in the genus *Vaucheria*, confirming the observations of previous writers. He adopts Hansgirg's classification of the species into four groups, viz.:—Corniculatæ, Tubuligeræ, Piloboloideæ, and Anomalæ; and describes in detail the characters of the species belonging to three of them as follows:—(1) Tubuligeræ, *V. orni-*

* Journ. de Bot. (Morot), x. (1896) pp. 357–67, 388–98; xi. (1897) pp. 5–14, 24–34, 66–76 (12 figs.). Cf. this Journal, 1896, p. 656.

† Flora, lxxxiii. (1897) pp. 304–26 (4 figs.).

‡ 'Index Desmidiacearum citationibus locupletissimis atque Bibliographia, Berlin, 1896, 310 pp.

§ Flora, lxxxiii. (1897) pp. 88–134 (55 figs.).

thocephala, *polysperma*, *aversa*, and *dichotoma*; (2) Corniculatæ, (*a*) Sessiles, *V. repens*, *sessilis*, *clavata*, and *pachyderma*; (*b*) Racemosæ, *V. hamata*, *terrestris*, *uncinata*, and *racemosa*; (3) Anomalæ, *V. geminata* and *de Baryana*.

Protoplasmic Communications in Volvox.*—Prof. A. Meyer has studied the nature and purpose of the protoplasmic connections between the cells in *Volvox globator*, *V. aureus*, and *V. tertius* sp. n., the last species characterised by a stratification of the gelatinous membrane, and displaying also different heliotropic properties. Both the optical and the microchemical phenomena indicate that the protoplasmic filaments which connect cell with cell are threads of normal cytoplasm displaying no special structure. These threads occur in very much greater numbers in the generative than in the trophic hemisphere.

Comparing the protoplasmic communications in *Volvox* with those which have been detected in other families of the vegetable kingdom, the author regards them of the same nature as those of Angiosperms, as well as those which occur in the animal kingdom, and probably also of the Rhodophyceæ, Phæosporeæ, and Schizophyceæ. It is probable that such connections exist between all the cells of an individual, and that every individual, both vegetable and animal, is a unit-mass of cytoplasm.

Fungi.

Influence of Light and of the Substratum on the Development of Fungi.†—M. A. Lendner has experimented on the effect of the access and withdrawal of light on various Fungi, chiefly Mucorini and Ascomycetes, grown on different media. The results differ with different species. All the Mucorini developed sporanges under the influence of light when grown on solid substrata; in liquid media the results varied with the species. In the case of the conidial forms of the Ascomycetes, conids were always formed under the influence of alternate day and night; under continuous light, the results varied with the species. The author regards all the phenomena of heliotropic sensitiveness in Fungi as connected simply with nutrition.

Parasymbiosis of Fungi.‡—Prof. W. Zopf finds fresh confirmation of his theory that many of the fungi which grow on lichens are not true parasites, but have a kind of symbiotic relationship to the host, which he terms *parasymbiosis*, the hyphæ of the "parasite" enveloping the algal constituent of the lichen, without inflicting any injury upon it. The observations were made on *Rhymbocarpus punctiformis*, which attacks *Rhizocarpon geographicum*, and on *Conida punctella* and *C. rubescens*, growing on *Diplotomma alboatrum*. The hyphæ of the parasite were distinguished from those of the lichen by the fact that the latter are coloured a beautiful blue by iodine solution, while the former are not.

Effect of Low Temperatures on Mucor Mucedo.§—Prof. R. Chodat finds that this fungus is not killed by subjection to very low

* Bot. Ztg., liv. (1896) 1te Abt., pp. 187–217 (1 pl. and 7 figs.). Cf. this Journal, 1895, p. 662.
† Ann. Sci. Nat. (Bot.), iii. (1897) pp. 1–64 (7 figs.).
‡ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 90–2. Cf. this Journal, *ante*, p. 151.
§ Bull. Herb. Boissier, 1896, pp. 890–7.

temperatures (−70° to −110° C. for 36 hours). The mycele continues to develop, though much more slowly than at ordinary temperatures, and normal sporanges are formed. Since respiration is entirely suspended at this temperature, the ordinary theory that respiration is a necessary condition of vegetable life must be abandoned.

Protoplasm of Mortierella.* —M. L. Matruchot states that in a species of this genus of Fungi the older parts of the hyphæ contain no protoplasm; or, if there is any, it is granular, without structure, and encloses drops of oil. In the younger parts, on the other hand, the cytoplasm consists of a hyaline portion, not sensitive to staining reagents, penetrated by filaments which are only slightly granular, and which take up stains readily. These threads vary in number from 2 to 10, but do not constitute a network. They vary considerably in thickness, and are the seat of the streaming of the protoplasm, which does not take place in the denser surrounding hyaloplasm.

Characters of Ustilagineæ.†—Herr P. Dietel describes the characters of *Ustilago Ischæmi*, parasitic on *Andropogon Ischæmum.* It possesses two kinds of hyphæ:—the peripheral, which arise in a somewhat thick layer immediately beneath the epiderm of the host-plant, and develop into colourless sterile epidermal cells; and the fertile, which run at right angles to the former, produce the ustilagospores by successive abstrictions, and exhaust themselves in the formation of them. The species must belong to the genus *Cintractia*, if the centripetal order of formation of the spores can be retained as a distinctive generic character. But the author shows that it cannot be so retained. Other species of *Ustilago* exhibit the same differentiation of hyphæ into the envelope-producing and the spore-producing kinds. A similar basipetal formation of clusters of spores occurs in *Tolyposporium Junci.*

Composition of the Mycele of Mould-Fungi.‡—Herr Marschall has investigated the composition of the mycele of typical mould-fungi—*Aspergillus niger*, *Penicillium glaucum*, *Mucor stolonifer*—and finds the average percentage of proteid substances to be as high as 38, while of cellulose there is only 5·03 per cent., and of substances soluble in alcohol 14·03 per cent. As regards their composition, mould-fungi occupy an intermediate position between bacteria and the higher plants, containing more nitrogenous matter and less carbohydrates than the latter, more carbohydrates and less nitrogenous matter than the former. As contrasted with the spores of *Penicillium glaucum*, the mycele contains a larger proportion of proteids, while the spores contain nearly twice as much cellulose, starch, and substances soluble in alcohol.

Histology of the Uredineæ.§—M. Sappin-Trouffy has again followed out carefully the history of development of the Uredineæ in the following genera:—*Uromyces*, *Puccinia*, *Gymnosporangium*, *Triphragmium*, *Phragmidium*, *Melampsora*, *Thecopsora*, *Cronartium*, *Endophyllum*, *Coleosporium*;

* Comptes Rendus, cxxiii. (1896) pp. 1321–3.
† Flora, lxxxiii. (1897) pp. 77–87 (1 pl.).
‡ Arch. f. Hygiene, xxviii. (1896) p. 16. See Bot. Centralbl., 1896, Beih., p. 483.
§ Le Botaniste (Dangeard), v. (1896) pp. 59–244 (70 figs.). Cf. this Journal, 1893, p. 342.

in most cases, in several species of each genus. The following is given as an analytic key to the characters of the genera:—

Promycele external.	
Teleutospores pedicellate, independent.	
Teleutospores 1-celled	*Uromyces*
,, 2-celled	*Puccinia*
,, 3-celled	*Triphragmium*
,, 4–11-celled	*Phragmidium*
Teleutospores pedicellate, gelatinous.	
Teleutospores 2-celled	*Gymnosporangium*
Teleutospores sessile, united into a crust.	
Teleutospores 1-celled	*Melampsora*
,, 4-celled	*Thecopsora*
Teleutospores sessile, confluent in a row	*Cronartium*
Promycele internal (probasid)	*Coleosporium*
Pseudo-promycele	*Endophyllum*

In all these genera there is great uniformity in the structure of the nucleus and in its behaviour during division, and especially in the process already described under the name of pseudo-fecundation.

Parasitic Fungi.—Herren M. Woronin and S. Nawaschin * confirm their statement of the specific distinction of *Sclerotinia heteroica* and *S. megalospora*. The former produces sclerotes on *Ledum palustre*, the latter on *Vaccinium uliginosum*, and not *vice versâ*.

Mr. G. Pim † describes a new parasitic fungus, *Ramularia Rapæ*, growing on the leaves of the rape.

Under the name *Schinzia scirpicola*, Herr C. Correns ‡ describes a new species parasitic on *Scirpus pauciflorus*, and distinguished by the sculpture of the spore-membrane.

Prof. A. S. Hitchcock and Mr. J. B. S. Norton § give a detailed account of the life-history and parasitism of the common smut of Indian corn, *Ustilago Zeæ Mays*, together with a complete bibliography and synonymy. They state that infection takes place only through the conids, which germinate in soft growing tissues of the host. A description is also given of the less common "head smut" of Indian corn, *Ustilago Reiliana*.

Black-Rot of the Vine.—M. P. Viala ‖ states that, of *Guignardia Bidwellii*, the parasitic fungus which causes this decay, pycnids, spermogones, peritheces, conidiophores, sclerotes, and chlamydospores are known. The peritheces hibernate, as well as the sclerotes; chlamydospores are formed only under abnormal conditions. The pycnids play the most important part in the reproduction of the fungus.

M. A. Prunet ¶ finds that the sclerotes may germinate in the autumn of the year in which they are formed, instead of in the following spring,

* Zeitschr. f. Pflanzenkr., vi. (1896) pp. 199–207 (2 pls.). See Bot. Ztg., lv. (1897) 2te Abt., p. 28. Cf. this Journal, 1895, p. 81.

† Journ. Bot., xxxv. (1897) pp. 57–8.

‡ Hedwigia, xxxvi. (1897) pp. 37–40 (1 fig.).

§ Kansas State Agric. Coll. Bull. No. 62, 1896, 44 pp. and 12 pls.

‖ Comptes Rendus, cxxiii. (1896) pp. 905–7.

¶ Op. cit., cxxiv. (1897) pp. 250–2.

as is the case with most sclerotes. A high temperature is not required for their germination, if the air is sufficiently moist.

White-Rot of the Vine.*—M. P. Viala has followed out the production of the hitherto unobserved spermogones and conidiophores, as well as the pycnids and peritheces, of *Charrinia Diplodiella*, the fungus which produces the white-rot of the vine.

"Leprosy" of the Beet.—M. P. Vuillemin † differs altogether from the conclusion of Saccardo and Mattirolo as to the systematic position of the parasitic fungus which produces this disease, and which they name *Œdomyces leproides*, and place near to *Entyloma* among the Ustilagineæ. The author states the disease to be due to a well-known species of Chytridiaceæ, *Cladochytrium pulposum*, which infests many species of Chenopodiaceæ.

In another note ‡ the same author points out the remarkable resemblance in appearance of the protoplasm of the nutritive apparatus of the *Cladochytrium* to the striated muscular fibres of animals.

Prof. P. Magnus § regards the fungus as belonging to the genus *Urophlyctis* (Chytridiaceæ). The spores are formed by the conjugation of two cells arising from different filaments.

Cell-membrane of Lichens.‖—According to Herr F. Escombe, the membrane of the hyphæ of *Cetraria islandica*, after the extraction of oils, colouring matter, astringent substances, lichenin, &c., consists mainly of an insoluble anhydride of galactose, which the author terms *paragalactan*. No chitin or cellulose could be detected. The membrane of *Peltigera canina* contains no cellulose, but apparently a small amount of chitin. The algal cells of *Evernia prunastri* contain cellulose.

Minks's Lichen-Theory.¶—Sig. A. Jatta criticises, on the whole favourably, Minks's theories of syntrophy and protrophy in lichens. Although restricted in their influence, the phenomena belonging to them are among the most important in the life-history of lichens.

Roccelleæ.**—Herr O. V. Darbishire gives a monograph of this tribe of the Graphidaceæ, a family of fruticose lichens. He classifies them under eight genera, viz.:—*Roccella* with twelve species; and seven monotypic genera, *Pentagenella* g. n., *Combea*, *Schizopelte*, *Dendrographa*, *Roccellaria* g. n., *Dictyographa* g. n., and *Ingaderia* g. n.

The following are the diagnoses of the new genera:—

Pentagenella. Thallus fruticulosus, strato corticali distincto conglutinatis ex hyphis formato transversalibus, strato gonidiali et strato medullari stuppeo; apothecia lateralia, orbicularia, hypothecio et perithecio decolorato, amphithecio thallino gonidia continente, intra hypothecium strato gonidiali instructa, sporis decoloribus; soralia nulla.

* Comptes Rendus, cxxiv. (1897) pp. 105–6. Cf. this Journal, 1895, p. 209.

† Comptes Rendus, cxxiii. (1896) pp. 758–9; Bull. Soc. Bot. France, xliii. (1896) pp. 497–505.

‡ Comptes Rendus, cxxiv. (1897) pp. 905–7.

§ Ann. Bot., xi. (1897) pp. 87–96 (2 pls.).

‖ Zeit. Phys. Chem., xxii. (1896) pp. 288–306. See Journ. Chem. Soc., 1897, Abstr., p. 155. Cf. this Journal, 1896, p. 656.

¶ Bull. Soc. Bot. Ital., 1896, pp. 255–60, 315–21; 1897, pp. 12–18. Cf. this Journal, 1896, p. 439.

** Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 2–10 (1 pl.).

Roccellaria. Thallus fruticulosus, strato corticali non valde distincto, ex hyphis formato longitudinalibus conglutinatis, strato medullari gonidia continente, infra corticem densissima; apothecia lateralia, orbicularia, hypothecio et perithecio fusco-nigro, amphithecio thallino nullo, infra hypothecium gonidia pauca strati medullaris; sporis decoloribus; soralia nulla.

Dictyographa. Thallus fruticulosus, complanatus, reticulatus, strato corticali nullo distincto, sed ex axibus chondroideis, ex hyphis formatis longitudinalibus conglutinatis constante, strato medullari intra axes longitudinales stuppeo gonidia continente; apothecia lateralia, orbicularia, hypothecio et perithecio decolorato, amphithecio thallino gonidia continente; sporis fuscescentibus; soralia nulla.

Ingaderia. Thallus fruticulosus, teretus, strato corticali nullo distincto, sed ex axibus chondroideis, ex hyphis formatis longitudinalibus conglutinatis constante, strato medullari intra axes longitudinales stuppeo, gonidia continente; apothecia lateralia, elongata, simplicia aut ramosa, hypothecio et perithecio fusco-nigro, amphithecio thallino nullo, infra hypothecium sæpius gonidia pauca, strati medullaris; sporis decoloribus; soralia nulla.

Latent Life in the Uredineæ.*—In the chlorophyllaceous cells of the leaves of wheat infested with *Puccinia glumarum*, M. J. Eriksson finds exceedingly minute protoplasmic corpuscles, which he regards as the primordial form in which the protoplasm of the parasite becomes differentiated. He considers this to be a latent or *mycoplasmatic* condition of the fungus in the protoplasm of the host-plant, mingled with the latter in a symbiotic mode of existence which may be termed *mycoplasm-symbiosis.*

Kefir.†—Dr. Ed. de Freudenreich, who has been for some time occupied in researches relative to the bacteriology of Kefir, finds that this barm owes its properties to four micro-organisms, *Saccharomyces Kefir*, *Streptococcus a* and *b*, and *Bacillus caucasicus.* The yeast, which is composed of large oval cells and is easily stainable, ferments maltose and glucose, but not milk. *Streptococcus a* coagulates milk, and forms lactic acid, while *Streptococcus b* does not clot milk, though producing abundant acid. *B. caucasicus* is a small slightly mobile rodlet, which does not clot milk, though it turns it acid and imparts to it an astringent flavour. The main result of the author's observations is to show that Kefir is a mixed ferment, the effect of which is due to the co-operation or symbiosis of several micro-organisms. The chief part is played by *Sacch. Kefir*, the streptococci rendering indispensable assistance. What share *B. caucasicus* has in the process is difficult to say, though it may help to form Kefir-grains. The fact that it is found always, and in considerable numbers, in Kefir shows that its presence is not accidental.

Amylomyces Rouxii and other Starch Ferments.‡—M. J. Sanguinetti, who made a comparative study of *Aspergillus oryzæ* of Koji, of the *Mucor alternans Gayoni*, and of the *Amylomyces Rouxii* of Chinese yeast,

* Comptes Rendus, cxxiv. (1897) pp. 475–7.
† Ann. de Micrographie, ix. (1897) pp. 1–33; and Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 47–52, 87–95, 135–41 (2 figs.). Cf. this Journal, 1889, p. 99.
‡ Ann. Inst. Pasteur, xi. (1897) pp. 264–76.

has found that these three Mucedineæ possess a very energetic saccharifying power; that of *A. Oryzæ* being the most intense, *Amylomyces* next, and *Mucor alternans* last. In all the media examined, *Amylomyces* left more hydrates of carbon untransformed than the other two, owing to its combustive power being much less. *Amylomyces* possesses a more considerable fermentative power than the other two, owing to its feebler combustive properties; and it is the only one useful in practice for industrial purposes, either for direct fermentation of amylaceous substances or for the utilisation of distillery residue. The three Mucedineæ were cultivated at 30° C., and in the following media:—(1) sterilised sucrase-free yeast-water, to which were added starch, dextrin, saccharose; (2) brewery wort; (3) distillery wort; (4) distillery "vinasse," i.e. the residue after alcoholic fermentation.

Pathogenic Action of Blastomycetes.* — Prof. F. Sanfelice, in a further communication, supports his contention that the bodies found in certain neoplasms, and described by numerous authors as Sporozoa, are nothing else than Blastomycetes. The results of inoculation with cultures of *Saccharomyces neoformans* on *Mus musculus*, white rats, rabbits, dogs, and fowls, were confirmatory of the author's view. Tumours were developed not only at the primary injection site, but were found also as secondary deposits. *S. neoformans* was found in the primary and secondary deposits; the Blastomycetes were usually free and not intracellular. In one dog the tumours were epitheliomatous.

Pathogenesis of the Soor Fungus.†—Dr. M. Steiner has shown by experiments on rabbits, that the Soor fungus may be pathogenic to animals. By injecting suspensions of pure cultures of the Soor fungus in 0·6 per cent. salt solution, into the ear or jugular vein, a general mycosis was induced, but not in all cases. The dose injected was 1 ccm. per kilogram of animal. The fungus was found in pure cultivation in every organ and part of the body where the injection was successful. The foci where the fungus was deposited were surrounded by a small-celled infiltration.

Mycorhiza of Corallorhiza.‡ — Mr. A. V. Jennings describes the mycorhiza which infests the parenchymatous tissue of the rhizome of *Corallorhiza innata*, and spreads out for a long distance into the surrounding soil. The hyphæ of the mycorhiza penetrate the epidermal cells of the host through long tufts of hairs, which serve for their collection and transmission. The mycorhiza appears to belong to an agaric, probably a *Tricholoma* or *Clitocybe*.

Protophyta.

α. Schizophyceæ.

Auxospores of Diatoms.§—Herr G. Karsten describes the mode of formation of the auxospores in *Dickiea crucigera*, *Nitzschia longissima*,

* Annali d'Igiene Sperimentale, vi. (1896) p. 265. See Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 158–9. Cf. this Journal, 1896, p. 552.
† Centralbl. Bakt. u. Par., xxi. (1897) pp. 385–8 (1 pl.).
‡ Rep. 66th Meeting Brit. Ass., 1896, pp. 1011–2.
§ Flora, lxxxiii. (1897) pp. 33–53, 203–22 (3 pls.). Cf. this Journal, 1896, p. 662; *ante*, p. 62.

Melosira Borreri, and *Gallionella nummuloides*. In the first-named species the process differs from that in other Naviculeæ in that the two conjugating individuals always place themselves with their valve-sides next one another. *Gallionella* exhibits a departure from Pfitzer's statement that in the Melosireæ each of the cells which goes to the formation of an auxospore has first been formed by division. In this instance the nucleus passes from the older into the younger cell. The mode of formation of the auxospores in the Melosireæ coincides with that in *Synedra affinis*, with only unimportant differences. It is, in fact, a modification of the process of cell-division.

In *Synedra affinis* two auxospores are formed from each cell by longitudinal division. Each auxospore has two well-developed nuclei, each with a large nucleole. In *Brebissonia Bœckii* the two conjugating diatoms are always so placed that their girdle-bands lie side by side or one on the other. In *Achnanthes brevipes* two mother-cells take part in the formation of each auxospore. The author believes that in all cases the formation of an auxospore is but a modified form of longitudinal division, conjugation of the daughter-cells of two individuals taking the place of the conjugation of nuclei within one and the same individual. He argues in favour of the near relationship of the Diatomaceæ to the Desmidieæ.

The author distinguishes two types of auxospore-formation in diatoms:—(1) That of the Melosireæ, in which the auxospores are formed by the agency of a single cell-division, usually greatly reduced; (2) that of the Naviculeæ, Cymbelleæ, Achnantheæ, and Fragilarieæ, in which a double cell-division takes place, the second division being often reduced. He derives the conclusion that originally diatoms multiplied only by division, and that the formation of auxospores is a mode of increase and rejuvenescence derived from a purely vegetative multiplication in two different ways.

Structure, Division, and Movements of Diatoms.*—Herr R. Lauterborn publishes a detailed treatise on the structure of the protoplasm in diatoms, especially in reference to the division of the nucleus and of the cell. The "red corpuscles" are regarded as reserve-substances employed by the cell for building up new matter, as, e.g., in the process of cell-division. The centrosome has been observed in other species besides the one in which it was originally detected, viz. in *Surirella splendida*, *S. biseriata*, *Pinnularia major*, and *P. nobilis*. The division of the nucleus and of the cell are described in detail in several species, especially in *Surirella calcarata*, where the process attains a great degree of complexity. The paper is accompanied by a careful bibliography.

Dr. O. Müller† criticises in several points Lauterborn's explanation of the causes of the movements of diatoms. He regards the movements as taking place by means of currents of a mucilaginous substance projecting through the raphe on to the outer cell-wall. He has never seen any trace of the threads described by Lauterborn as springing from the central node.

* 'Unters. üb. Bau, Kerntheilung, u. Bewegung d. Diatomeen,' Leipzig, 1896, 165 pp., 10 pls., and 2 figs. See Bull. Soc. Belge de Microscopie, xxi. (1897) p. 27. Cf. this Journal, 1894, p. 606.

† Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 70–8.

Van Heurck's Synopsis of the Diatomaceæ.*—An English translation of this important work has appeared in advance of the original treatise in French. It makes up a volume of nearly 600 pp., illustrated by 35 pls. containing 917 figs., besides 300 inserted in the text. In addition to the systematic portion, it contains a full account of the structure, movements, multiplication, and reproduction of diatoms. The author regards it as an established fact that a substance passes from the cell-cavity through canals or pores in the silicified coat.

Schmidt's 'Atlas der Diatomaceen-Kunde.'—Hefts 52, 53 of this magnificent work, just published, contain 8 plates, Nos. 205–212, chiefly devoted to various species of the genera *Surirella*, *Plagiogramma*, and *Navicula*.

Structure of Cyanophyceæ.†—Prof. E. Zacharias confirms his previous conclusion that the central body of the Cyanophyceæ differs in important points from the nucleus of other organisms. He now considers it doubtful whether the central substance contains nuclein like the chromosomes. In *Gloiotrichia pisum* it is probable that the central body of the spore and of the cells immediately above it contains glycogen. The cell-protoplasm contains, at different stages, varying quantities of granules, which are chemically different from the central substance. The cell-division takes place without showing karyokinetic processes, the disposition of the constituents of the central body being variable and without rule. The granules in the cell-protoplasm appear to increase in size and number when the cells are able to assimilate carbon.

Development of Sphærozyga.‡—In addition to the ordinary *Nostoc*-form of *Sphærozyga oscillarioides*, Herr W. Schmidle finds, growing on *Vaucheria sessilis*, a form in which the cells which usually develope into resting-spores, remain in a purely vegetative condition, or become disorganised. Other cells, on the other hand, in the middle of the filament, grow to a large size, and in these appear a number of very minute cells or spores. These do not swarm out, as described by Zukal in other Cyanophyceæ, but escape through the gradual gelatinisation of the membrane of the mother-cell. In this condition the *Sphærozyga* resembles a colony of *Aphanothece*. From other cells filaments arise which produce hormogones, and which are indistinguishable from a *Calothrix*. All intermediate stages occur between this and the *Aphanothece*-form.

β. Schizomycetes.

New Genus of Schizomycetes with Longitudinal Fission.§—Mr. A. V. Jennings records the existence of a Schizomycete, *Astrobacter Jonesii*, found by Mr. A. C. Jones in fresh water. Its chief characteristic is that it divides longitudinally, thus eventually producing a distinctly stellate arrangement. Simple rod-like forms were observed, but more frequently V- or Y-shaped cells, resulting from longitudinal fission. After division the new segments become more and more widely separated

* 'A Treatise on the Diatomaceæ,' by Dr. H. Van Heurck, translated by W. E. Baxter, 1896. See Bull. Soc. Belge de Microscopie, xxi. (1897) p. 24.
† Rep. 66th Meeting Brit. Ass., 1896, pp. 1021–2. Cf. this Journal, *ante*, p. 156.
‡ Ber. Deutsch. Bot. Gesell., xiv. (1896) pp. 393–401 (1 pl.).
§ Rep. 66th Meeting Brit. Ass., 1896, p. 1012.

at the ends, till regular three- or four-rayed stars (and later on six- or eight-rayed) were produced. There was no tendency to the pear-shaped swelling seen in *Pasteuria ramosa*, and no spores were noticed.

Emulsion and Sediment Figures produced by Motile Bacteria.*—Prof. W. Beijerinck states that motile bacteria, when occurring in great numbers in thin layers of a nutrient solution, form, after being allowed to rest for a few minutes, characteristic accumulations. These accumulations are either columnar in shape and run up and down right through the whole thickness of the fluid, or are flat and lie at the bottom of the vessel. In either case the groups or accumulations are sharply defined, and are separated from one another by fluid poor in bacteria, or devoid of them. The columnar groups are called emulsion-, the flat-groups sediment-figures. The former most commonly originate in thick fluid media, such as liquefied gelatin; the latter in thin liquid media, such as bouillon. In any case the figures are the result of the specific properties of the bacteria, though all mobile bacteria are not equally suitable for the production of emulsion-figures. The emulsion-figures are probably caused by local currents; in the interspaces fluid saturated with carbonic acid ascends, while within the columns a liquid medium saturated with oxygen descends. The author, after describing *Bacterium termo*, proceeds to discuss the changes caused by currents, by dilution, and by chemotaxis. In the course of his remarks the author introduces a new word, "tonotaxis," or sensitiveness to osmotic variations, and concludes by describing the influence of an oil-drop.

Nitre-Fungi.†—In their reply to Winogradsky, who asserted that the results obtained by Prof. A. Stutzer and Herr R. Hartleb were due to unskilful manipulation, these writers give a short retrospect of the points at issue, and then clearly state their own view, which is to the effect that nitrification is a transitory function of a definite organism, which under certain conditions can thrive on organic nutrient media. The proof of this is promised later. Meanwhile they mention an interesting observation which tends to support their view. A pure culture of the nitrate organism was transferred to nutrient fluid, the source of nitrogen being sodium nitrite. Through the vessels a current of air was transmitted. For the first flask the air was filtered through cotton-wool; for the second it was passed through a thick layer of strong caustic soda solution; so that, in the one flask, carbonic acid was present, in the other not. In the latter vessel had been placed a small quantity of glycerin. The vessels were kept in the dark at a temperature of 25°–30° C., and after a lapse of about 12 days the microbes in the first flask had produced nitrate and had undergone no morphological change. In the second flask there was no nitrate, the medium was turbid and contained numerous rodlets and cocci, and also a mycele similar to that which had so frequently spoilt the aqueous nutrient media of previous experiments.

Denitrifying Bacteria and the Loss of Nitrogen caused by them.‡—Herren R. Burri and A. Stutzer isolated from horse-dung two bacteria

* Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 1–6, 40–7 (1 fig. and 1 pl.).
† Op. cit., ii. (1897) pp. 6–9, 54–7. Cf. this Journal, *ante*, p. 145.
‡ Ann. Agron., xxii. (1896) pp. 491–4. See Journ. Chem. Soc., 1897, Abstr., p. 114.

which together, but not singly, decompose nitrites with liberation of free nitrogen. One was identified as *B. coli commune*, whilst the new one was designated *B. denitrificans* i. Another variety, *B. denitrificans* ii., which liberates nitrogen from nitrates and nitrites, was isolated from old straw. This microbe throve in artificial solutions as well as in nitrate-broth, and destroyed the nitrate in the same length of time. *B. coli* with *B. denit.* i. caused no turbidity in the artificial solution in a week, and did not decompose the nitrate in the least. With *B. coli* and *B. denit.* i., and also with *B. denit.* ii., the destruction of nitrate is checked when the amount of nitrate exceeds 0·5–0·6 per cent., owing to excessive alkalinity. Phosphoric acid (0·06–0·07 per cent.) checked the fermentation by *B. coli* and *B. denit.* i.; whilst *B. denit.* ii. was active with 0·14 per cent. of acid. *B. denit.* i. and *B. coli* reduce nitrates completely in the absence of oxygen, but without evolution of nitrogen, the nitrate being converted into nitrite. But with even a limited access of air these organisms will produce free nitrogen. *B. denit.* ii. decomposes nitrates normally in complete absence of air; whilst with aeration the fermentation is hindered or prevented.

Inoculation of Nodule-Bacteria in different Host-Species.*—Herren F. Nobbe and L. Hiltner have carried on a series of experiments on the inoculation of bacteria from the root-tubercles of one to those of a different species. The results were, as a rule, negative, the inoculation being certain only from one plant to another of the same species. An exception is afforded by the Vicieæ, where inoculation, without essentially lessened effect, is possible from one species to another. The effect of inoculation was increased vigour and development of the plant; increased production of flower and fruit was observed, especially in the case of peas and red clover. The authors state that root-tubercles have no essential influence on the growth above ground, so long as the soil contains sufficient nitrogen.

Bacterial Diseases of Plants.†—Mr. E. F. Smith gives a *resumé* of the diseases of plants ascertained to be due primarily to the attacks of Schizomycetes, arranged according to the host-plant which they attack. Five of these belong to the beet and two to the hyacinth. The bacterial disease of the potato is referred to an unnamed organism (Kramer's potato bacillus), which differs from both *Bacillus amylobacter* and *B. butyricus* in not being anaerobic.

Bacteriosis of Celery.‡—Dr. Ugo Brizi describes a disease which affected the celery plants in North Italy in the past year. The parts of the plant (*Apium graveolens*) most attacked were the stems, which first showed the malady, presenting yellow to brownish spots, which afterwards ulcerated. Microscopical examination showed the presence of a large bacillus (*Bacterium Apii*), which was easily cultivated on various media.

Bacterial Disease of the Squash-Bug.§—Mr. B. M. Duggar found that squash-bugs (*Anasa tristis*), kept for laboratory purposes, died in

* Landwirth. Vers.-Stat., xlvii. (1896) pp. 257–68. See Journ. Chem. Soc., 1897, Abstr., p. 64.

† American Naturalist, xxx. (1896) pp. 626–43, 716–30, 796–804, 912–24; xxxi. (1897) pp. 34–41, 123–38.

‡ Atti R. Accad. Lincei, vi. (1897) pp. 227–34.

§ Bull. Illinois State Laboratory Nat. Hist, iv. (1896) pp. 340–79 (2 pls.).

considerable numbers; and on microscopical examination discovered a bacillus to which the mortality was due. This organism (*Bacillus entomotoxicon*) occurs in the blood and tissues of the insect. It is $1 \cdot 2$–$1 \cdot 8\,\mu$ long by $0 \cdot 6$–$0 \cdot 8\,\mu$ broad; it is motile, does not form spores, and stains well with most anilin dyes. It is aerobic, and potentially anaerobic. The colonies on agar are white, with fanlike radiations. Gelatin is liquefied. Milk is rapidly coagulated, with a highly offensive odour. It grows well at room temperature, and is killed by exposure to high temperatures. The infected insect becomes sluggish, swells, and after death rapidly liquefies. The toxin is lethal to many species of insect. The disease is easily communicated to healthy squash-bugs by contact with the fluids of infected insects, or with agar cultures. The young insects are easily infected, the older ones being more resistant, and the larvæ apparently quite refractory.

Leptothrix placoides.*—Dr. A. R. v. Dobrzyniecki describes a species of Leptothrix (*L. placoides*) which was isolated from an old tooth stopping. It consists of long delicate structureless threads, which, when stained, seem to be made up of chains of rodlets, and in which spore-like bodies were observed. The Leptothrix-iodine reaction (iodopotassic iodide acidulated with lactic acid) was successful. The organism was cultivable on agar, blood-serum, and gelatin, the latter being liquefied, but not in bouillon or on potato. The colonies are white, firm, and discoid.

Cladothrix odorifera.†—Herr Rullmann regards this organism, to which the odour of freshly turned-up soil is largely due, as a variety of *C. dichotoma*.

Silkworm Microbe.‡—Sig. L. Macchiati gives reasons for identifying the microbe which has been named *Streptococcus Pastorianus*, the cause of the flaccid condition of silkworms, with the earlier described *S. Bombycis*.

Rejuvenescence of Effete Pébrine Corpuscles.§—It is well known, says M. M. Krassilschtchik, that pébrine corpuscles, when old, lose the power of exciting the disease in silkworms. Their activity and virulence may, however, be restored if they are swallowed by the common sparrow. Infected moths kept over from the preceding year are pounded up in a mortar with a little water. Pieces of bread soaked with the mixture are given to sparrows. On the third day the excrement is found to contain active pébrine germs. Silkworms fed on mulberry leaves contaminated with the *fresh* excrement acquire pébrine. On the other hand, *dried* excrement does not excite pébrine (*Microsporidium*), but sets up *flacherie* (*Streptococcus Pastorianus*) and *grasserie* (*Micrococcus lardarius*), or even a mixed infection of the two diseases.

It would seem therefore that birds contribute to the propagation of pébrine, their intervention being indispensable for rejuvenating inactive corpuscles. Some of the sparrows fed on the infected moths died, the control birds remaining quite healthy.

* Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 225–9 (4 figs.).
† Op. cit., 2te Abt., ii. (1896) pp. 116–7.
‡ Bull. Soc. Bot. Ital., 1896, pp. 292–7.
§ Comptes Rendus, cxxiii. (1896) pp. 358–9.

Bactericidal Action of Tannin.*—Prof. G. Goegg records a large series of elaborate experiments with tannins of various derivation on five microbes, for the purpose of testing their bactericidal properties. The microbes were *B. anthracis*, *B. pyocyaneus*, *B. coli. com.*, *B. prodigiosus*, *St. aureus*; and the tannins, aspidospertannic, coffee-tannic, catechu-tannic, gallic, kino-tannic, rhatany-tannic, and tannic acids. Extract of rhatany and kino resin were also used to determine the difference between the pure tannins and preparations containing tannin. The author's work clearly establishes that officinal tannin is less energetic than other tannins termed physiological. Aspidospertannic acid, for example, is far more bactericidal than officinal tannin. Hence there is some relation between the bactericidal action and the remarkable tanning action which Quebracho Colorado (from which aspidospertannic acid is obtained) has in the leather industry.

Kino-tannic acid acts more powerfully than the kinos themselves; and rhatany-tannic acid exerts a considerable bactericidal action on *B. pyocyaneus* and *St. py. aureus.* Spore-forming bacteria appear to be little sensitive to the action of tannin; on the other hand, *St. py. aureus* is extremely so.

Mechanism of Immunity imparted by Anti-coagulating Substances.†—MM. Bosc and Delezenne made experiments relative to the immunity imparted by anti-coagulating substances. They found that leech extract or pepton, when injected into the blood, is able to produce certain modifications which increase the defensive powers of the organism against infectious agents. These modifications are characterised by a remarkable increase in the vitality and phagocytic properties of the white corpuscles, and by augmentation of the bactericidal power of the blood. The intravenous injection of the anti-coagulating substances into rabbits and dogs 15–45 minutes before the injection of *coli* bacillus or of *Streptococcus*, is able to confer on these animals a real immunity, and even to impart an action absolutely inhibitory against experimental infection.

Bacteriology of Plague.‡—Herr Kolle states that the pus in the bubos contains bacilli with rounded ends. Both ends stain deeply, the central portion hardly staining at all. This bacillus is also found in the blood and in the spleen. It does not stain by Gram's method. On agar the colonies are whitish grey; on gelatin, which is not liquefied, they are light brown and finely granular. In grape-sugar bouillon the organism thrives. No spore-formation was observed. The cultures are killed in a few minutes at 100°, and at 58° in a few hours.

Ætiology of Dysentery.§—Dr. W. Janowski concludes, from an exhaustive review of 84 works on dysentery by different writers, that this disease is the result of a co-operation of several parasites, and is not due to the pathogenic action of a single microbe. Two varieties of dysentery are distinguished, the ordinary malady caused by the associ-

* Ann. de Micrographie, ix. (1897) pp. 49–144.

† Comptes Rendus, cxxiii. (1896) pp. 500–3.

‡ Deutsch. Med. Wochenschr., March 4, 1897. See Brit. Med. Journ., Epit., April 3, 1897, p. 56.

§ Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 88–100, 151–8, 194–202, 234–55.

ated action of bacteria, and the tropical, which has certain peculiarities in its clinical and anatomical aspects. This form is probably excited by the co-operation of a definite species of amœba with bacteria.

Chicken-Cholera in Australia.*—Mr. C. J. Pound reports the discovery of chicken-cholera in Australia. The birds (ducks and fowls) had died with the symptoms and phenomena of *Septicæmia hæmorrhagica*. The blood was fatal in about 14 hours to rabbits and mice. The biological characters of the isolated organism are, that it does not spore, is non-motile, is aerobic, the colonies on gelatin at 70° F. are at first white and spherical, afterwards becoming yellowish and irregular in shape. On potato, at incubation temperature, the growth is yellowish and waxy looking; growth in beef-broth is rapid, the medium becoming turbid. As the organism was found to be so fatal to rabbits, the author advised that cultures should be used for the purpose of destroying these rodents; and the report to the Government of Queensland mainly deals with the methods of cultivating the microbe and of employing the disease for the destruction of rabbits. It also deals with the transmissibility of the disease, the practical working of the scheme, and contains reports of a large number of experiments with chicken-cholera on domesticated and wild birds and animals.

Microbial Origin of Baldness.†—Dr. L. Wickham describes how Sabouraud, who has been occupied with the subject for three years, discovered that *alopecia areata* and *seborrhœa* are probably due to the action of the same organism, a bacillus, which, cultivated on acid glycerinised gelose, gives brick-red colonies. The mechanism of the process appears to be that the bacillus invades the hair-follicle, exciting *seborrhœa*, in consequence of which the papilla atrophies, and, *pari passu*, the hair. Experiments made with the toxin of the *seborrhœa* bacillus, obtained by filtration from cultures in liquid media, showed conclusively its specific action.

Differentiation of Diphtheria from Pseudo-Diphtheria Bacilli.‡—Dr. L. de Martini, who has been trying to obtain a practical test for differentiating the true diphtheria bacillus from the organism which so closely resembles it, started with two types of non-virulent bacilli, one of which (*a*) acidified neutral bouillon, while the other (*b*) rendered this medium distinctly alkaline, and that within 24 hours. On ordinary liquid serum, bacillus *a* grew well, but in liquid diphtheria serum, not at all. Bacillus *b* did badly in both. Both *a* and *b*, and also virulent diphtheria bacilli, grew well on coagulated ordinary and diphtheria serums at 70°. The author infers from the foregoing that there is the greatest probability that the type *a* was a degenerated form of the diphtheria bacillus, and that type *b* must be regarded as a pseudo-diphtheria bacillus.

Spirillum Obermeieri and Relapsing Fever Blood.§—Dr. J. Tictin records some observations he made with the blood of relapsing fever patients. Attempts were made to keep the spirillous blood at room tem-

* 'Report relating to the Microbes of Chicken-Cholera,' Queensland, 1897, 22 pp. and 3 figs.
† Brit. Med. Journ., 1897, i. pp. 1028–30.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 87–8.
§ Tom. cit., pp. 179–86.

perature in glass vessels. Under these conditions the movements of the spirilla soon ceased, the microbes died, their bodies degenerated, and finally disappeared. Cover-glass preparations made from such blood showed *Spirochætæ* in leucocytes. As phagocytosis was not observed in the blood of patients or of apes suffering from relapsing fever, the author concludes that leucocytes can only attack spirilla successfully when the latter are enfeebled. Observations on splenectomised apes are alluded to, but the results are not yet published. An interesting observation made by the author, namely, that spirilla are demonstrable within the bodies of bugs, led to the suggestion that the disease might be transferred through the agency of these insects.

Bacillus forming Butyric Acid from Glycerol.*—Dr. O. Emmerling isolated from cow-dung by Fritz's method a bacillus which is named *B. boocopricus.* It is very similar to *B. subtilis*, and grows well on gelatin. With beef-broth it does not form indol. With glycerol at 36°, in the presence of calcium carbonate, methylic alcohol, acetic acid, butyric acid, and traces of formic and succinic acids, are produced. From grape-sugar, ethylic alcohol and lactic acid are produced.

Pigment-forming Micrococcus from Red Milk.†—Dr. G. Keferstein describes a coccus which imparts a reddish hue to milk. The colour first appears five or six days after inoculation, and attains its maximum degree in about two weeks. The coccus grows slowly, but best on agar at 22° C. The formation of the pigment is dependent on the presence of air. On gelatin the colonies are small and rose-coloured, afterwards deepening in hue; the medium is not liquefied. The cocci have no special arrangement, and are easily stained by the usual methods. The coccus is not pathogenic to mice, and is resistant to dry heat.

Influence of Carbonic Acid on the Growth of, and Toxin-formation by Diphtheria Bacilli.‡—It is usually held that bacteria thrive best on faintly alkaline media; the medium, however, is only alkaline at first; for as soon as germination begins the alkalinity diminishes, and finally gives place to acidity. According to the experiments made with diphtheria bacilli by Herr N. P. Schierbeck, an alkaline reaction, even of minimum degree, is positively harmful, while an acid reaction of the medium exerts a favourable influence, provided that there be free carbonic acid present. When CO_2 is absent, or when the reaction of the medium is neutral, the author found that bacterial development was far less than with CO_2 and an acid reaction. Under the influence of CO_2 toxin formation appeared to be more rapid, and the contradictory results obtained by different observers relative to toxin formation under the influence of currents of air appear to be explained by the author's experiments.

Pathogenic Bacillus found in Ice-Creams and Cheese.§—MM. V. C. Vaughan and G. D. Perkins found in ice-cream and cheese a bacillus which grows aerobically and anaerobically. Numerous persons who had

* Ber. Deutsch. Bot. Gesell., xxix. (1896) pp. 2726–7. See Journ. Chem. Soc., 1897, Abstr., p. 113. † Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 177–9.

‡ Arch. f. Hygiene, xxvii. No. 4. See Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 165–6.

§ Arch. f. Hygiene, xxvii. No. 4. See Centralbl. Bakt. u. Par., 2te Abt., ii. (1896) pp. 799–800.

partaken of the creams and of the cheese were seized with vomiting and diarrhœa and other symptoms of toxin poisoning. Though greatly resembling *B. coli communis*, it is distinguished therefrom by the absence of the indol reaction; it coagulates milk more quickly; the agreeable ethereal odour of milk cultures of the ice-cream bacillus is not developed by the *coli* bacillus in the same medium; on carrots, onions, and some other vegetables the ice-cream bacillus grows quickly and develops an acid smell. Milk stained with rosolic acid is more quickly decolorised by this bacillus than by *B. coli com.* The ice-cream bacillus is pathogenic to guinea-pigs, rabbits, cats, dogs, mice, and rats, and its virulence is increased by passage through animals. The toxin was not isolated.

Spontaneous Coagulation of Milk.*—Dr. G. Leichmann states that he has discovered a coccus which, from frequent observations, he believes to be one of the causes of the spontaneous souring of milk. In some samples it is quite as numerous as *Bacterium lactis acidi*. This discovery will serve to explain the presence of optically inactive lactic acid; for, while *B. lactis acidi* produces recto-lactic, the coccus forms lævo-lactic acid, so that by a combination of the two latter the inactive acid results. Though the two bacteria are not unlike in form and size, they are distinguished, not only by the difference in their products, but also by the fact that the coccus forms gas.

Agglutination Phenomenon in Glanders.†—Mr. A. G. R. Foulerton states that agglutination of the glanders bacillus can be brought about by contact with a serum, (1) from a case of active infection by the glanders bacillus, (2) from active infection of typhoid bacillus, (3) from a horse immunised against diphtheria. No such action is manifested by either normal human or equine serums. On reversing the experiments, it was found that a certain though decidedly less active agglutination of the typhoid bacillus was caused by both antidiphtheritic and glanders serums. Thus the serum reaction in glanders as an aid to clinical diagnosis is extremely doubtful; and the foregoing results suggest that the absolute specificity of serum agglutination in different diseases has yet to be proved.

Agglutination Phenomenon and the Cholera Vibrio.‡—From a series of experiments made with the cholera vibrio, Dr. A. Taurelli Salimbeni finds that the agglutination, as far at least as this microbe is concerned, is produced exclusively outside the organism. Agglutination was not observed either in the subcutaneous tissue or in the peritoneal sac of animals which had been actively or passively immunised. In another series, in which the serum and vibrios were mixed together in vitro and in vacuo, it was found that the tubes remained unchanged, while in control tubes in contact with air the ordinary agglutination took place.

Biological Status of Bacillus Tuberculosis.§—Mr. A. C. Jones suggests that the so-called tubercle bacillus is really a stage in the life-history of some higher form of fungus with a definite mycelial growth, and that it would be more appropriately designated *Tuberculomyces*.

* Centralbl. Bakt. u. Par., 2[te] Abt., ii. (1896) pp. 777–80.
† Lancet, 1897, i. p. 1201. ‡ Ann. Inst. Pasteur, xi. (1897) pp. 277–86.
§ Rep. 66th Meeting Brit. Ass., 1896, pp. 1015–6.

This view is supported by the fact that incipient branches may be observed not unfrequently in samples from sputa or cavity contents. More rarely there are definite threads or hyphæ, which exhibit true branching, and often contain one or two spores, forming oval, highly refracting, deeply stained swellings on the course of the filaments. These spores have a close resemblance to chlamydospores, and are not to be confounded with the unstained intervals in the common rodlet, and described by Koch and others as spores. These spaces are really the result of plasmolysis. Old cultures, examined as sections, do not show separated rodlike forms isolated from one another, and lying at all angles, but strands of parallel filaments frequently exhibiting dichotomous branching.

Influence of certain Yeasts in Destroying the Vitality of the Typhoid and Colon Bacilli.*—Dr. J. S. Billings and Dr. Adelaide W. Peckham made a series of researches upon the influence of light, of desiccation, and of the products of certain micro-organisms, upon the vitality of the typhoid and colon bacilli. Insolation of plate cultures was found to destroy all the germs in from three to six hours, while diffuse daylight, gaslight, or electric light, produced little or no effect. Bouillon tubes inclosed in coloured glass tubes showed an increase up to the eighteenth day, after which the numbers began to decrease. Insolation not only affects pathogenic bacteria, but also the culture media, so that they become less capable of supporting the growth of these organisms after periods of insolation varying from 1 to 60 days. Desiccation experiments showed that these organisms retained their vitality for at least five months. Further researches made to ascertain the influence of the common water bacteria or their products upon the vitality of the typhoid and colon bacilli showed that this influence was practically nil.

Bacillus of Friedlaender in Tonsillitis and Pharyngitis.†—Mr. W. C. C. Pakes has found the pneumobacillus in five cases out of 500 examinations of patients suffering from tonsillitis and pharyngitis. The morphological characters were, non-motility, polymorphism, decoloration by Gram's method, presence of a capsule. Cultures on gelatin, agar, blood-serum, and in bouillon were characteristic; the gelatin was not liquefied, gas production in glucose-gelatin, formation of acid in lactose bouillon, coagulation of milk with acid reaction, were exhibited. Mice inoculated with cultures died, the typical bacillus being found in the heart-blood and in the spleen.

Bacterium coli anindolicum and Bacterium coli anaërogenes.‡—Herr W. Lembke reports on two bacteria isolated from dog's fæces, which, in their appearance and growth-characters, resembled *B. coli commune*, and differed therefrom in that the one forms no indol, and the other produces no gas in media containing grape-sugar. The growth of the two differed on gelatin, potato, and in bouillon. Their length was 0·002 mm. and their breadth 0·001 mm. They were mostly in pairs,

* Smithsonian Report for 1894 (1896) pp. 451–8.
† Brit. Med. Journ., 1897, i. p. 715.
‡ Arch. f. Hygiene, xxvii. pt. 4. See Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 281–2.

though not unfrequently several were linked together. *B. anindolicum* is motile and flagellated, while *B. anaërogenes* is motionless and devoid of flagella. *B. coli anindolicum* gives in bouillon with potassium nitrite and strong sulphuric acid a red colour which can be extracted with amyl alcohol. It ferments grape and milk sugars with formation of gas and acid. *B. coli anaërogenes* also ferments both these sugars, but without production of gas. On account of the quantity of acid produced, the two organisms were held to belong to the *coli* group. Only *B. coli anaërogenes* was pathogenic to mice, guinea-pigs, and rabbits.

Trichorrhexis nodosa.* — Dr. St. Markusfeld finds that the disease of the hair known as Trichorrhexis nodosa is produced by a bacillus which can be demonstrated in all cases by staining and cultivation, and which will infect healthy hairs. The bacillus is endosporous, about 2 μ long and 0·5 μ broad, and has rounded ends. It often forms filaments, and is a facultative anaerobe. It is cultivable on bouillon, agar, and gelatin, the latter being liquefied. It coagulates milk. Pure agar cultures suspended in bouillon and inoculated on healthy hairs reproduced the disease.

* Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 230–4.

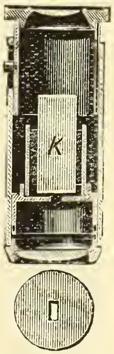
MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Stands and Optical Equipments.†—In an editorial article figures of two stands are reproduced from the latest catalogue (No. 20) of Reichert of Vienna. General remarks are made concerning oculars, and a list is given of the numbers, focal lengths, amplifications, and prices of the oculars of various firms. The apertures, focal lengths, and prices of achromatic, apochromatic, and semiapochromatic objectives, both dry and immersion, are quoted from catalogues and compared.

Fig. 16.



(3) Illuminating and other Apparatus.

Ocular-Dichroiscope.‡—Herr C. Leiss figures a combined eye-piece and dichroiscope (fig. 16), with the aid of which the two colours shown by crystals of microscopic dimensions may be seen side by side, and so directly compared. This is an improvement on the usual method of rotating the polariser or the crystal. A rectangular diaphragm is placed behind the calcite prism K, as in the ordinary dichroiscope.

(4) Photomicrography.

Method of Projecting a Micrometric Scale upon a Microscopic Specimen.—The accompanying figure (fig. 17) illustrates the apparatus contrived by Prof. A. E. Wright for measuring and counting microscopic objects, described on p. 182, and exhibited at the March meeting of the Society.

The window-pane and the projection-scale (which is etched upon a piece of plate glass) are shown in optical section at A and B respectively. The method of suspending the scale, so that it may be at right angles to the beam of light which is thrown upon the microscopic mirror, is shown at C. The scale is allowed to tilt forward until, as in medallions A and B, an equal number of vertical and horizontal divisions appear within the microscopic field. The minified image of the projection-scale, which is superposed upon the microscopic object, is shown in optical section at G. The adjustment of the condenser, which is essential to the superposition of the minified image upon the microscopic specimen, is most easily achieved by first focusing the microscopic objective upon the microscopic specimen, and then, while keeping this plane under observa-

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

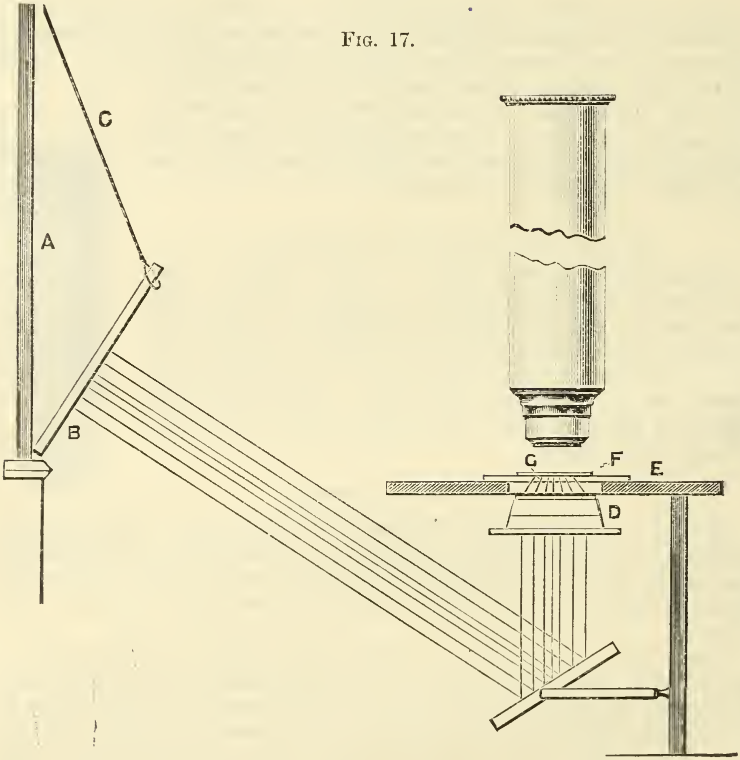
† Zeitschr. f. angew. Mikr., ii. (1897) pp. 351–60 (2 figs.).

‡ Op. cit., iii. (1897) pp. 5–6 (1 fig.).

tion, making the necessary adjustment in the vertical height of the condenser.

Medallion A (fig. 18) shows the figure of squares superposed upon the micrometric ruling of an ordinary stage micrometer, which is ruled in tenths of millimetres. Any line in the projection-scale can be superposed upon any line of the stage micrometer by a mere movement of the mirror round its vertical or horizontal axis. When any one line of the projection-scale has been superposed upon any line of the stage micro-

Fig. 17.



meter, all the other lines can be made to correspond by adjusting the distance between the projection-scale and the Microscope.

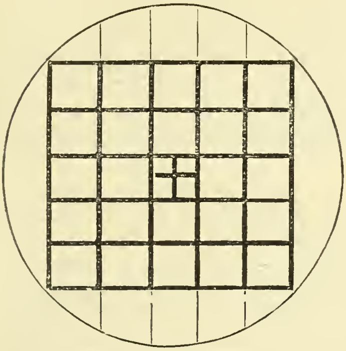
Medallion B (fig. 19) shows the application of the projection-scale * to the enumeration of red and white blood-corpuscles. The appearances shown in the medallion are obtained by substituting for the stage micrometer, shown in medallion A, a specimen of 200-fold diluted blood, which has then been filled into an unruled hæmc-cytometer-cell of a depth of 0·2 mm.

The white blood-corpuscles are most conveniently enumerated by

* Projection-scales of this pattern may be obtained from Mr. A. E. Dean, jun., 73 Hatton Garden, E.C.

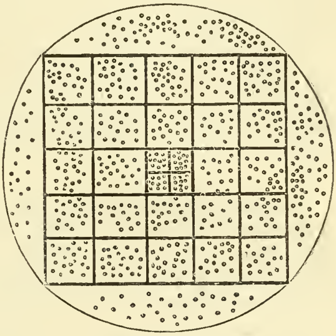
counting the number that fall within the area of the block of 25 squares. The red blood-corpuscles are most conveniently enumerated by counting the number which fall within the central square, which, to facilitate enumeration, is here divided into four smaller squares. The number of red and white blood-corpuscles in one cubic millimetre of blood can be conveniently arrived at by superposing the scale in turn

FIG. 18.



Medallion A.

FIG. 19.



Medallion B.

upon ten different portions of the microscopic specimen, and by then multiplying the total red and white blood-corpuscles which were found in the areas which have just been specified by 10,000 and 400 respectively.

In fig. 17, D represents the substage condenser, E the slide or hæmocytometer-cell, and F the cover-glass.

(5) Microscopical Optics and Manipulation.

Knife and Strop for Microtomes.*—Herr G. Marpmann mentions the advances made in section-cutting since the introduction of the microtome; he figures a knife made during the last 17–18 years by W. Walb of Heidelberg, and mentions a sharpening strop with rounded surface also made by W. Walb.

B. Technique.†

(1) Collecting Objects, including Culture Processes.

Nutritive Medium for Algæ.—In his important work on Reproduction in Algæ and Fungi,‡ Dr. Klebs recommends, for the culture of Algæ, the employment of both fluid and solid media. As a fluid medium he finds Knop's the best, viz.:—4 parts calcium nitrate, 1 part magnesium sulphate, 1 part potassium nitrate, 1 part potassium phosphate.

* Zeitschr. f. angew. Mikr., iii. (1897) p. 6 (1 fig.).

† 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.

‡ *Vide ante*, p. 147.

In preparing it, a concentrated solution (B) may be made of the last three salts, and another (A) of the first. A proper amount of A is to be added to B after dilution to the desired percentage. By this method only a small part of the insoluble calcium phosphate will be precipitated. Solutions containing 0·2 to 0·5 per cent. of salts were found most useful.

Cultivating the Bacillus of Seborrhœa.*—M. Sabouraud has overcome the difficulty of isolating the bacillus of *seborrhœa* and of *alopecia areata* by cultivating in a very acid medium, the ingredients of which are as follows:—Pepton, 20 grm.; glycerin, 20 grm.; acetic acid, 5 drops; water, 1000 grm.; gelose, 13 grm. The temperature used was 35° C. A white coccus was disposed of by using immunised gelose; i.e. by preparing the gelose with fluid in which the coccus had been cultivated. The same result was obtained by heating the cultures to 65° C. for 10 minutes.

Preparing Plague-Serum.†—Prof. A. Lustig and Dr. G. Galeotti prepare a vaccine from the plague bacillus which has the chemical characters of a nucleo-proteid. The bacillus, the virulence of which has been ascertained, is cultivated on large agar plates for three days at 37°. The surface is then scraped, and dissolved in 1 per cent. KHO. After filtration through paper, the vaccine is obtained by precipitation with acetic or hydrochloric acid, or by saturation with sulphate of ammonium after neutralisation. The precipitate, having been repeatedly washed, and dissolved in a very weak solution of sodium carbonate, is ready for use. Transit through the Chamberland filter deprives the vaccine of much of its activity. The minimum lethal dose of the acid precipitate is 5·28 mgrm. per 100 grm. weight of animal. Animals vaccinated with very small, or with one-half or one-third of the smallest fatal dose, injected subcutaneously at intervals of two days, are rendered quite indifferent to large injections of virulent cultures. The immunity lasts about five weeks. From animals thus rendered immune, is obtained, after 14 days, a preventive and curative serum, of which 1 ccm. suffices to prevent peritoneal infection and to cure a rat weighing 180–200 grm., which had been peritoneally injected with four to five loopfuls of virulent culture.

The authors are endeavouring to obtain a prophylactic and antidotal serum from the horse.

New Method of obtaining Diphtheria Antitoxin.‡—Dr. Smirnow, of St. Petersburg, has succeeded in obtaining a diphtheria antitoxin, which is stated to be of considerable effective value, by electrolysing virulent diphtheria broth cultures. In itself the antitoxin appears to be quite harmless, and its preparation simple and rapid.

Technique of Serum Diagnosis.§—Dr. A. S. Delepine, after alluding to the methods used since the beginning of 1896 for demonstrating the action of blood or blood-serum on the corresponding microbes, states that he has finally adopted the following simple but effective procedure, for

* Brit. Med. Journ., 1897, i. p. 1029. † Tom. cit., pp. 1027–8.
‡ Arch. Sci. Biol. Petersburg, iv. (1896) No. 5. See Nature, April 22, 1897, pp. 597–8. § Brit. Med. Journ., 1897, i. pp. 967–70.

which all the apparatus required consists of (*a*) a sterilised lancet-shaped needle; (*b*) the small pipette in which the blood has been collected, and of such diameter that after it has been broken across (the platinum loop, which is used for measuring the serum, can easily be introduced into it if necessary); (*c*) a platinum loop, measuring about 1 mm. in diameter, and holding about 1 mgrm. of fluid; (*d*) slide and cover-glass; (*e*) a tube-culture of the typhoid bacillus in neutral bouillon. The culture should not be more than 24 hours old, should be free from clumps, and the bacillus actively motile. The procedure is as follows:—With the sterilised loop nine drops of the culture are deposited separately on slide or cover-glass. One drop of blood is then added, and the 10 drops thoroughly mixed together. The phenomena observed differ according to whether the serum is potent or not. If the serum be potent, all the bacilli will be agglomerated in from five to thirty minutes; if feeble, the clumps form gradually, but positive diagnosis can be made in from about a half to two hours. For further information and details the original should be consulted.

(2) Preparing Objects.

Preparing and Staining Celery for Demonstrating Bacteria.*—Dr. U. Brizi hardened the diseased parts for 48 hours in a liquid composed of 100 parts of water, to which were added 1 part of glacial acetic acid and 1 part of chromic acid. The pieces were further hardened in 75 per cent., and then in absolute alcohol. The sections were cut by the paraffin method, and after the paraffin had been removed by means of chloroform, were washed in warm water and then immersed in an aqueous 1 per cent. solution of methyl-green for three or four hours, after which they were treated with water acidulated with hydrochloric acid. In this way everything but the bacteria was decolorised, and then the sections were contrast-stained in an aqueous solution of picrocarmin, in which they were allowed to remain for about an hour. The sections, having been washed and dehydrated, were mounted in balsam. Another good stain was gentian-violet and acetic acid (water 100, acetic acid 10, saturated alcoholic solution of gentian-violet 20). The sections were treated with this solution for about an hour, and then placed in strong spirit to which a few drops of hypochlorite of soda were added. By this procedure the tissue was quite decolorised, the bacteria being stained violet.

Microchemical Methods for Examining Cells.†—According to Prof. E. Zacharias, a mixture of methylen-blue and fuchsin S may be used with great advantage to study the distribution of nuclein in the cell. If tissues of different origin are treated with dilute hydrochloric acid, and this mixture afterwards added, the constituents of the cell which contain nuclein are stained a deep blue, the parts without that substance being red. Sperm-cells of the Rhine-salmon were treated with dilute hydrochloric acid to remove protannin, and then stained with the above mixture. Instantly the envelopes of the heads which contain the nucleic acid were beautifully stained bright blue; the inner part of the heads seemed to be colourless; the tails were stained red. Similarly treated,

* Atti R. Accad. Lincei, vi. (1897) pp. 229–34.
† Rep. 66th Meeting Brit. Ass., 1896, p. 1022.

the chromatin bodies of all the nuclei which have as yet been examined were stained blue, the rest of the nuclei and the cell-protoplasm red.

Employment of Dead Bacteria in the Serum Diagnosis of Typhoid and Malta Fever.*—Prof. A. E. Wright and Surgeon-Major D. Semple confirm Widal's observation that the agglomeration phenomenon is equally characteristic with dead bacteria, and they further find that it also holds good for *Micrococcus melitensis.* Emulsions of fresh agar cultures were drawn up into small glass capsules, and these exposed to a temperature of 60° C. for five to ten minutes. The dead bacteria capsules were laid aside for three to nine weeks, and then, having been well shaken up, were used for serum diagnosis. Microscopical observation did not reveal any differences in the method in which agglomeration occurred in the living and dead cultures after addition of dilute serums; and the experiments with capillary sero-sedimentation tubes gave even more interesting results.

(3) Cutting, including Imbedding and Microtomes.

Cutting and Mounting of Sections of Cereal Grains.†—Mr. J. D. Hyatt says that, for making satisfactory sections of grains, the main precaution consists in slightly moistening the kernels. Indian corn may be kept moist for 24 hours, wheat four or five hours, rye five or six, barley ten or twelve, and oats not more than one or two hours. For imbedding, paraffin is the best material, as it holds the grain so firmly that it may be cut in any direction. Any section-cutting contrivance will serve, provided the knife be sharp. If the sections be too thin the starch-grains will fall out, and if too thick the gluten cells will be disagreeably opaque. Glycerin-jelly is the best medium for mounting. The sections are best removed from the knife by a camel's hair brush, and are then deposited in water, from which they are transferred to the centre of a horizontally placed slide. Warm glycerin-jelly is then put on, after which a cover-glass, slightly heated over a spirit-lamp, is carefully deposited on the gelatin. The cover-glass must be allowed to settle gradually and by its own weight, no pressure being applied. If the gelatin have become too hard to allow the cover to settle, the cover may be pressed, and then heat applied to the under-surface of the slide.

(4) Staining and Injecting.

Effect of certain Chemical and Physical Agents on the Staining of Sporous and Asporous Bacteria.‡—M. C. X. Hieroclés exposed the following bacteria, *B. mycoides*, *B. subtilis*, drumstick bacillus, a thermophilous species cultivated at 56° C., typhoid and diphtheria bacilli, to the influence of certain agents, to ascertain whether the action of the latter improved or deteriorated the absorption of pigments in solution. Aqueous and anilin-water fuchsin solutions were used. Dry and moist heat increased the stainability of sporogenous bacteria and their resting forms for anilin-water fuchsin. *B. subtilis* and *B. mycoides* stained

* Brit. Med. Journ., 1897, i. pp. 1214–5.
† Journ. New York Micr. Soc., xiii. (1897) pp. 19–24 (1 pl.).
‡ Arch. f. Hygiene, xxviii. p. 163. See Centralbl. Bakt. u. Par., 1[te] Abt., xxi. (1897) pp. 416–7.

better with aqueous solutions. Chlorine and bromine water increased the power of anilin-water fuchsin, and somewhat decreased that of aqueous fuchsin. Bromine vapour was detrimental to spores and bacilli; while chlorine gas seemed to make the spores and bacilli of *B. subtilis* and the drumstick bacillus stain more easily. Formalin and iodopotassic iodide solution had no effect; and sunlight diminished the stainability of *subtilis* bacilli and spores. Chlorine gas was detrimental to typhoid bacilli for aqueous fuchsin solution, and bromine vapour destroyed the cell-plasma. The effect of the agents used was to make diphtheria bacilli swell up, and their staining paler.

New Hæmatoxylin-Stain.*—The following process is recommended by Herr M. Raciborski. Leave the preparation for from 2–20 minutes in Delafield's hæmatoxylin; then wash with water, and for 2–5 minutes with iron-alum, then again with water, alcohol, and toluol, and imbed in canada-balsam. This process affords very good results for botanical purposes, and has the advantage of a great saving of time. Secondary staining with saffranin (in anilin water), and washing in 1 per cent. alcoholic acetic acid, affords a good double-stain.

Flagella Staining.†—Mr. D. McCrorie stains flagella with "night-blue," an anilin pigment which shows as well in artificial as in sunlight. The formula used is, 10 ccm. of a concentrated solution of night-blue, 10 ccm. of a 10 per cent. solution of alum, and 10 ccm. of a 10 per cent. solution of tannic acid. The addition of 0·1–0·2 grm. of gallic acid seems to impart additional value, but excellent results are obtainable without it. The method adopted is to dry the film in an incubator for two minutes; then pour on the stain and incubate again for two minutes, or hold the cover for the same time about two feet above a Bunsen burner; wash off the excess of stain, and, after drying in an incubator, mount in balsam.

(6) Miscellaneous.

Method of extemporising a Blowpipe for making Sedimentation Tubes.‡—Prof. A. E. Wright and Surgeon-Major D. Semple use an ordinary spray producer, such for instance as an ether freezing apparatus; the reservoir is filled with methylated spirit. The flame produced in this way is quite hot enough for any ordinary glass-working apparatus. It is quite hot enough to draw out glass tubing into capillary sero-sedimentation tubes. Only two points in connection with the working of the flame required to be attended to, viz. (1) the spirit must be finely divided, i.e. the spray must not be too coarse, otherwise the flame will not be sufficiently hot; (2) the spirit must be fed into the spray tube in sufficient quantity and in a regular manner.

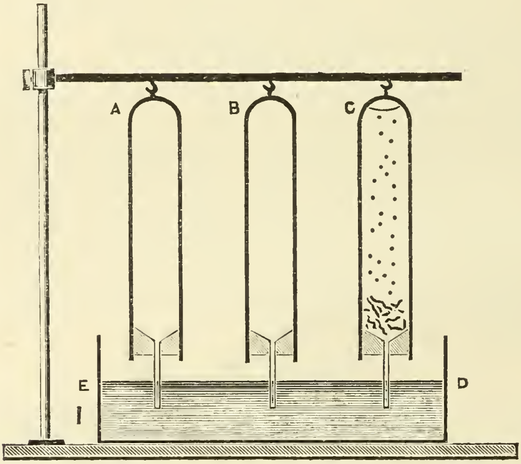
Botanical Application of the Röntgen Rays.§—Herr J. Istvánffy has experimented on the effect of the light of Crookes's vacuum-tubes on plants. He finds that the rays penetrate only the woody tissue, as can be made manifest in a leaf of *Camellia*, the veins of which appear white

* Flora, lxxxiii. (1897) p. 75.
† Brit. Med. Journ., 1897, i. p. 974. ‡ Tom. cit., p. 1215.
§ SB. K. Ungar. Naturw. Gesell. Buda-Pest, Feb. 12, 1897. See Bot. Centralbl., xlix. (1897) p. 267.

in the image. All other tissues, whether containing chlorophyll or not, are impermeable to these rays.

Demonstration of the Evolution of Oxygen by Diatoms.* — Mr. T. C. Palmer has succeeded in demonstrating the absorption of carbon dioxide and the elimination of oxygen by diatoms experimentally by the following process, dependent on the property of hæmatoxylin of assuming a yellow colour with a tinge of brown when absorbing CO_2, while, in the presence of nascent oxygen, the red hue gradually deepens, finally becoming a deep blood-red. In the apparatus here figured (fig. 20), the dish is filled up to the line D E with water tinted with a freshly made solution of hæmatoxylin, sufficient to stain it a pale red. The tube A is then filled with the same solution, stopped with rubber, through which is passed a quill tube, and the tube suspended, the very fine end of the quill dipping into the water. Another portion of the hæmatoxylin

Fig. 20.



solution is acidified by CO_2 from the lungs, blown into it through a glass tube, till it assumes a brownish-yellow tint, and the tubes B, C, prepared in the same way, are filled with this solution; living diatoms (*Eunotia major*) having been placed in tube C. The apparatus is now exposed to bright light, preferably to direct sunlight. Gas arises from the diatoms in tube C, and simultaneously the colour of the liquid, which is at first like that in B, begins to change. Within 15 minutes the colour has again become almost or quite as red as that in tube A. The CO_2 has now, in large measure, disappeared from the solution. The action continues, and the colour in tube C deepens rapidly, showing oxidation, and this action continues until the colour is blood-red. Still more striking results are obtained as follows:—In tube A is placed a living snail; in B live diatoms; C being left for comparison. Under the influence of sunlight, in the course of a few minutes, A pales

* Proc. Acad. Nat. Sci. Philadelphia, 1897 pp. 142–4 (1 fig.).

rapidly from the CO_2 given out by the snail; B as rapidly darkens and reddens; while C remains unchanged.

Microchemical Reaction for Nitric Acid.*—Mr. J. L. C. Schroeder van der Kolk has for several years used the following test, which is somewhat similar to that recently proposed by R. Brauns.† The substance to be tested is placed with a drop of sulphuric acid in the hollow of a glass slide, and from the cover-glass hangs a drop of barium hydroxide solution; when nitric acid is driven off, typical crystals of barium nitrate appear in the drop on the cover-glass. As the substance tested does not come into contact with the barium solution, the presence of sulphates, phosphates, &c., does not affect the result.

Dead-Black Surface on Brass.‡— To 2 grains of lamp-black in a saucer add, says Mr. L. A. Wilson, just enough gold-size as will hold the lamp-black together, and mix thoroughly. Dip a lead pencil into the gold-size, and the right quantity will be obtained; add drop by drop. After the lamp-black and size are thoroughly mixed and worked up, add 24 drops of turpentine, and work up again. Apply the mixture with a camel's hair brush. When thoroughly dry, the brass will look as if it had just come from the optician's hands.

Laboratory Notes. — Prof. K. Goebel § recommends the following objects for the purposes specified:—The leaves of *Elatostemma sessile* for the exudation of drops of water. *Klugia notoniana* for the formation of the embryo within the ovule. The protoneme of Mosses for the formation of starch out of sugar. The germination of the protoneme from the spore can be well followed out in *Funaria hygrometrica.*

Herr M. Raciborski || finds the epidermal cells of the perianth-leaves of cultivated species of *Albuca* favourable objects for observing the formation of crystalloids in the vacuoles within the endosperm. No fixing or staining of the object is necessary. The elaioplasts can also be demonstrated in the same cells.

Reversible Mailing Cases.¶—Messrs. Bausch and Lomb have brought out new mailing cases for microscopical slides. All the pieces are similar and interchangeable, thus avoiding the use of "tops" and "bottoms." An ample depression in the face of each piece allows the stowing of a slide with a large cover. Any number of slides and cases may be adjusted and piled one above the other, or one slide may be held securely by simply reversing one piece of wood.

* Neues Jahrb. Mineral., i. (1897) p. 219.
† Cf. this Journal, 1896, p. 687.
‡ The Microscope, v. (1897) pp. 43–4.
§ Flora, lxxxiii. (1897) pp. 74–5.
|| Tom. cit., p. 75.
¶ Journ. New York Micr. Soc., xiii. (1897) pp. 41–2 (2 figs.).

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on the 21st of April, 1897, at 20 Hanover Square, W., The President (E. M. Nelson, Esq.) in the Chair.

The President having, in pursuance of notice given at the last meeting of the Society, declared the present meeting to be special for the purpose of making alterations in two of the Society's rules, called upon Mr. J. J. Vezey—in the absence of Prof. Bell—to read the notice and the proposed alterations.

Mr. Vezey then read the notice by virtue of which the special meeting was constituted, and also read Rules 10 and 20 in their altered form as follows:—

"*Rule* 10. Every person elected an Ordinary Fellow shall sign the following form of declaration, and shall pay the admission fee, or the first instalment thereof, as provided by Rule 20, and first annual subscription or composition, within two months from the date of election, or within such further time as the Council may allow. In default of such signature and payment the election of such Fellow shall be void.

I, the undersigned, having been elected a Fellow of the Royal Microscopical Society, *hereby agree that I will be governed by the Charter and Bye-laws of the Society for the time being; and that I will advance the objects of the Society as far as shall be in my power. Provided that when I shall signify in writing to one of the Secretaries that I am desirous of ceasing to be a Fellow thereof, I shall (after payment of all annual subscriptions and any balance of admission fee that may be due from me, and returning any books, or other property belonging to the Society in my possession) be free from this obligation.*

Witness my hand this *day of* 18

Rule 20. Every Ordinary Fellow shall pay an admission fee of two guineas, or at his option the sum of two pounds ten shillings, payable in five consecutive annual instalments, and a further sum of two guineas as an annual subscription."

The object of the alterations was obviously to enable such Fellows as might desire it to pay their admission fees by instalments instead of in one payment as heretofore.

The President then formally moved that these alterations in Rules 10 and 20 be adopted.

Dr. Dallinger having seconded the proposal, it was put to the meeting by the President, and declared by him to be carried unanimously.

The special meeting was then declared to be at an end, and the minutes of the meeting of 17th March last were read and confirmed, and were signed by the President.

The President exhibited an improved form of his mechanical stage, and read a description of the alterations made and the advantages obtained thereby. (See p. 185.)

Dr. Dallinger thought that the stage in its present form was to be highly commended, as it firmly clipped the object, and yet left it free for such manipulation as might be needed with homogeneous lenses, at the same time avoiding the possible danger to the mount that arose from the older over-arching spring.

The President said, in answer to a question, that provision had been made for tightening up the bevelled gear by means of a capstan-headed screw provided for the purpose.

Mr. F. Enock was then called upon by the President to describe an extremely interesting exhibition under twenty-six Microscopes in the room of examples of every known genus of the British Mymaridæ.

Mr. Enock said he felt he ought at the outset to thank the Society for affording him this opportunity of exhibiting a complete collection of the Mymaridæ. Of course he supposed that everyone there would know something about them; but having overheard someone inquire what are the Mymaridæ, perhaps it might be well just to mention that they are minute Hymenopterous insects, all of which are egg-parasites, depositing their own eggs inside the eggs of other insects. In size they are so small that they must all be treated as microscopical, the smallest exhibited that evening being only 1/85 in. long, and the largest not more than 1/50 in. Not very much had hitherto been known about them, and he might fairly say that the British Mymaridæ would come under the head of neglected families. In 1797 Dr. Shaw exhibited an insect of this class, and made a drawing of it; but he was not at all certain what it was. Very few drawings appeared to have been made of these minute creatures, and those which were preserved were, in some cases at least, such as to make recognition impossible. A. H. Haliday, however, established the family in 1833, but it was elaborated by Francis Walker in 1846. Some time ago he wanted to identify a specimen which was found by Sir John Lubbock in 1862, and named by him *Polynema natans;* and through the kindness of the Trustees of the Dublin Museum, Haliday's type collection of British Mymaridæ was lent to him. He found this collection had been very much neglected as to its condition; it consisted of 172 specimens gummed upon card—some very much gummed—but he had obtained permission to remount them where desirable, and had gone through the whole collection, making a separate drawing of each, and had found his examination of them to be a very interesting study. One genus, named by Haliday *Panthus*, had been suppressed by Walker, who considered it to be identical with Haliday's *Anagrus*. This, however, had proved to be not the case; and by restoring this, Haliday's collection was made up to eleven genera. Since he had given his attention to the matter—principally in 1885—he had discovered eight new genera; and he was sure that he should be able to find many more by devoting a little more time to the subject. All the species searched for the eggs of injurious insects, and he had watched them with great interest running about over the eggs, tapping each with their antennæ, and if the egg was all right, boring through it and then laying an egg, or sometimes two eggs, inside. He had watched this being done by *Alaptus fusculus*, and had kept these eggs under observation, and at length saw the little *Alapti* emerge, and had identified them with what had been previously classed as another species under the name of *Alaptus minimus*; and he believed there were many others which had not been so well made out, but which might prove to belong to other species. He had, as already mentioned, discovered eight new genera, but he could not say how many species, as the drawing of such minute objects with anything like accuracy involved a very great strain upon the eyesight. Fortunately, however, when properly mounted, these insects all lent themselves admirably to photomicrography; he had already taken some, and had brought these to the meeting for inspection; but he hoped to be able to take a negative of every one, and also hoped in time to be able to work out a complete monograph of the British Mymaridæ; but he felt that very few persons were interested in this group, and little had been done in this direction lately except by Dr. Gooch and himself. Observations as to their habits were difficult to carry out; and as for dissections—well, they would understand that if the insect was so small, the diameter of the ovipositor must be very small indeed; and when they came to measure the internal diameter of the ovipositor, it was found to measure only 1/4000 in. It was astonishing to note how these minute creatures exhibited such an amount of intelligence as he had witnessed. *Alaptus* would, for instance, keep exclusively to one kind of egg, and would never lay its own in any others but these. He had tested this by putting an *Alaptus* upon a leaf with a number of different kinds of egg, and had invariably found it to disregard all but the one sort; indeed, he on one occasion put only one of the right kind amongst a quantity of others, and saw the little insect run over all of them, touching each egg with its antennæ, and rejecting them in turn until it found the one in question, when it instantly stopped, bored this egg, and laid one inside it. He had never bred but one kind of *Alaptus* from the same species of egg. He had also watched the egg struck, and had then dissected it, and had kept it under observation, seeing the germ grow until it became an active larva; and he had seen the various parts develop and fall into position until the creature became perfect. The classification of this family was very much in confusion, as might be expected from the way some of the species had been determined. Sir John Lubbock, in 1862, found an aquatic species, to which he gave the name of *Polynema natans*, and he made a drawing of this for reference. A French observer, Ganin, bred a number from the eggs of a dragon-fly, and made another drawing. It happened that he (Mr. Enock) had seen both these drawings, and had no hesitation in saying they were of different genera; and yet both Sir John Lubbock and Ganin had agreed that they represented the same creature, which was incredible to him if they had really both compared the drawings and descriptions. The one found by Ganin was undoubtedly some kind of *Anagrus* which did not really live in the water and use its wings for swimming like the one found by Sir John Lubbock. He had bred a number from the eggs of a dragon-fly, and these certainly were *Anagri*. They walked about for some time on the bottom of the glass vessel; but when he removed them with a pipette and placed them in a saucer, the moment they reached the air they flew away to the window. He concluded, therefore, that they could not fly under water, and he noticed that they made no attempt to swim, which proved to him that Ganin's specimen could not be the same as Sir John Lubbock's. He also noticed that Haliday stated in his description that his specimen had a keeled thorax, which Ganin's *Anagrus* certainly had not; and when he exhibited a specimen which he had recently found, at the soirée of the Royal Society, it was recognised as being the same as Haliday's *Cataphractus*, discovered in 1846. Another form, discovered also by Sir John Lubbock in 1862, was named by him *Prestwichia*; this was a female, and turned out to be, not a Mymarid, but an aquatic Hymenopter which used its legs for swimming. The male of this remained undiscovered until last year, when he had himself the good fortune to find it. He urged all who took any interest in this branch of natural history to search for these Mymaridæ. They were far more common than might be generally supposed, and he did not think there would be a window of a house on which they could not be found in summer-time; he had himself found not less than 600 on the window panes of a house at Woking, but amongst all these he was only able to find two males; and this naturally suggested the question, where do all the males get to? Last year he collected a large number of the eggs of the Alder fly, and from these he bred about 700 parasites, and he got ten broods in the course of the season, as it took exactly a fortnight for them to go all through their changes. Next month these insects would begin to come out, and should therefore be looked for. The males were all apterous, and they emerged from the egg first; they then watched for the emergence of the females, and as soon as these appeared copulation took place, the female flew away, and the life of the male was probably a very short one. The genus *Litus* was very peculiar, and in appearance was very much like a flea; but though he had carefully watched for the male, it had up to the present time remained undiscovered. Out of the 172 specimens in Haliday's collection, he found more than one-half were wrongly named, or had been placed in the wrong genus; they were all very much mixed, and therefore wanted very careful examination. In conclusion, he wished to thank the Fellows of the Society for listening so patiently to his rather rambling remarks about this little known family; he had never before had the opportunity of showing at the same time representatives of the entire family, and he tendered his sincere thanks to the Society for rendering it possible for him to do so.

The President thought that all who were present would concur in passing a very hearty vote of thanks to Mr. Enock for bringing this beautiful collection of the Mymaridæ before them, and also for the very interesting remarks which he had made in the course of his description.

Dr. Dallinger said it was not usual for a vote of thanks to be seconded which had been moved from the chair, but on that occasion he thought they might depart from this custom. He felt sure they had all been interested and instructed by what Mr. Enock had described and shown them, and the subject had proved to be just one of those which showed how very much there was to be done in many directions by microscopists, if only they addressed themselves to them, and so discovered how to find the large amount of work that remained to be done in apparently exhausted fields. Mr. Enock had certainly shown them that evening how and where to find one.

Mr. Vezey read an extract from a letter received from Mr. C. J. Pound, a Fellow of the Society, and Government Bacteriologist at Brisbane, as follows:—

"I have only just returned from a six months' visit to the Bulloo River district (1000 miles inland), where I have been conducting an exhaustive series of experiments with the bacteria of chicken-cholera on rabbits living under natural conditions in some instances in open country.

"You may remember that in 1887 the late M. Pasteur proposed to destroy the rabbits in Australia with this disease, but his scheme was rejected by a Royal Commission appointed by the New South Wales Government.

"However, the results of my investigation, which have been highly satisfactory, tend to prove the efficacy of Pasteur's scheme of rabbit destruction.

"A copy of my report will be forwarded to you in a few days" (see p. 240).

It was announced that Mr. Ernest Hinton had promised to exhibit at the next meeting, May 19, some specimens of injections and other objects of interest. Invitations to non-Fellows could be obtained on application to the Assistant-Secretary.

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

By the President:—Improved form of Mechanical Stage.

By Mr. F. Enock:—Mounted specimens of the following genera of Mymaridæ:—*Alaptus* ♂ and ♀ Haliday; *Anagrus* ♂ and ♀ Haliday; *Anaphes* ♂ and ♀ Haliday; *Camptoptera* ♂ and ♀ Foerster; *Cosmocoma* ♂ and ♀ Foerster; *Eustochus* ♂ and ♀ Haliday; *Gonatocerus* ♂ and ♀ Nees; *Litus* ♀ Haliday; *Mymar* ♂ and ♀ Curtis; *Ooctonus* ♂ and ♀ Haliday; *Panthus* ♂ Haliday; eight new genera discovered by F. Enock. Also the following Aquatic Hymenoptera:—*Cataphractus* Haliday; *Prestwichia* ♀ Lubbock, ♂ Enock. A. H. Haliday's type collection of British Mymaridæ. Photomicrographs of Mymaridæ, &c.

New Fellows:—The following was elected an *Honorary* Fellow:—Prof. Dr. G. B. de Toni. *Ordinary* Fellows:—Mr. George Harry Baxter, Rev. Joseph Birkbeck, Mr. Thos. Sebastian Davis, Mr. John Hassall, Mr. John Stewart Remington, Mr. John G. Robinson, Mr. Fredk. Richard Rowley.

MEETING

HELD ON THE 19TH OF MAY, 1897, AT 20 HANOVER SQUARE, W., E. M. NELSON, ESQ., PRESIDENT, IN THE CHAIR.

The Minutes of the Special Meeting held on 21st of April, 1897, and also those of the Ordinary Meeting of the same date, were read and confirmed, and were signed by the President.

Prof. Bell said they had received a letter from Dr. G. B. De Toni, acknowledging the intimation of his election as an Honorary Fellow of the Society at the Ordinary Meeting on the 21st of April last. Dr. de Toni expressed his sense of the great honour conferred upon him by this act on the part of the Society, and returned his hearty thanks to the Fellows for their action in the matter.

Prof. Bell said that amongst the donations received since the last meeting was a book by Dr. Van Heurck on the X Rays, for which no doubt the Society would return its thanks, although at present the X Rays were not, so far, as he knew, of any special service to the microscopist.

Prof. Bell said that the Society had also received a very valuable donation from Mr. Rousselet, who had presented them with a series of 426 slides of the Palates of Mollusca which had been given to him by Miss Saunders. These slides were prepared by Mr. H. M. Gwatkin, whose attention to the subject was known to many of the Fellows of the Society. This collection had been given to Mr. Rousselet with a request that he would bestow them where they would be most likely to be of service, and to do the best he could with them. He thought the Society would agree with him that Mr. Rousselet had fulfilled the last portion of the request by giving these slides to the Society.

The President thought this was a collection likely to be of much value to the Society, because a number of specimens like these of the same class of objects was of great use to any one who was working at the subject for comparison. He was sure, therefore, that all present would join in a very hearty vote of thanks to Mr. Rousselet for placing them in possession of so desirable an addition to the Society's Cabinet.

A vote of thanks to Mr. C. F. Rousselet was then put from the chair, and carried by acclamation.

The President said he regretted there was nothing else upon the Agenda paper for the evening, excepting an exhibition of a number of very excellent specimens of injections and other objects by Mr. Ernest Hinton. These were shown under the Microscopes upon the tables, and would, no doubt, be inspected by the Fellows present with great pleasure and interest. He thought that the descriptive labels beside each instrument would render any further description unnecessary to those who saw the objects; but he felt that their thanks were due to Mr. Hinton for bringing them for exhibition. He therefore moved "that a very hearty vote of thanks be given to Mr. Ernest Hinton, for affording this opportunity of examining these preparations."

The motion was then put from the chair, and carried unanimously.

The meeting then resolved itself into a Conversazione, at which the following objects were exhibited:—

Mr. Ernest Hinton:—Feet of Toad (two preparations). Foot of Frog. Upper jaw of Toad. Under jaw of Toad. Surface of stomach of Toad injected with chrome. Ditto, ditto, injected with carmine. Surface of small intestine of Toad injected with chrome. Ditto, ditto, injected with carmine. Surface of skin of Toad from belly and back. Surface of human skin. Ova of Frog. Lung of Python injected with chrome. Ditto, ditto, injected with carmine. Large intestine of Python. Small intestine of Python injected with chrome. Ditto, ditto, injected with carmine. Small intestine of Grass Snake injected with chrome. Ditto, ditto, injected with carmine. Small intestine of Goat. Ditto of Lynx. Ditto of Emu. Large intestine of Emu. Leaf of *Drosera rotundifolia* showing captured insect. Heads of *Chrysops relictus*, *Hæmatopota pluvialis*, *Palloptera pulchella*, *Tryptera chrysanthemi*, *Tryptera reticulata*, prepared without pressure, to show the eyes in their natural brilliant colours.

New Fellows:—The following were elected *Ordinary* Fellows:—Mr. Charles Hoole and Mr. Harry Moore.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

AUGUST 1897.

TRANSACTIONS OF THE SOCIETY.

VI.—*On the Development and Structure of Dental Enamel.**

By J. Leon Williams, D.D.S., L.D.S., F.R.M.S.

(*Abstract of a paper read before the R.M.S.*, 17*th March*, 1897.)

Plates II.–V.

A little more than a year ago I had the honour to present a paper before the Royal Society on the subject of enamel development. This paper, as I said at the time, was in the nature of a preliminary statement, made while investigation was in progress, for the purpose of placing on record several new facts which had appeared. The significance of these facts was hardly touched upon, and, in truth, not fully seen by myself at that time. Further investigation has shown more clearly the bearing of these new points upon many of the old problems of enamel development and structure. It seemed fitting to me that these discoveries, or what I believe to be such, should be brought before the Society best qualified to discuss such problems from the microscopist's point of view. The several phases of enamel development and structure to which I especially wish to call your attention this evening are—

1st. The method of the distribution of the blood supply to the enamel organ.

2nd. The arrangement of the cells of the *stratum intermedium* with reference to the blood supply.

3rd. The function of the *stratum intermedium*.

4th. The function of the ameloblasts.

5th. The true structure of the so-called "stellate reticulum."

6th. The modus operandi of enamel formation.

7th. The structure of completely formed enamel.

* This paper, when read before the Royal Microscopical Society, was illustrated by nearly 100 photographs, covering all the points mentioned.

EXPLANATION OF PLATES.

See description on each separate Plate.

8th. The evidences of the method of enamel formation as disclosed by caries of this tissue.

9th. The bearing on various cytological problems of the facts elucidated under the foregoing headings.

Our studies, you will observe, do not begin until the development of the tooth-germ has reached that stage where the formation of enamel is about to begin. It is at this point and at periods a little later that I wish to call your attention to the arrangement of the blood supply to the enamel organ.

The enamel organ, during the earlier stages of its development, is bounded on both its internal and external aspects by a layer of cells derived from the columnar layer of cells of the mucous membrane. Between these two layers is the so-called "stellate reticulum." At the commencement of enamel formation the stellate reticulum forms a large proportion of the bulk of the tooth-germ; but, as development proceeds, this tissue gradually disappears, and the outer layer of columnar epithelium approaches nearer and nearer to the inner layer. In the meantime important changes have been going on in both the outer and inner layers of epithelial cells. The inner cells, originally composed of but a single layer, have divided into two, the outer of the two layers being called the *stratum intermedium*, while the inner layer constitutes the ameloblasts or enamel-forming cells proper. The importance or significance of the changes which take place in the layer of cells on the external surface of the stellate reticulum seems to me to have been largely overlooked. Outside of the external layer of epithelial cells is a kind of connective tissue, and in this connective tissue blood-vessels are developed at an early stage in the formation of the tooth-germ. When the development of blood-vessels has reached that stage in which they form a complete network surrounding the enamel organ, important changes are observed to be taking place in the layer of epithelial cells lying inside and close to this network of blood-vessels. A development of the cells takes place outwardly into the network of blood-vessels in the form of epithelial papillæ. At about the time when these papillæ are well developed, the stellate reticulum has nearly disappeared, and the outer papillary layer of epithelial cells with the accompanying blood-vessels comes in contact and unites with the outer part of the inner layer of cells, or the *stratum intermedium*. In the embryos of some animals, when this union of the two layers of epithelial cells occurs, the cells of the *stratum intermedium* are also entirely converted into epithelial papillæ. In other embryos this does not occur, or only occurs to a limited extent. (See fig. 1.)

Dr. Lionel Beale, the late Prof. Heitzmann, and, I believe, one or two others, claim to have seen blood-vessels developing in the "stellate reticulum." My studies of developing teeth extend over nearly twenty years, during which time I have never yet found a specimen showing the development of blood-vessels in the "stellate reticulum." I have specimens, however, which I believe may possibly explain what has been regarded as a discovery. The connective tissue lying outside of and adjoining the stellate reticulum, being separated from it only by the single layer of epithelial cells referred to, is often so like the stellate reticulum in structure as to be easily mistaken for it under certain circumstances, even by an expert. It is in this connective tissue, which so closely resembles the stellate reticulum, that the blood-vessels are always developed. By some very slight displacement the two tissues might come into actual contact, and thus an error with reference to the point mentioned would easily arise.

The papillary arrangement of the cells of the *stratum intermedium* reaches its highest point of perfection in the persistently growing incisor teeth of the rodents. Here all traces of the *stratum intermedium,* as it has always been figured, completely disappear; and in its place we have an arrangement of papillæ interlocked with loops of capillaries and with larger blood-vessels lying in immediate contact with the outer end of these papillæ. (See fig. 2.)

The structure of completely formed enamel is, as we shall see, made up of two distinct features. I shall be able to show you clearly that the enamel rods or prisms are not composed of a single homogeneous substance, as has always been supposed, but that the basis or substructure of these rods is distinctly fibrous or granulo-fibrous. Into this fibrous matrix the calcific material is deposited. I believe there is the strongest possible evidence, short of absolute proof, that this calcific material of enamel, which is first deposited in the form of an albumen-like fluid, is secreted from the blood-vessels by the papilliform arrangement of epithelial cells which constitute the *stratum intermedium.* We must think of this material as drawn from the blood-supply by cell action. Now, the ameloblasts, which have heretofore been regarded as vested with the entire function of enamel formation, are nowhere in contact with the blood-vessels. Lying between them and the blood-supply we always find the cells of the *stratum intermedium.* If, then, we regard the ameloblasts as the sole enamel-formers, we must think of them as somehow drawing the enamel material from the blood-vessels through the completely passive layer of cells known as the *stratum intermedium*—an extremely improbable phenomenon.

In the absence of positive proof, the highest probability always stands as the strongest form of evidence; and the highest probability seems clearly to be that the cells of the *stratum intermedium* are the first active agents in selecting the calcific material for enamel building from the blood. The gland-like papilliform arrangement of these cells strongly suggests the function, and their immediate contact with the source of supply makes the evidence almost positively conclusive. It is, of course, highly probable that the albumen-like calcific material undergoes some modification in passing through the ameloblasts, but their function with reference to this material is, at most, secondary. (See fig. 3.)

Dr. R. R. Andrews, of Cambridge, Mass., read a paper on enamel formation before the Columbian Dental Congress at Chicago in 1894, in which he describes an appearance of fibres passing from the ameloblastic layer of cells into the forming enamel. Dr. Andrews was the first to describe the fibres which form the organic matrix of enamel, and to him must be given full credit for their discovery; but he was entirely in error as to their origin and ultimate disposition. He thought these fibres had their origin in the *stratum intermedium*, or, possibly, in the connective tissue lying outside of the enamel organ proper. One does not *always* see these fibres passing from the ameloblasts into the forming enamel. When we come to examine the structure of completely formed enamel, we shall see clearly why this is so. There is a great variety in the appearances of the organic basis of the enamel rods, and this variety in appearance corresponds perfectly with differences to be observed in the structure of the cytoplasm of the ameloblastic cells. Occasionally the cytoplasm of the enamel-forming cells is seen to be composed of strings or fibres, sometimes smooth, sometimes granular in appearance, and more or less connected with each other by lateral offshoots. More frequently, however, the cytoplasm of the ameloblasts is seen to be arranged in sections, which sections are more or less globular in appearance, the body of the cell being composed of five or six of these globular sections. The structure of these sections somewhat resembles that of the nucleus of the cells, i.e. it is spongiose in character, with radiating processes by means of which the sections are united to each other longitudinally in the same cell, and, not infrequently, laterally to those in adjoining cells.

The cytoplasm of the cells, in both the fibrous and the sectional arrangement, is seen to be connected with the nuclei; and, from a study both of the cells and of the completely formed enamel rods, we conclude that the substructure of the rods is simply the calcified cytoplasm of the cell; the function of the ameloblasts is therefore to supply this organic matrix or substructure into which the calcific material secreted by the cells of the *stratum intermedium* is deposited.

The exact manner in which the formation of enamel is effected will be very clearly shown in figs. 5 and 6. For many years there have been two opposing theories as to the method of enamel formation. Some of you may remember the controversy between Professors Huxley and Carpenter on this subject, which extended over several years between 1850 and 1860. Prof. Carpenter attempted to show that enamel was produced by direct cell calcification, while Prof. Huxley maintained that it could not be so produced, and that it was the product of the secretion of the enamel organ. Most of the eminent anatomists of the last fifty years have stoutly defended one or other of these two theories. It now seems evident that each of these theories came very near expressing just half of the truth. Enamel seems to be produced by an infiltration of the inner ends of the ameloblasts with the albumen-like calcific material which is secreted from the blood by the cells of the *stratum intermedium.* It appears as though the more liquid portion of the cell structure is replaced by the albumen-like substance containing the lime salts. When the inner ends or sections of the ameloblasts become completely infiltrated, so as to form in appearance a series of globular bodies, they are shed off or become partially separated from the cells, and melt more or less completely into the surface of the forming enamel. I say *partially* separated, because there appears never to be a complete break in the continuity of the cytoplasmic strings or network constituting the organic substructure of enamel. The cytoplasmic strings or fibres pass without break from the ameloblasts into the forming enamel. The process of ripening and shedding off of the globular bodies appears to occur simultaneously over the entire surface of a forming tooth; and in this simultaneous or rhythmic action we probably have a complete explanation of the lines of stratification seen in formed enamel. The Retzius bands are due to pigmentation, and not to imprisoned air entering the ground-off ends of enamel rods, as claimed by Von Ebner. This is very clearly shown in fig. 8, where the enamel rods are seen to pass without break in their continuity completely through the dark bands.

It would perhaps be going too far afield to enter upon a discussion of the methods by which this harmony of cell action is secured. It is one of the great problems of biology ; and I shall do no more on the present occasion than to suggest that in this particular instance simultaneous cell action may be secured through the medium of the protoplasmic processes or threads which, passing from one cell to another, are everywhere seen to unite not only the ameloblasts but also the cells of the *stratum intermedium.*

The organic substructure of enamel is formed by the continual outward growth of the ameloblast, the cells as they grow outward continually shedding off their infiltrated inner sections, so that the length of the ameloblast is maintained with considerable regularity throughout the entire process of enamel formation. There are, however, not infrequently to be seen marked exceptions to this rule; the ameloblasts over a certain area sometimes appear to become rapidly engorged with the calcific material, and the ends of these particular cells are shed off more rapidly than are those of the surrounding cells, and more rapidly than the outward growth of the cell can occur; so that the result is that these particular cells are for the time made much shorter in appearance than the neighbouring cells.

The "stellate reticulum" has always been represented as composed of triangular or stellate-shaped cells united by long processes. Such an arrangement leaves a large amount of space between the cells unaccounted for. The stellate appearance in this tissue, as shown in ordinary balsam-mounted specimens, is largely produced by shrinkage. The interior of the enamel organ is really composed of large irregularly round cells, which are modifications of the cuboidal layer of epithelial cells. These cells are apparently very soft and watery; and, being very large, the manipulation and chemical treatment necessary for mounting in balsam causes a complete evacuation of the cell contents and shrinkage of the intercellular substance. I cannot conceive that the points of intersection of the reticulum containing nuclei represent anything else than the corners of the larger cells which contain nuclei, and which, because of the small area, are not washed out in the treatment of the section. Any other view makes it necessary to account for the development of two totally distinct sets of cells from the original cuboidal layer.

The appearances seen in sections of mature enamel confirm the views I have just presented, as to the methods of formation of this tissue. I have said that the structure of the cytoplasm of the ameloblasts varies markedly. Scarcely two specimens can be found in which the structure of the cells is exactly alike; but all of the observed differences may be broadly classed under two headings—cells in which the cytoplasm is arranged in sections, and others in which the cytoplasm is in the form of continuous parallel strings or fibres united by offshoots. We shall find that one or other of these two forms is usually to be seen as the calcific organic matrix of the completely formed enamel rod.

Passing now from our study of normal or sound enamel, let us for a few moments examine the appearances of decaying enamel; for I think we shall find that caries of this tissue throws an important side light on the problems we are considering. If a section of enamel be treated for a short time with lactic acid, the appearances are such as are shown in the photograph now on the screen. In photographs of decaying enamel or enamel sections treated with acids, we find the rods sometimes split or separated into sections by the dissolution of the cement substance. In other specimens, when the cement substance is dissolved, there remains nothing but the calcified plasmic strings, which also finally disappear under the continued action of the acid.

In conclusion, I wish to call your attention to the bearing which the structure of fully formed enamel, and the relation of this structure to that of the cytoplasm of the ameloblast, have upon some of the more recent problems of cytology. There are at present, as you are all doubtless aware, two theories concerning the structure of protoplasm, one or other of which is accepted by most of the leading histologists. One is the foam or alveolar structure theory of Bütschli, and the other that advocated by Fromann, Arnold, Fleming, and probably by much the greater number of contemporary investigators. This view teaches that the more solid portions of the cell structure consist of coherent threads, strings, or fibres, which everywhere pervade the ground substance, either separately or united by offshoots, and generally combining to form a meshwork, reticulum, or spongiose structure.

The threads of the meshwork or reticulum have often been observed to be granular; and this appearance has led to another theory, which has been especially developed by Altmann, teaching that these granules (now generally termed microsomes) are actually bioblasts or organic units capable of assimilation, growth, and division, and constituting the elements out of which the fibres or threads are formed. The suspicion that these various features may to a considerable extent be due to the action of the reagents used in the treatment of the tissues has stood in the way of a complete acceptance of the views mentioned. Prof. Wilson, in treating of the structural basis of the cells, says of these granular fibres, "The difficulty is to determine whether this appearance represents the normal structure, or is produced by a coagulation and partial disorganisation of the threads through the action of the reagents. . . . It is very difficult to determine this point in the case of the cyto-microsomes, owing to their extreme minuteness. The question must, therefore, be approached indirectly by way of an examination of the nucleus and its relation to the cytoplasm. Here we find ourselves on more certain ground, and are able to make an analysis that in a certain measure justifies the hypothesis that the cyto-microsomes may be true morphological elements having the power of growth and division like the cell-organ formed by their aggregation." It will be seen from this quotation that Prof. Wilson is strongly inclined to regard the granular appearance of the cytoplasmic threads as a true structural feature.

Van Beneden, in speaking on the same subject, expresses himself in a much more positive manner. He says, "In my opinion every fibrilla, though it appear under the Microscope as a simple line devoid of varicosities, is formed at the expense of a moniliform fibril composed of microsomes."

I believe my studies of the structure of the enamel rod enable me to throw a little light on these difficult problems. We have seen in the calcified organic matrix composing the basis of the enamel rod, every structural feature to be observed in the cytoplasm of the ameloblast; and we may conclude, as I have previously remarked, that this calcified matrix faithfully represents the cytoplasmic structure of the cells. There is here no question about effects produced by chemical reagents. The calcification of the cement substance of the enamel has most perfectly preserved the minutest structural features of the cytoplasm. With the finest lenses and an amplification of from 2500 to 3000 diameters, we are able in nearly every instance to resolve the fibres composing the calcified organic matrix of the enamel rods into a continuous thread of granules. And we observe further that, although these granular threads form a fairly constant feature in the structure of the enamel rod, yet there is aside from these a very great variety in the structural appearances of the organic matrix even within the limits of normality. Prof. Wilson, in speaking of the varied appearance of the cytoplasmic network, suggests that it represents different physiological phases of the cell. He says, "It is possible, nay probable, that in one and the same cell a portion of the network may form a true alveolar structure, such as is described by Bütschli, while other portions may, at the same time, be differentiated into actual fibres." This view is, as we have seen, strongly confirmed by the appearances of the enamel rods. Following the course of an enamel rod, we often find that for some distance the matrix is entirely composed of parallel threads, and that this form of structure suddenly changes into one made up of sections of an alveolar or spongiose character.

The paper which I read before the Royal Society was subsequently extended for publication in an American journal; and in this extended form I suggested that the bodies somewhat resembling the nucleus in structure, which are frequently to be observed throughout the entire length of the ameloblasts, had their origin in the nucleus. I fear this suggestion was generally regarded as an unwarrantable speculation. Since that time Prof. Wilson's book on the cell has appeared, and from that I quote the following passage bearing upon this point. He is speaking of the evidence that a part of the egg cytoplasm in the eggs of Amphibia, Echinoderms, and some worms, is directly or indirectly derived from the nucleus, and he says: "A large number of observers have maintained that a similar giving off of solid nuclear substance occurs during the earlier stages of growth; and these observations are so numerous and some of them are so careful, that it is impossible to doubt that this process really takes place. The portions thus cast out of the nucleus have been described by some authors as actual buds from the nucleus." The mass of the evidence, Prof. Wilson says, goes to show that these eliminated nuclear materials are to be regarded as food-matter or *formative substances.* This was precisely my suggestion with reference to the spongiose globular bodies which appear in the cytoplasm of the ameloblast; and it was made more than a year before the publication of Prof. Wilson's volume, nor did I know until I read this book that similar suggestions had been made by other investigators.

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.†

Experimental Embryology.‡—Prof. O. Hertwig subjected fertilised ova of *Rana esculenta* to the influence of rapid rotation, and observed the remarkable "Mechanomorphoses" induced by the centrifugal force. The apparatus described 145 rotations per minute; some of the ova, those most under the influence of the centrifugal force, failed to develop at all; others, only slightly influenced, developed normally; a third set, 24–32 cm. from the centre, developed almost meroblastically. This interesting result was apparently due to an artificial accentuation of the normal polar differentiation of the frog's ovum. Left in the machine they did not develop beyond the blastoderm stage; but if transferred within 24–48 hours to normal conditions, they developed into embryos, some of which showed the frequent *spina bifida* abnormality.

Removal of Shell from Developing Ova.§—M. Ch. Féré has succeeded in directly observing the development—which tends to be abnormal—of eggs from which the shell has been wholly or partly removed. He tried three methods:—(*a*) opening the upper side and replacing the shell by a watch-glass; (*b*) opening the posterior end (Béguelin's method) and re-covering it with part of a shell from another egg; (*c*) placing the whole egg without its shell in a glass vessel. Two results are clear—that the embryo has more power of resistance to such disturbances than is usually supposed, and that the method is useful in experimental teratological work.

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

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

‡ SB. K. Preuss. Akad. Wiss., 1897, pp. 14–18 (1 fig.).

§ Journ. de l'Anat. Physiol., xxxiii. (1897) pp. 259–66.

Protoplasmic Connections between Blastomeres.* — Prof. J. A. Hammar finds that blastomeres are, in many cases, not quite isolated from one another, but are connected more or less definitely by protoplasmic bridges. He finds this in Cœlentera (*Cyanea capillata*, *Aurelia aurita*, *Actinoloba dianthus*); in Worms (*Pomatoceros triqueter*, *Prostheceræus vittatus*, *Malacobdella grossa*); in Echinoderms; in Molluscs (*Æolis papillosa*); in Tunicata (*Clavelina lepadiformis*, *Ciona intestinalis*); and in other cases.

Mesoderm and Body-Cavities.†—Dr. T. H. Montgomery, jr., comments upon the multifarious development of the mesoderm. It may arise from the ectoderm, from the endoderm, or from both; it may arise from the endoderm by multipolar delamination, by unipolar delamination, or in the form of epithelial diverticula; its origin is further complicated in meroblastic ova. Moreover, mesoderm and mesenchyme are but extremes of a series.

As to the cavity enclosed by the mesoderm, it may be derived from archicœl or from gastrocœl; and it is interesting to inquire where a morphological distinction can be drawn between, for instance, the archicœlic cœlome of an Annelid and the gastrocœlic cœlome of a lancelet. The author discusses such questions, and concludes that particular differentiations of body-cavity cannot be safely homologised with similarly situated cavities in other groups. Not even apparent similarity of development can be relied on; for the early development and differentiation of the cavities must be referred, directly or indirectly, to the modes of cleavage and gastrulation, which often differ widely in closely allied forms. Indeed, before seeking to homologise the body-cavity, the morphological value of the organs and their mutual topography must first be determined.

Epitrichium of the Chick.‡—Herr B. Rosenstadt, in his studies on cornification, has been led to investigate the epitrichium of the chick, i.e. those cells on bill, scales, &c., in which both nucleus and cytoplasm are subject to kerato-hyaline degeneration. He concludes that the epitrichium represents a phylogenetically primitive state, a *Vorstufe* of the *stratum corneum*, just as keratohyalin may be said to bear the same relation to horn. In Mammals also this phylogenetic survival may recur; but the formation of horn is entirely independent of that of keratohyalin.

b. Histology.

Relation between the Form and the Metabolism of the Cell.§ Dr. M. Verworn gives illustrations from Protozoa, &c., to show the dependence of cell-form on its chemical relations with the surrounding medium. Thus it is well known that with the withdrawal of oxygen the formation of pseudopodia ceases, and many other cases are familiar.

Cell-Boundaries.‖—Prof. Ch. van Bambeke discusses the question of cell-boundaries in animals, and the meaning of the term cell-membrane.

* Arch. f. Mikr. Anat., xlix. (1897) pp. 92–102 (1 pl.).
† Journ. Morphol., xii. (1897) pp. 355–66.
‡ Arch. f. Mikr. Anat., xlix. (1897) pp. 561–85 (1 pl.).
§ Sci. Progr., April 1897, pp. 370–78 (1 fig.).
‖ Bull. Soc. Belge de Microscopie, xxiii. (1897) pp. 72–87.

After sketching the various views held by prominent histologists, he proposes a classification, which, though tedious, will be useful.

A. Cell bounded by a layer with single contour:—
The surface (Dujardin, 1848);
The contact membrane (Max Schultze, 1863);
The plasmic membrane (Pfeffer, 1890);
The protoplasmic membrane (Delage, 1895).

B. Cell bounded by a layer with double contour:—
(1) *Soft and plastic.*
The limiting or enveloping layer (Fol, 1879);
The Grenzschicht, zona limitans (His, 1897).
(2) *Resisting and inert.*
True cell-membrane (Waldeyer, 1895);
The dead envelope (His, 1897);
The cuticular membrane (Delage, 1895).

With this paper, that by Prof. F. E. Schulze* should be compared.

Plasmocytes.†—Dr. Gustav Eisen has made an elaborate study of the blood of *Batrachoseps attenuatus*, a Batrachian common in California. The red cells vary enormously in size and shape, and very few of them are nucleated. But the most interesting feature of the blood is the presence of a new corpuscle, which Dr. Eisen has termed *plasmocyte.* He seeks to show that these plasmocytes are the remnants of the extra-nuclear part of fusiform corpuscles, which are remnants of erythrocytes; that the plasmocytes consist of the archosome—archoplasm and centrosomes—which has survived, while the nucleus has been destroyed; that this archosome has surrounded itself with various envelopes of cytoplasm; and that the plasmocytes have thus become free and independent elements of the blood. The present paper deals only with *Batrachoseps*, but the author has also found the plasmocytes in *Phrynosoma*, *Diemyctylus*, and in man.

The plasmocyte may be defined as a corpuscle, generally without a cell-wall, always without a nucleus, consisting of the archosome and three spheres of cytoplasm. It shows powers of growth, movement, phagocytosis, &c.

Distinction between Leucoblasts and Erythroblasts.‡—Prof. A. Trambusti makes some observations on the extreme difficulty of distinguishing between the young stages of red and white blood-corpuscles, and considers the various differentiating characters suggested by Van der Stricht, Bizzozero, and others. He has found a secure differentia in the presence of granulations in the leucoblasts and leucocytes, demonstrable by double staining with safranin and indulin, or with thionin and eosin.

Sympathetic Ganglion-Cells.§—Dr. A. J. Juschtschenco finds great uniformity in the sympathetic ganglia of Mammals. The cells are especially multipolar, with an axis-cylinder process and many proto-

* Cf. this Journal, 1896, p. 607.
† Proc. California Acad. Sci., i. (1897) pp. 1–72 (2 pls.).
‡ Bull. Acad. Roy. Belg., xxxiii. (1897) pp. 333–41 (1 pl.).
§ Arch. f. Mikr. Anat., xlix. (1897) pp. 585–607 (2 pls.).

plasmic processes. The latter end either in "nids pericellulaires" (Ramon y Cajal) on adjacent cells, or freely between these. The neurites of the sympathetic cells pass out without dividing, and only rarely give off characteristic collaterals. The entrant fibres are distinguishable from those which pass out; they end in fibrous branching around the ganglion-cells and their protoplasmic processes. These fibres also send nerves to the vessels. In general form the sympathetic ganglion-cells are not essentially different from those of the cerebro-spinal axis.

Plasticity of Cerebral Neurones.*—Dr. J. Demoor gives an interesting description of the moniliform state exhibited by the prolongations of the cerebral neurones when subjected to various kinds of excitation. The transformation of a nervous branch into a moniliform filament involves considerable modifications in the multiple contacts which the cells have established *inter se*. It results in a relative individualisation of the neurones, which tends to lessen the association of individual cell activities. It may be connected with fatigue and sleep. In any case the histological change is evidence of the sensitive plasmic plasticity of the neurones.

c. General.

Problems of Nature.†—Dr. G. Jaeger has, during the last thirty years, made many suggestive contributions to general biology, e.g. in regard to the continuity of the germ-plasm, which are not so well known as they should be, except in so far as biological progress has absorbed and outstripped them. In some instances, the idiosyncrasies of this biologist have obscured his indubitable merits of originality. But he has recently found an enthusiastic editor, translator, and exponent in Dr. H. G. Schlichter, and the volume before us contains representative selections from Jaeger's writings. As such it is very welcome. The zoological part deals with the origin and development of the first organisms, protoplasm, the laws of development, the origin of species, sexual selection, pangenesis, inheritance, the influence of gravity, &c.; and the whole is at once suggestive and entertaining. The editor takes some extraordinary liberties with the English language, and gives himself away unreservedly in a glossary (after Gould). It is also regrettable that a selection of this sort—obviously executed *con amore*—should not have a more adequate bibliography. There should at least have been clear indication of the proportions which the selections bear to the original papers, and where these original papers are to be found. The page at the end of the book is quite insufficient.

Chances of Death.‡—Prof. Karl Pearson has published a work, the first volume of which must rank high among recent contributions to evolution-theory. The book consists of a collection of twelve essays, five of which are reprints; several are of more interest to the sociologist and psychologist than to the biologist in the limited sense. The

* Arch. Biol., xiv. (1896) pp. 723–52 (12 figs.).

† 'Problems of Nature. Researches and Discoveries of Gustav Jaeger, M.D., selected from his published writings. Edited and translated by Henry G. Schlichter, D.Sc.' Williams and Norgate, 8vo, London, 1897, 261 pp.

‡ 'The Chances of Death, and other Studies in Evolution,' 2 vols. 8vo, London and New York, 1897, ix., 388, and 460 pp., illustrations.

most important from the latter point of view are those on the chances of death, reproductive selection, and variation in man and woman.

In the first the mortality frequency for age curve is given. It is analysed into five components of chance distributions of mortality centering round five distinct ages of life—old age, middle age, youth, childhood, and infancy—the latter extending backwards to some nine months before birth. The skewness of distribution varies for each of these ages. The several mortalities are—484, 173, 51, 41, and 24 per 1000 respectively.

Reproductive selection is the increase in fertility that must be the necessary consequence of the inheritability of fertility, so long as the increasing fertility is not correlated with any detrimental character that would be held in check by natural selection. On the other hand, if there be any neutral characters correlated with fertility, then the inevitable cumulation of fertility results in an appearance of a definitely progressive variation of such neutral characters. Thus a possible explanation is afforded of the definite variations of many authors. For instance, stature seems to vary with fertility in woman; this would tend to raise the height of the race about 3 inches in 1000 years. But, as a matter of fact, the death-rate of large families is higher than that of small families. Thus natural selection checks reproductive selection in man. There is a differential fertility in the classes of human society, but natural selection, or at any rate a differential death-rate for the classes, checks here also the effects of a reproductive selection. Indeed, it tends to reverse those effects. On the other hand, there is a differential marriage rate for the classes. The total effect of these three interacting causes is that, on the whole, society is recruited rather from the artisan class than from the commercial or professional classes.

The current doctrine that the male is more variable than the female is a pseudo-scientific superstition. The statistics by which the hypothesis has been supported have been mainly drawn from data relative to pathological conditions, some even from the investigation of characters that are in reality secondary sex characters. The data are always inadequate, if not inadmissible. Skull measurements give reliable data. They may be collected at random, so as to yield fair samples of the population. They are related to the brain, which is so significant in human evolution. Absolute relative variability has often been taken as the criterion, rather than the comparison of the coefficients of variation. The examination of 17 groups of measurements of different parts of the body shows that in 11 groups the female is more variable than the male, and in six the male more than the female. The differences of variability are slight; less than that between members of the same race living in different conditions. Such as it is, it is probably due to a difference in the severity of the struggle for existence.

Ontogeny and Phylogeny.*—Prof. A. Hyatt entitles his paper 'Cycle in the life of the individual (Ontogeny), and in the evolution of its own group (Phylogeny).' In the introductory portion he has an interesting historical note on Oken's (1805) prevision of the cell-theory, and on Meckel's (1811) early statement of recapitulation doctrine. He

* Proc. Amer. Acad., xxxii. (1897) pp. 209-24.

continues the history to Von Baer and Louis Agassiz, and onwards. After re-stating his own terminology, Prof. Hyatt expresses his conviction that "the cycle of the ontogeny is the individual expression and abbreviation recapitulation of the cycle that occurs in the phylogeny of the same stock; and, while the embryonic, nepionic, and neanic stages give us, in abbreviated shape, the record of the epacme, the gerontic stages give, in a similar manner, the history of the paracme." The author also expounds the law of acceleration in the inheritance of characters, or tachygenesis. It has been found that characteristics are inherited in successive species or forms in a given stock at earlier and earlier stages in the ontogeny of each member of the series. This law is called "the crawling, walking, hopping, skipping, and jumping law."

Nocturnal Protective Coloration.*—Mr. A. E. Verrill discusses the nocturnal protective coloration of mammals, birds, fishes, insects, &c. He notes the prevalence of black, dark-brown, and grey among animals of nocturnal habit, and points out the great protective value of these colours, especially when they are broken up by patches of white or light yellow, thus obscuring the outlines of the animal and giving the effect of patches of moonlight on a shadow. The colours of many butterflies, conspicuous during the day, blend so well with the flowers on which they rest at night, that they are not readily distinguishable from them even in bright moonlight. The markings of tiger, leopard, jaguar, &c., are much more effective for concealment in the dusk than by day. In the second part of his paper, Mr. Verrill records his observations on colour-changes in fishes, and in the common squid during sleep. Some species of fishes while asleep have colours very different from those seen in the daytime, and very many show a marked increase in intensity or contrast of colours. The scup or porgy (*Stenotomus chrysops*) is silvery during the day, with a pearly iridescence, but at night it becomes a dull bronze or grey, with transverse black bands. The common squid at night takes on its darkest colours. It has the power of changing its colours at will, but its nocturnal colour is probably automatic and protective.

Air and Life.†—Dr. H. De Varigny has translated his essay on 'L'Air et la Vie,' which gained a Smithsonian prize. He deals first with the air from a chemical and physical point of view, and then passes to the biological rôle of the various constituents considered both chemically and physically. The essay combines in attractive form much useful information, e.g. as to anaerobic organisms, the rôle of micro-organisms in the assimilation of atmospheric nitrogen, the effects of altered pressure, the biological rôle of substances suspended in the atmosphere, and so on.

Some Questions of Nomenclature.‡—Dr. Th. Gill took this as the subject of his address to the Zoological Section of the American Association. He discusses the history of nomenclature, the "Draconian code" provided by Linnæus and Artedi, the misapplication of names, the variations of names, the making of names, and so on. The latter part of the address considers the various ways of stating the grades of classification from phylum to variety.

* Amer. Nat., xxxi. (1897) pp. 99-103.
† Smithsonian Misc. Coll., 1071 (1896) 69 pp.
‡ Proc. Amer. Ass. Adv. Sci., xlv. (1896 meeting) 1897, pp. 135-65.

Influence of the Gradual Cooling of the Globe on Evolution.*—M. R. Quinton believes that the general cooling of the globe has been a factor of capital importance in animal evolution. Those forms have succeeded which have been best able to sustain their internal temperature. Thus the bird's organisation is in this respect far superior to that of Mammals; and the class is much more successful. Even in detail, in a particular series, say of Mammals, the progressive perfecting of the respiratory system can be traced.

Evolution of Head-Scales in Boidæ.†—Dr. H. C. E. Zacharias has made a study of this subject, which we cite here for its evidence of "a hundred per cent. variability"—no two cases being the same—and for its theory of the import of movements and pressure as determinants in the evolution of scales in general.

Function of the Lateral Organs.‡—Dr. H. Stahr relates his observations on the habits of *Polyacanthus* (*Macropus*) *viridiauratus*—the well-known Chinese Macropod—particularly as regards their sexual by-play. He was much impressed by the part which tactile sensations seemed to play as sexual stimuli, and his suggestion is that an important function of the lateral line system may be to receive stimuli produced by the elaborate movements. As he says, the sexes communicate with one another partly by the lateral organs.

Freshwater Fauna of South Africa.§—Prof. Max Weber gives some of the results of his exploration in 1894, especially as regards the freshwater fishes, molluscs, and crustaceans. He begins with a brief sketch of the different regions—Savanna, Erica or Protea, Karroo, and Kalahari—with particular reference to the fauna. One of the peculiar conditions is, what may be called the periodicity of many of the rivers; one of the most striking and doubtless correlated results is the sparseness of the freshwater fauna.

Weber classifies the freshwater fauna as follows:—

1. Universal freshwater animals.
2. Regional freshwater animals.
    a. Local or autochthonous.
    b. Of marine origin, (1) relicts, and (2) immigrants.

The south-west portion of South Africa has faunistic peculiarities which point (*a*) to an ancient independence (and connection with other circumpolar southern regions), and (*b*) to a subsequent union with the rest of Africa by which the faunistic unity has been lost.

New Amphioxus.‖—Dr. A. Willey notes among his zoological observations in the South Pacific, the occurrence of a new lancelet—*Asymmetron caudatum* sp. n. It seems more closely allied to *A. lucayanum* Andrews—located upwards of 8000 miles away in the Bahamas—than to its relatives in Torres Straits, less than 600 miles away.

The characteristic generic features verified in this new species are the following. The right metapleur is continuous with the ventral fin; the latter has no fin-chambers and no fin-rays; the right and left

* Comptes Rendus, cxxiv. (1897) pp. 831–4 (3 figs.).
† Zool. Jahrb. (Abth. Syst.), x. (1897) pp. 56–90 (4 pls., 3 figs.).
‡ Biol. Centralbl., xvii. (1897) pp. 273–82.
§ Zool. Jahrb. (Abth. Syst.), x. (1897) pp. 135–200 (1 pl.).
‖ Quart. Journ. Micr. Sci., xxxix. (1896) pp. 219–31 (1 pl.).

metapleura pass equally into the rostral fin in front; an intertentacular membrane is present between the ventral buccal cirri; the buccal cirri are plain; and lastly, there is a pair of very short postatrial cæca.

In addition to the length of the body and the number of myotomes, an important specific feature of *Asymmetron caudatum* is the rostral fin, which is marked off from the dorsal fin by a constriction. There is a distinct caudal fin extending to the posterior extremity.

INVERTEBRATA.

Hard Parts of Invertebrata.*—Mr. L. P. Gratacap, in an essay on "fossilisation," gives the following summary in regard to the hard parts of Invertebrates. The calcareous Foraminifers are composed of calcite, with some aragonite. True corals are composed almost entirely of aragonite. Alcyonarians contain for the most part calcite, with small amounts of aragonite and phosphate of lime. Echinoderma and many Annelids have their tests or tubes composed of calcite. Crustacean shells contain varying intermixtures of calcite and phosphate of lime. Bryozoa have cases composed of a mixture of calcite and aragonite. Brachiopods have shells of calcite and some phosphate, the latter almost restricted to the Inarticulata. In some bivalves the shells are wholly composed of aragonite; in oysters and scallops, of calcite; in *Mytilus* and *Pinna*, the outer layer is calcite, the inner aragonite.

New Discoveries in the Mammoth Cave.†—Dr. R. Ellsworth Call has made some additions to the list of forty or so species which Dr. Packard described in his monograph in 1889. Without exception, the seven new forms are very minute, which explains their late appearance in the faunistic list of this much-studied cave. There are two new Thysanura, *Entomobrya cavicola* Banks, and *Smynthurus mammouthia* Banks; a new Psocid, *Dorypteryx hageni* Banks; two new Acarina, *Rhagidia cavicola* Banks, and *Linopodes mammouthia* Banks; a new Dipteron, *Limosina stygia* Coquillet; and a new Gasteropod, *Corychium stygium*. Some new fungi were also found, e.g. *Coprinus micaceus*.

Distribution of Marine Organisms.‡—Dr. A. E. Ortmann criticises a recent lecture by Dr. John Murray. (1) Ortmann denies the great resemblance between Arctic and Antarctic organisms; (2) he points out that pelagic larvæ are *not* absent from the cold polar waters; (3) he maintains that the true limitation of life-regions in the sea is according to conditions of illumination, and not by the mud-line or the like; (4) he notes that the deep-sea fauna *does* include some very ancient types, like the Eryonidea among Decapods.

Mollusca.

Pulsations of the Heart in Molluscs.§—Mr. F. C. Baker has examined 39 species of Bivalves and Gasteropods in reference to the pulsations of the heart. In some species it is very constant, in others

* Amer. Nat., xxxi. (1897) pp. 285–93.
† Tom. cit., pp. 377–92 (2 pls.).
‡ Zool. Jahrb. (Abth. Syst.), x. (1897) pp. 217–8.
§ Journ. Cincinnati Soc. Nat. Hist., xix. (1897) pp. 73–8.

very erratic. The more active the species, the larger is the number of pulsations. The average for bivalves is 22 beats per minute, the minimum 10, the highest 36, excepting *Sphærium stamineum* with 57; the average for Gasteropods is 98, the lowest 50, the highest 162. In hibernation the pulsations are reduced almost to nothing.

α. Cephalopoda.

Notes on Nautilus.*—Dr. A. Willey directs attention to the special pre-ocular and post-ocular tentacles in *Nautilus*. The ordinary non-ciliated tentacles adhere to surfaces by the suctorial ridges on their lower and inner sides, and they also seize food. The ciliated ocular tentacles, white in colour with a little brown pigment, are probably accessory olfactory organs associated with the rhinophore which lies directly below the eye. In *Nautilus* the food is found by smell rather than by sight.

Dr. Willey has demonstrated the presence of vibratile cilia on the sensory epithelium of the outer osphradia and the post-anal papillæ, which confirms his view that the latter represent a pair of *inner* osphradia.

The Florida Sea-Monster.†—Mr. A. E. Verrill described, on the strength of photographs and local reports, part of the mutilated body of what seemed to be an octopus of gigantic size. Examination of the tissues shows that they belong to a whale, probably a sperm whale!

γ. Gastropoda.

Structure and Affinities of Pleurotomaria.‡—MM. E. L. Bouvier and H. Fischer discuss some structural features of these interesting forms. As old as the oldest Trilobites, they have persisted until to-day, though living specimens have only been found twice. The species described (*Pl. quoyana*) belonged to the *Blake* collection. In some respects it is normal enough, resembling Haliotidæ or Trochidæ in the position of its sense-organs, as to its buccal mass, its musculature, its cerebral ganglia, &c. It is distinguished (1) by the feeble development of the epipodium; (2) by the peculiar development of the branches of the visceral commissure which arise from the cerebro-pallial connectives about the middle of their course; and (3) by the structure of the scalariform nerve-cords in the foot. There is a superior pallial portion, which agrees with the pallial cords of the Placophora, and an inferior, the pedal portion, which resembles the pedal cords of the same. Thus the pallio-pedal cords of *Pleurotomaria* may be regarded as the result of the concrescence of the pedal cords with the *ganglionic portion* of the pallial cords; and the type illustrates the first stage of a ganglionic concentration which becomes more and more accentuated as we ascend the Gasteropod series.

Multiple Reno-Pericardial Canals in Elysia viridis.§—Dr. E. Hecht recognises the correctness of Pelseneer's observation that there are several reno-pericardial canals—a unique character—in *Elysia viridis*.

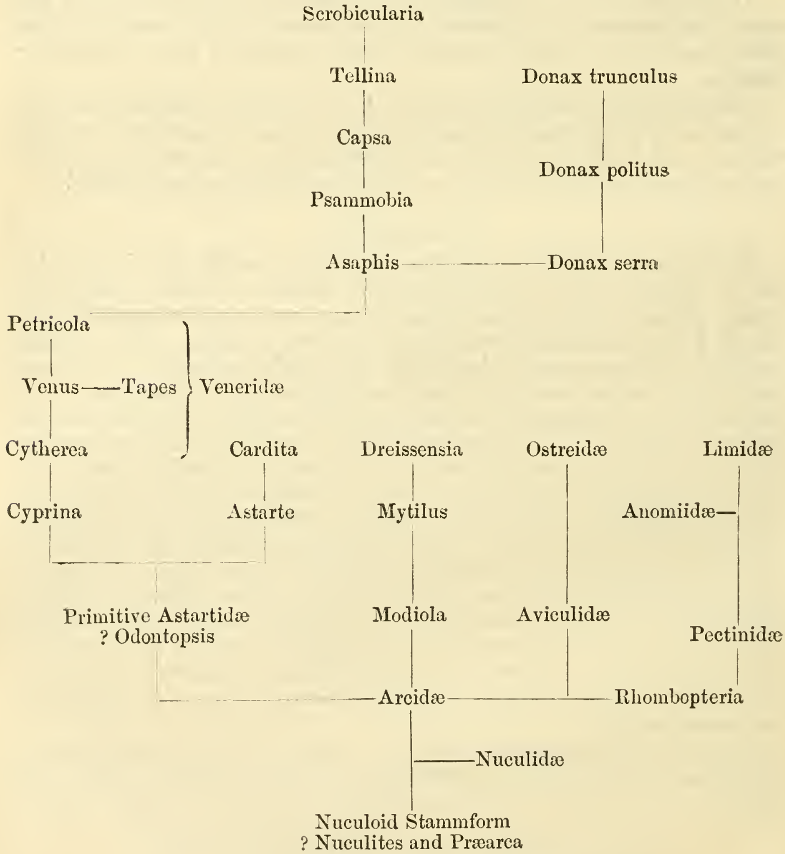
* Quart. Journ. Micr. Sci., xl. (1897) pp. 197–201 (1 pl.).
† Amer. Nat., xxxi. (1897) pp. 304–7 (2 pls.).
‡ Comptes Rendus, cxxiv. (1897) pp. 695–7.
§ Bull. Soc. Zool. France, xxii. (1897) pp. 66–7.

He had previously described a single canal; but, prompted by Pelseneer, has made further observations which have convinced him that they are multiple.

δ. Lamellibranchiata.

Clasmatocytes in Lamellibranchs.*—M. J. Chatin describes peculiarly large cells which occur in the lacunar tissue of oysters, scallops, fresh-water mussels, &c. They measure from 100 μ to 300 μ, are rounded, branched, or claviform, show a granular plasma, and emit large prolongations which habitually break off. They are comparable neither to the "cells of Leydig," nor to the Mastzellen of Ehrlich, but to the clasmatocytes which Ranvier first described in Vertebrates.

Classification of Lamellibranchs based on the Gills.†—Mr. E. L. Rice has made an elaborate study of the gills as a basis for classification, and has reached conclusions somewhat different from Pelseneer's. His scheme of relationships is the following:—



* Comptes Rendus, cxxiv. (1897) pp. 693–5.
† Jen. Zeitschr. f. Naturwiss., xxxi. (1897) pp. 29–89 (2 pls.).

Embryonic Shell of Bivalves.*—M. Félix Bernard describes the embryonic shell or "prodissoconque" in a number of Lamellibranch types. The stage which shows it is well marked, it is a period of rapid embryonic growth and differentiation, it is terminated by a short period of arrest. He argues that the larva with the prodissoconque represents an ancestral type—with its two adductors, its pedal muscles, its three pairs of ganglia, its creeping foot, its mantle with free lobes and no siphon, its gills situated far back, its velum, and so on. Antecedent to the prodissoconch is the *protostracum* without cardinal differentiation, as seen in the Glochidium larva; this earliest stage he has succeeded in demonstrating at the apex of all the prodissoconques studied.

Arthropoda.

Appendages of Arthropods.†—Herr A. Jaworowski returns to his theory that Arthropod appendages [and gills in Crustacea] are referable phylogenetically to respiratory insinkings of the skin. Anatomical, developmental, and pathological facts all seem to him to point to the conclusion that mouth-parts, limbs, wings of insects, eye-stalks of Crustacea, &c., are referable to primitive folded lung-like insinkings of the skin. His arguments do not appear to us in any way conclusive, but they are of the sort often used in speculative phylogenetic studies, and are nothing if not ingenious. They lead him to renewed confidence in the unity of the Arthropod *Urstamm*.

α. Insecta.

Aquatic Insects of the Illinois River.‡—Mr. C. A. Hart publishes the first paper of a memoir on the insect fauna of the Illinois River and adjacent waters. It is designed partly as a basis for further work, and partly for the use of Illinois students. It is admirably conceived as a faunistic guide, giving prominence to the nutritive and other bionomical relations of the forms described, and to their life throughout the year.

Myasis of Alimentary Canal in Man.§—Dr. P. Lallier has published his thesis on this subject. He has compiled a very complete record on the subject, and furnishes a useful bibliography. There is no doubt that larvæ of *Anthomyia*, *Sarcophaga*, *Musca*, *Calliphora*, *Teichomyza*, &c., may live for some time in the food-canal of man. The author discusses their introduction, effects, and distribution, and the medicinal treatment of cases.

Viviparity in Ephemerids.‖—Dr. R. Heymons directs attention to M. Causard's ¶ observation of viviparity in *Clœopsis diptera* Latr., and points out that von Siebold noted the viviparous birth of an Ephemerid in 1837, and Calori (in *Clœon dipterum*) in 1841. Causard's observation is very welcome, but not altogether novel. Heymons notes further that viviparity may be more frequent in southern regions, for *Clœon dipterum* is demonstrably oviparous in Berlin.

* Comptes Rendus, cxxiv. (1897) pp. 1165–8.
† Zool. Anzeig., xx. (1897) pp. 177–84 (3 figs.).
‡ Bull. Illinois Lab. Nat. Hist., iv. (1897) pp. 149–284 (15 pls.).
§ 'Étude sur la Myase du tube digestif chez l'homme.' Thèse. 8vo, Paris, 1897, 120 pp., 1 pl.
‖ Zool. Anzeig., xx. (1897) pp. 205–6.
¶ Comptes Rendus, cxxiii. (1896) p. 705.

Luminosity of Glowworms.*—Dr. H. Muraoka has studied the physical character of this light. In its natural state it behaves like ordinary light. The filtered rays, like Becquerel's fluorescence rays, seem to have characters midway between ultra-violet rays and Röntgen rays.

Seasonal Dimorphism in African Butterflies.†—Mr. A. G. Butler returns to his thesis, in answer to some criticisms by Mr. G. A. K. Marshall.‡ His point is this :—"In a country which is hot and dry throughout the year, wet-season forms will be naturally extremely rare (if present at all), whereas the reverse will be the case in a uniformly moist climate. Now, where a species ranges throughout Africa to Arabia, it exhibits in one locality a single type (say dry-season), and perhaps in abnormal seasons, when light showers fall, a second type (intermediate between dry and wet); or, if the country be moist, a wet-season and an intermediate-season form occur, but no dry-season form."

Zeuzera Æsculi.§—M. Laboulbène describes the caterpillar of this butterfly. It is a borer and wood-eater, and has been doing much damage to trees in Morocco.

Optic Lobes of Bee's Brain.‖—Mr. F. C. Kenyon gives an account of the minute structure of these bodies. It is too complex to be profitably summarised without a diagram; but the following sentence may be cited :—"It appears that, setting aside the outer or retinal elements, there are concerned in the transmission of visual stimuli to the central portion of the brain some six or seven neural elements, and that such stimuli may reach (1) the optic body, (2) the mushroom bodies, and (3) the hinder lower portion of the brain, and that they may pass over one or other of the optic commissures—provided the upper one is a real commissure—to the inner fibrillar body of the opposite lobe, and thus indirectly reach the mushroom bodies, the optic bodies, and the posterior region of the brain on the opposite side."

Danish Galls.¶—Sofie Rostrup gives a list of the Danish gall-forming animals and of the plants infested. The list includes, besides insects (Coleoptera, Hymenoptera, Lepidoptera, Diptera, and Phytophthires), a number of Acarina and Nematoda.

Odonate Nymph from a Hot Spring.**—Mr. D. S. Kellicott notes the occurrence of dragon-fly nymphs in a hot spring. The exact temperature at the time and place of capture was not ascertained, but the water in the pool (45 ft. long) was near the boiling point at one end, as low as blood-heat at the other. Some of the nymphs were taken at the hottest part of the pool. As the larvæ are carnivorous, other animals must be present.

Mouth-Parts of Insects.††—Dr. J. B. Smith has studied the development of the mouth-parts in a large number of insects. As to the labial structures, he concludes that mentum and submentum may unite and

* Journ. Coll. Sci. Imp. Univ. Japan, ix. (1897) pp. 129–39.
† Trans. Entom. Soc. London, 1897, pp. 105–11. ‡ Op. cit., 1896, p. 551.
§ Bull. Soc. Nat. d'Agriculture de France, lvi. (1896) pp. 646–52.
‖ Amer. Nat., xxxi. (1897) pp. 369–76 (1 pl.).
¶ Vidensk. Med. Kjöbenhavn, 1896, pp. 1–64.
** Journ. Cincinnati Soc. Nat. Hist., xix. (1897) pp. 63–5 (2 figs.).
†† Trans. Amer. Philos. Soc., ix. (1897) pp. 175–98 (3 pls.).

tend to become internal head-structures. The ligula is rarely paired, may be rigid or flexible, and has closely associated with it the hypopharynx. The paraglossæ are never jointed, and tend to become obsolete. The labial palps are essentially tactile. From the most generalised type, found in the Blattidæ, the modification is first from a divided to a single ligula; next to a disappearance or obsolescence of the paraglossæ; later the labial palps also disappear, and finally the hypopharynx is dispensed with.

As to the maxillæ, the sclerites form three series, each of which has its own possibilities of development. The lacinia never develop except as chewing or piercing organs, the galea varies in the direction of forming an enveloping organ for all the other mouth-parts, and the subgalea eventually unites along one margin for that purpose. There is a tendency to develop a ridged membrane on the inner surface of the galear joints, which culminates in the pseudotrachea of the muscid labella. The palpifer has a small range of development, from an unjointed flexible tactile organ to a rigid piercing structure, and, as this becomes useless, to a process for the attachment of muscles used to flex the proboscis.

Classification of Orthoptera.*—M. L. Bordas divides Orthoptera into—(I.) Acolotasia, *without* diverticula at the anterior end of the mid-gut (Phasmidæ and Forficulidæ), and (II.) Colotasia, *with* intestinal diverticula, more or less numerous (Blattidæ, Mantidæ, Acrididæ, Locustidæ, and Gryllidæ). The classification, primarily based on the absence or presence of cæca, is elaborated in reference to the number and arrangement of the Malpighian tubules, the structure of the gizzard, &c.

Development of Apterygota.†—Dr. R. Heymons has studied the development of *Lepisma saccharina* L. The segmentation is peripheral, not total, and an amnion and serosa are developed. Thus the *Insecta apterygota* are not exclusively *anamnia*, as is usually said. At the same time, it must be noted that in *Lepisma* the amnion-cavity is a large space between the blastoderm and the surface of the egg, and that there is no complete separation of amnion and serosa, an amnion pore being left. The antithesis between the Pterygota and the Apterygota is thus lessened by *Lepisma* and its relatives.

Check-List of Coccidæ.‡—Mr. T. D. A. Cockerell points out that there is at present, as the 'Zoological Record' shows, unusual activity among coccidologists. A check-list, complete to date, has been a desideratum, and this he has now supplied. In his list he ignores all "nomina nuda" (names without description), and separates off the "nomina seminuda" (with inadequate description) from the "nomina valida," of which 773 are recorded.

Mosquito-Bite.§—Mr. E. S. Morse has an interesting letter in *Nature* on acquired immunity from mosquito-bite and insect stings. Mr. G. Macloskie, in the same number, describes the mosquito's three pairs

* Comptes Rendus, cxxiv. (1897) pp. 821–3.
† SB. Akad. Wiss. Berlin, 1896, pp. 1385–9.
‡ Bull. Illinois Lab. Nat. Hist., iv. (1896) pp. 318–39.
§ Nature, lv. (1897) pp. 533–4.

of salivary glands, and the union of their six ductules into a common duct which leads into the hypopharynx. This injects the toxin into the wound.

Natural Repellent Effect of "Warning Colours."*—Dr. A. Alcock describes the behaviour of a very docile young Himalayan bear, which showed a marked appetite for grasshoppers. It crunched with every sign of relish the common bright-green and dull-brown grasshoppers found in Calcutta. On the other hand, it strongly objected to the glaring-coloured and evil-smelling *Aularches miliaris* L., which has an abdomen with alternate stripes of black and scarlet, and black fore-wings with canary-yellow spots. This insect secretes a most peculiarly pungent-smelling frothy fluid; but after the bear had once smelt it, the mere sight of it seemed to be enough for him. Dr. Alcock does not, however, say at what distance the bear could smell the grasshopper. So far as the observation goes, it seems to him to support the belief "that when an insect has been found by experience to be unpleasant to (taste and) smell, it has only to be seen to be avoided; and that any conspicuous markings that lead to the immediate recognition of such an insect by eyesight and at a distance are likely to be of such benefit to the insect as to be acted on by Natural Selection."

Ejection of Offensive Liquids by Insects.†—Sig. V. Izquierdo has observed various cases of the defensive ejection of irritant fluids by insects.

Colours of Lepidoptera.‡—Mr. A. G. Mayer has made some interesting investigations on the colours and colour-patterns of moths and butterflies. He has analysed the colours in many cases by means both of the spectroscope and of Maxwell's discs, and finds that pure colours are very rare, a percentage of black being almost always present. He has further studied the development of colour in the wings of *Callosamia promethea* and *Danais plexipus* Fab., and has confirmed the results of previous authors as to the order of development. A series of experiments with the wings of butterflies with and without the scales failed to show that the latter in any way affect the power of flight, and the author therefore concludes that the scales are only of importance in connection with colour-production. The second part of the paper contains a detailed account of colour-variation in the Heliconidæ, the observations, in the author's opinion, all tending to support the theory of mimicry. The paper includes a copious bibliography and numerous tables of variation.

Notes on Termites.§—Herr K. Czerwinski has found the larvæ of the "soldiers" and "nasuti" in a species of *Eutermes* from Brazil. He has also found the frontal gland in imago, nymph, and worker. It is multicellular, most complex in the "nasuti," and opens at a white spot or "fontanelle" where the chitin is very thin. There is a paired and an unpaired system of sympathetic nerves, both arising as short strands

* Journ. Asiatic Soc. Bengal, lxv. (1896) pp. 539–40.

† Actes Soc. Scient. Chili, 5th part of vol. v. (1895, published March 1897!) pp. 257–61 (1 fig.).

‡ Bull. Mus. Comp. Zool. Harvard, xxx. (1897) pp. 169–256 (10 pls.). See also Proc. Boston Soc. Nat. Hist., xxvii. (1897) pp. 243–330 (10 pls.).

§ Zool. Anzeig., xx. (1897) pp. 199–202.

from the brain. In front of the superior œsophageal ganglion lies the frontal ganglion, from which the œsophago-gastric nerve runs backwards beneath the brain close to the œsophagus. Behind the brain it becomes connected with the paired system. From the head it extends to the thorax, and forms a stomach ganglion. The paired system consists of two pairs of ganglia, close behind the brain, connected by commissures with one another and with the unpaired system. In short, the system is like that of Orthoptera.

New Scale-Insects.*—Mr. W. G. Johnson describes five new species of scale-insects:—*Aspidiotus forbesi* on cherry, apple, pear, plum, &c.; *A. comstocki* on sugar maple; *A. æsculi* on buckeye; *A. ulmi* on white elm; and *Chionaspis americana* on the same.

δ. Arachnida.

Oogenesis in Pholcus.†—Prof. Ch. Van Bambeke describes the changes in the ovarian ovum of *Pholcus phalangioides* Fuessl. during the period of growth. Four stages may be distinguished, especially as regards the formation of the nutritive vitellus.

(1) First there is the appearance and development of a structure which probably represents the vitelline body of Balbiani.

(2) Then follows the disintegration of this vitelline body.

(3) The third stage is marked by the fact that the elements derived from the disintegration of the vitelline body are transformed into fatty drops and granules.

(4) In the fourth stage the germinal vesicle loses its definite wall, and comes into more intimate relations with the cytoplasm. The latter, becoming more active, secretes or elaborates the materials which give rise to the vacuolisation of the vitellus. The adipose granules probably furnish the material which renders the cytoplasm more capable of forming the vitelline spheres or true nutritive vitellus.

Mites and Ants.‡—Herr E. Wasmann discusses the myrmecophilous mites which infest ants. They occur in the *Hypopus*-form, and it seems difficult to refer them to their proper genus, *Tyroglyphus* or some other. A single ant may bear hundreds or even thousands of mites, all lying in the same way, with their head pointing to the apex of the part on which they are fixed. Wasmann also speaks of the "syntrophy" of *Lælaps oophilus* Moniez, which occurs freely on the surface of the eggs of ants (*Formica sanguinea* and *F. rufobarbis*), but without doing them any damage, apparently depending on the salivary secretion of the ants, which are always licking their eggs.

ε. Crustacea.

Pigments of Lobster.—Miss M. I. Newbigin § has investigated the pigments of *Homarus*, *Nephrops*, and *Astacus*. She succeeded in obtaining a blue pigment in solution from the exoskeleton of *Homarus* and *Astacus*, and believes that this pigment is of the nature of an unstable

* Bull. Illinois Lab. Nat. Hist., iv. (1896) pp. 380–95 (6 pls.).
† Bull. R. Acad. Belg., xxxiii. (1897) pp. 307–21.
‡ Zool. Anzeig., xx. (1897) pp. 170–3.
§ Journ. Physiol., xxi. (1897) pp. 237–56.

combination between a red lipochrome and an organic base, probably derived from the muscle. The red colour of the shell in *Nephrops* is due to the same red lipochrome in combination with lime. The green colour of the eggs of the lobster the author finds to be due to the mingling of the blue pigment of the shell with a yellow pigment, which also occurs in the liver and shell, and which does not give the lipochrome reactions. There is some evidence to show that this yellow pigment is capable of being transformed into the red lipochrome. The author is of opinion that the yellow pigment of the liver (hepatochrome) is widely distributed among the Decapod Crustacea, that it may be modified into the red lipochrome which may directly colour the shell, or may become converted into the blue compound. The numerous colour variations of the group are thus in part accounted for.

Photomechanical Changes in Retinal Pigment-Cells of Palæmonetes.*—Dr. G. H. Parker gives the following general summary of his results. (1) The only parts of the retina in *Palæmonetes* that exhibit photomechanical changes are the three kinds of pigment-cells. (2) The proximal retinular cells contain black pigment-granules. In the *light* these are diffused with slight concentration at the distal end and around the rhabdome; in the *dark* the pigment is limited to the retinal nerve-fibres. (3) The change from the dark to the light condition takes 30–45 minutes; the reverse change 45–60 minutes. (4) The changes are probably due to the internal protoplasmic movements.

(5) The accessory pigment-cells have a yellowish-white pigment; in the *light* this is massed partly at the base of the retina, partly near the distal surface of the first optic ganglion; in the *dark* it is almost wholly at the base of the retina. (6) The change from dark to light condition takes 45–60 minutes; the reverse change 105–120 minutes. (7) The changes are probably due to amœboid movements of the cells.

(8) The distal retinular cells contain black pigment granules. In the *light* they are contracted, and occupy a proximal position in the retina surrounding the axis of the ommatidium near the outer ends of the proximal retinular cells; in the *dark* they are expanded (flattened), and occupy a distal position in the retina, surrounding more or less completely the sides of the cone. (9) The change from dark to light condition takes 90–105 minutes; the reverse change 105–120 minutes. (10) These changes are produced in part by an amœboid movement of the cell, and probably in part by a muscle-like contraction of its axial portion.

(11) Each set of photomechanical changes in the light is more rapid than the reverse set in the dark. (12) The conditions of the two eyes are quite independent. (13) The photomechanical action within the retina is localised, small groups of pigment-cells responding to local stimulation. (14) The changes may occur even if optic nerve is cut. (15) They may occur almost completely even on excised retinas. (16) Incompleteness in such cases is probably due to the death of the retinal tissue. (17) The three kinds of retinal pigment-cells probably respond to direct stimulation from without, and are not influenced by nervous impulses from within. There is no good evidence in favour of normal double conduction of nervous impulses.

* Bull. Mus. Harvard, xxx. (1897) pp. 275-300 (1 pl.).

Trapeziidæ.*—Dr. A. E. Ortmann furnishes a systematic revision of this family of Decapods—a revision which seems to be much needed. He brings structural characters (of shape) into the foreground, and corrects the undue emphasis which has been laid upon colour. Three genera are recognised,—*Trapezia*, *Tetralia*, and *Quadrella*. The Trapeziidæ live among living corals, excepting only *Quadrella coronata* from among pearl-mussels. They are strictly littoral animals of the low-tide mark zone, the deepest habitat recorded being 22 fathoms for *Trap. cymodoce*. They occur in the whole Indo-Pacific region where there are coral-reefs; they are entirely absent, however, from the east side of America. The conclusions to be drawn from the distribution are discussed at some length.

New Paguridæ.†—Prof. J. R. Henderson reports on fourteen species collected by the 'Investigator' in 1893–4 in the Indian Ocean. Of the fourteen, no less than seven are new—*Eupagurus pergranulatus*, *Pylopagurus magnimanus*, *Catapagurus muricatus*, *Paguristes pusillus*, *P. puniceus*, *Parapagurus andersoni*, and *P. minutus*. The large proportion of new species is not remarkable when the deep-water habitat of the majority is taken into consideration.

Freshwater Crustacea of South Africa.‡—Prof. M. Weber's memoir on the freshwater fauna of South Africa includes an account of the Crustacea collected. In this he was helped by Dr. J. C. H. de Meijere and Dr. J. G. De Man. The new forms are *Sesarma eulimene* De Man, and *Leander capensis* De Man. The whole collection included only twelve species, and of these only *Telphusa* is regarded as genuinely "regional and local." Other forms, such as species of *Palæmon* and *Caridina*, *Sesarma eulimene*, and *Varuna litterata*, are regarded as immigrants from the sea.

Mysidæ of the Caspian.§—Prof. G. O. Sars describes a collection made by Dr. Grimm. The largest is a very magnificent form, *Paramysis Kessleri*, nearly 40 mm. in length. Between *Paramysis* and *Mesomysis*, a new genus *Metamysis* is established. The collection includes six new species.

New Cave Isopod.‖—Dr. B. Němec describes *Trichoniscus stygius* sp. n. from the Gabroviza grotto near Trieste. It certainly belongs to the genus *Trichoniscus*, but it is probably identical with Joseph's *Typhloniscus stygius*. The author discusses in a very unprejudiced manner the possible origin of blind cave animals, like this Isopod, whether (1) from congenitally blind ancestors who found the caves safe and congenial, or (2) from ancestors whose eyes degenerated in darkness, either (*a*) by direct modification, or (*b*) indirectly, the absence of light determining the direction of intra-selection and germinal selection.

Amphipods of the Caspian.¶—Prof. G. O. Sars describes 25 species of Amphipods from the Caspian, which raises the number of carefully

* Zool. Jahrb. (Abth. Syst.), x. (1897) pp. 201–16.
† Journ. Asiatic Soc. Bengal, lxv. (1896) pp. 516–36.
‡ Zool. Jahrb. (Abth. Syst.), x. (1897) pp. 135–200 (1 pl.).
§ Bull. Acad. Imp. Sci. St. Pétersbourg, iii. (1895) pp. 433–58 (8 pls.).
‖ Verh. K. K. Zool. Bot. Gesellsch. Wien, xlvii. (1897) pp. 58–64 (1 pl.).
¶ Bull. Acad. Imp. Sci. St. Pétersbourg, iv. (1896) pp. 421–87 (12 pls.).

examined forms to 53. They belong to four different families—Lysianassidæ, Pontoporeiidæ, Corophiidæ, and Gammaridæ, the last being most abundant. The collection described included 15 new species.

New Species of Branchipus.*—Dr. A. Alcock describes and figures a large and beautiful form—*Branchipus* (*Streptocephalus*) *bengalensis* sp. n., —found in flooded rice-fields near Calcutta. It is most closely related to *Br. rubricaudatus* Klunzinger from Arabia, and, through the female, to *Br. torvicornis* Waga from Warsaw. The body is rather over an inch long. The antennæ of the male are more than half as long as the body; those of the female form a pair of short broad leaf-like lobes, bending, in repose, over the eyes, like curtains.

North American Freshwater Ostracods.†—Mr. R. W. Sharpe gives an account of North American Cytheridæ and Cyprididæ, discussing 22 species. Fourteen of these are new to America, and about a dozen new to science. Two of these new forms belong to the genus *Limnicythere*, itself new to America. The systematic part of the paper is preceded by an interesting account of local and seasonal distribution prepared by Mr. C. A. Hart.

Olfactory Setæ of Cladocera.‡—Mr. D. J. Scourfield gives a short account of the structure, number, and arrangement of the peculiar little setæ on the first pair of antennæ in the Cladocera, usually considered to be olfactory. It appears that in the females the number of such setæ on each antennule is characteristic of families and groups of families. Thus the Polyphemidæ have 5, the Holopedidæ 6, and the remaining families, namely Sididæ, Daphnidæ, Bosminidæ, Lyncodaphnidæ, Lynceidæ, and Leptodoridæ, 9 olfactory setæ in each tuft. The number in the males is sometimes the same as in the females (Daphnidæ), but often greater (Lynceidæ). As regards the arrangement of the setæ, cases are mentioned where it is possible to distinguish closely allied species simply by the relative lengths and positions of these minute structures.

Some Manitoba Cladocera.§—Mr. L. S. Ross has the honour of writing the first systematic paper on the Entomostraca of Manitoba, and it is on this account that we notice his contribution, which deals with 30 species, including *Ceriodaphnia acanthina*, which is new.

Pycnogonids.‖—M. E. Topsent reports on the Pycnogonids collected in 1894–6 in the North Atlantic by the Prince of Monaco. The collection was very small, comprising only two species, *Colossendeis gigas* Hoek and *C. leptorhynchus* Hoek. The latter species was found by the 'Challenger' only in the South Pacific and Indian Oceans.

Annulata.

Ovum Centrosome in Chætopterus.¶—Mr. A. D. Mead has convinced himself that the asters and centrosomes in the ovum of *Chætopterus pergamentaceus* arise by a modification of the cytoplasmic reticulum.

* Journ. Asiat. Soc. Bengal, lxv. (1896) pp. 538–9 (1 pl.).
† Bull. Illinois Lab. Nat. Hist., iv. (1897) pp. 414–84 (10 pls.).
‡ Journ. Quekett Micr. Club, vi. (1896) pp. 280–88 (1 pl.).
§ Amer. Nat., xxxi. (1897) pp. 293–303 (1 fig.).
‖ Bull. Soc. Zool. France, xxii. (1897) pp. 106–7.
¶ Journ. Morphol., xii. (1897) pp. 391–4 (3 figs.).

The phenomena of their origin, and their relation to the secondary asters, are similar to those described by Reinke in the tissue-cells of the larval salamander.

Regeneration and Autotomy in Earthworms.*—Herr K. Hescheler made experiments in 1896 which showed that (in *Lumbricus Herculeus*, *L. rubellus*, *Allolobophora fœtida*, *All. caliginosa*, *All. terrestris*) the regeneration of a lost anterior end only occurred within narrow limits. When more than ten segments are lost, the regeneration decreases rapidly in completeness, and in most cases only four or five new segments are formed. Morgan got similar results; but Joest and Korschelt reported extraordinary regenerative power, far exceeding what Hescheler observed. As further experiments have confirmed Hescheler in his results, he suggests, in explanation of the discrepancy, that Joest and Korschelt must have worked with different species.

Hescheler has also shown that autotomy (*Selbstamputation*) occurs in the posterior region of *Lumbricus Herculeus*, *L. rubellus*, *Allolobophora fœtida*, *All. chlorotica*, *All. caliginosa*, *All. terrestris*, and *All. cyanea*. It is a general, habitual, and adaptive phenomenon, which may be induced by discomfort, by mechanical, chemical, and electrical stimuli, and in dying. The author compares what occurs in earthworms with observations on *Nephthys scolopendroides* and *Chætopterus*. What is limited in *Lumbricus* and *Allolobophora* is more pronounced in *Allurus*, and yet more so in *Criodrilus*, while *Lumbriculus* is reproduced by fission at certain seasons.

New North American Oligochæta.†—Mr. Frank Smith describes from the Illinois river, at Havana, a new Naidomorph *Pristina leidyi* sp. n., closely allied to *P. longiseta* Ehrenb.; also *Mesoporodrilus asymmetricus* g. et sp. n., in some important respects allied to *Eclipidrilus frigidus* Eisen. A Florida collection yielded *Microscolex hempeli* sp. n., which combines characters that seem to bring the genera *Rhododrilus* and *Deltania* very near together, and to emphasise the necessity of combining them with *Microscolex*, as Beddard has done. In a previous paper ‡ the author described *Thinodrilus inconstans* g. et sp. n., a new Lumbriculid.

New Oligochæta.§—Dr. W. Michaelsen describes Prof. Kükenthal's collection from Halmahera, Ternate, Borneo, &c. It includes among Geoscolecidæ *Glyphidrilus Kuekenthali* sp. n., and among Megascolecidæ *Pleionogaster ternatæ* sp. n. and seven new species of *Perichæta*. Among these there seems to be much variability; thus no fewer than six subspecies of *Perichæta halmaheræ* are distinguished.

Heart-Body of Enchytræidæ.‖—Prof. J. Nusbaum and Herr Jan Rakowski have studied the structure of the dorsal vessel and the so-called *Herzkörper* in *Fredericia* and *Mesenchytræus*, and conclude that the "heart-body" is derivable from the blood-gland known in other Enchytræidæ. The similarity of the histological characters and the similarity

* Vierteljahrschr. Nat. Gesellsch. Zürich, xlii. (1897) pp. 54–64.
† Bull. Illinois Lab. Nat. Hist., iv. Art. 14, pp. 396–413 (4 pls.).
‡ Tom. cit., pp. 285–97.
§ Abh. Senckenberg. Gesellsch., xxiii. (1897) pp. 193–243 (1 pl., 1 fig.).
‖ Biol. Centralbl., xvii. (1897) pp. 260–6 (4 figs.).

of position—within the vessels, in association with the endothelium—point to the conclusion that all these structures in Enchytræidæ are morphologically alike. What their functional import is remains obscure.

Eyes of Hirudinea.*—Dr. R. Hesse describes the optic organs in about a dozen species of Hirudinea. He begins with the Gnathobdellidæ, where the eye-structure is simplest, and discusses *Piscicola*, *Branchellion*, *Pontobdella*, *Clepsine*, &c. Among Rhynchobdellidæ he describes *Nephelis*, *Hirudo*, &c. In many cases his descriptions are only supplementary to previous work by others.

The optic cells form the structural basis; they occur diffusely, or in stretches, or in close aggregates. They differ, of course, in detail, but they are all alike in being continued into a nerve-fibre, and in having vacuolar structures in their plasma. These vacuoles are the specific characteristics of the optic cells, analogous to rods and cones. The pigment accumulations associated with the optic cells are, as usual, "*Blendungsvorrichtungen*."

In all Hirudinea, even in those without eyes, there are scattered optic cells; in *Clepsine bioculata* and *Cl. sexoculata* the number of free cells decreases as the eyes increase; in Ichthyobdellidæ only *Piscicola* has true eyes, in *Pontobdella* there are scattered optic cells, while *Branchellion* is between the two states. These and similar facts point to the conclusion that the eyes of Hirudinea have arisen by aggregation of optic cells, and by the closer association of these with pigment accumulations.

Rotatoria.

Some new Forms of American Rotifera.†—Dr. A. C. Stokes gives a description, with plate, of the following six "presumably" new species of Rotifers:—*Proales hyalina*, *Notommata vorax*, *Diglena contorta*, *Mastigocerca spinifera*, *Cathypna scutaria*, and *Cathypna glandulosa*. The first-named, *P. hyalina*, is certainly Ehrenberg's *Notommata tuba*, which Mr. C. Rousselet has recently described and renamed *Cyrtonia tuba*.‡ *N. vorax* seems to have considerable resemblance to Dujardin's *N. torulosa* with its globular auricles, if it is not identical with it. *Diglena contorta* seems to have much in common with Ehrenberg's *N. forcipata*, and, as it has no eyes and possesses auricles, it is questionable if it be a *Diglena*. Dr. Stokes gives this form two dorsal antennæ, which is a very unusual feature.

Lacinularia elongata, a new Rotifer.§—Mr. T. Shephard, in describing this new *Lacinularia*, gives the following principal characters:—Clusters fixed, with a dense matrix of adherent tubes of dirty brown colour; body of individual narrow and much elongated; corona only little wider than the body, slightly oval. A plate of five figures accompanies the description.

Brachionus bakeri and its Varieties.‖—Mr. C. F. Rousselet's object in figuring all the principal varieties of this Rotifer has evidently been

* Zeitschr. f. wiss. Zool., lxii. (1897) pp. 671–707 (2 pls.).
† Ann. and Mag. Nat. Hist., June 1897, pp. 628–33 (1 pl.).
‡ Cf. this Journal, 1895, p. 317.
§ Victorian Naturalist, May 1896 (1 pl.).
‖ Journ. Quekett Micr. Club, vi. (1897) pp. 328–32 (1 pl.).

to check the growing practice of giving new names to every slight variety; for this purpose, and also for reference, his plate of fourteen figures is very instructive and useful.

Metopidia pterygoida, a new Rotifer.*—Mr. M. F. Dunlop describes and figures this pretty and peculiar new species with wing-like expansions of the lorica, but otherwise allied to Perty's *Notogonia ehrenbergi*.

Nematohelminthes.

Classification of Nematoda.†—Dr. von Linstow criticises Schneider's old classification into Polymyarii, Meromyarii, and Holomyarii, the defects of which have been previously indicated by Bütschli and others. Von Linstow distinguishes three families:—

I. Secernentes. The lateral line bears a ridge or cushion with a narrow base, which expands internally and projects beyond the muscles. In both cushions or in one there is a longitudinal vessel opening ventrally at the excretory pore. Examples:—*Ascaris osculata*, *Oxyuris vermicularis*, *Ankylostomum duodenale*, &c.

II. Resorbentes. The lateral lines have broad areas, about as thick as the musculature, without a vessel, and apparently suctorial. These forms do not, when mature, inhabit the food-canal of their host. Examples:—*Filaria tricuspis*, *Dracunculus medinensis*, *Eustrongylus gigas*, &c., &c.

III. Pleuromyarii. The lateral lines have neither cushions nor special lateral areas; the œsophagus lumen is often a narrow chitinous tubule, and in some there is no intestine. Examples:—*Trichocephalus unguiculatus*, *Gordius tolosanus*, &c.

The same paper includes a description of several new species.

Excretory System of Nematodes.‡—Prof. N. Nassonow has followed Kowalewsky's injection method in studying the excretory organs of *Ascaris megalocephala* and *Oxyuris flagellum*. Powdered carmine or sepia injected into the cavity of the body of *A. megalocephala* is found aggregated in two pairs of giant stellate cells, connected with the lateral lines, and by irregular branches with the intestine. The lateral lines of *Oxyuris flagellum* consist of three rows of cells, the innermost cells being traversed by the excretory canal.

Alleged Nematode-Parasites of Truffles.§—M. J. Chatin examined a number of truffles (*Tuber melanosporum* and others) in which Nematodes occurred, and found that the worms were *Pelodera strongyloides* Schm. and *Leptodera terricola* Duj.; that is to say, two saprophytic forms which had taken to a new habitat. They are not truly parasitic in the truffle, nor are they possible parasites of man.

Molin's Genus Globocephalus.‖—Dr. von Linstow has studied the intestinal parasite of the pig, to which Molin gave (1861) the name *Globocephalus longemucronatus*. His careful investigation shows that the parasite belongs to the genus *Ankylostomum*.

* Journ. Quekett Micr. Club, vi. (1897) pp. 325–7 (1 pl.).
† Arch. f. Mikr. Anat., xlix. (1897) pp. 608–22 (1 pl.).
‡ Zool. Anzeig., xx. (1897) pp. 202–5 (3 figs.).
§ Comptes Rendus, cxxiv. (1897) pp. 903–5.
‖ Zool. Anzeig., xx. (1897) pp. 184–7 (4 figs.).

Classification of Gordiidæ.*—Dr. F. Römer describes *Chordodes baramensis* sp. n. from Borneo, out of a Mantid (*Hierodula basalis*), *Ch. compressus* sp. n., also from Borneo, and *C. moluccanus* sp. n. from Halmahera. He proceeds to a taxonomic survey of the family, describing 16 well defined species of *Gordius* (with notes of 9 doubtful forms) and 16 well defined species of *Chordodes* (with notes of 4 doubtful forms). Then follows a valuable diagnostic table.

Gordius and Mantis.†—M. F. Lataste describes the emergence of a living specimen of *Gordius chilensis* from a wounded *Mantis*, its suspected host.

Freshwater Nematodes of Hungary.‡—Dr. E. v. Daday gives a list of no less than 64 species. Forty-two are confined to fresh water, six occur in damp earth and in fresh water, nine live solely in earth saturated with fresh water, six are restricted to earth saturated with fresh and brackish water, one is confined to earth saturated with brackish water. The list of strictly freshwater forms includes 12 found elsewhere in Europe, and 30 which are recorded from Hungary alone.

Platyhelminthes.

Development of Nemerteans.§—Herr J. Lebedinsky describes the direct development of *Tetrastemma vermiculus* and *Drepanophorus spectabilis*.

The laid egg has two envelopes. It gives off two polar bodies, the first with four, the second with two chromosomes. One of them, probably the first, divides again. They often get into the segmentation-cavity.

The segmentation is total and approximately equal, and a segmentation-cavity exists in the 8-cell stage. The resulting bipolar blastula becomes bilaterally symmetrical, an elongated oval with the upper pole turned to the anterior end and the lower pole to the posterior end. At the upper pole the cells multiply and form the head-gland-area; at the lower pole is formed the endoderm area, bounded by four large round cells. The mesoderm is represented by four large round cells, the mother-cells of the body mesoderm. The bilaterally symmetrical blastula becomes an invaginated gastrula.

A pear-shaped gut arises from an invagination of the endoderm area. Subsequently the gut-wall acquires several layers by the transverse division of the endoderm cells, and the gastric cavity is much reduced. In later stages the gut re-acquires its single-layered wall. The gut opens by the blastopore, and is connected therewith by a tubular process, the future cæcum. The gut forms a diverticulum which communicates with the rectum.

The blastopore, at first large, gradually decreases in size, moving forwards, and closes very late. As it closes, the tubular process of the gut separates from the ectoderm, and forms the cæcum.

The head-groove, or frontal organ, begins as a group of highly

* Abh. Senckenberg. Ges., xxiii. (1897) pp. 250–95 (1 pl.).
† Actes Soc. Scient. Chili, vi. (1896) pp. 71–3.
‡ Zool. Jahrb. (Abth. Syst.), x. (1897) pp. 91–134 (4 pls.).
§ Arch. f. Mikr. Anat., xlix. (1897) pp. 503–56 (3 pls.); also pp. 623–50.

vacuolated cells; this rudiment is invaginated, and the cells bear a strong tuft of cilia; subsequently the groove is gradually reduced in size.

The head-gland begins as an area of round ectoderm cells; these become cylindrical, and the area is invaginated, increasing in *Tetrastemma*, dwindling in *Drepanophorus*.

A thickening of ectoderm is invaginated to form the proboscis. In *Tetrastemma* the invagination divides, a dorsal portion forming the proboscis, a ventral portion forming the secondary stomodæum which communicates with the œsophagus.

The œsophagus arises as a group of much elongated cells, which are invaginated and form a tubular cavity. In *Tetrastemma* this is constricted off from the ectoderm, and communicates with the secondary stomodæum.

The rectum is formed like the œsophagus, and communicates with the diverticulum of the gut.

The four primitive mesoderm cells, which lie before and behind the blastopore, divide karyokinetically, and each forms a mesoderm band, which differentiates into a somatic and a splanchnic layer. The paired anterior mesoderm bands subsequently form an anterior (ventral) mesoderm sack; the paired posterior mesoderm bands form a posterior (dorsal) mesoderm sack; the two sacks unite; the splanchnic layer clothes the gut, the somatic joins the ectoderm; the cavity between is the body-cavity.

The mesoderm of the proboscis arises from two mother-cells, which lie at first at the margin of the proboscis invagination, but subsequently migrate into the segmentation cavity. Each divides karyokinetically and forms a mesoderm band. Both of these differentiate into two layers with a cavity between. The bands envelop the proboscis and unite, the inner layer joining the proboscis, the outer forming the proboscis-sheath, with the rhynchocœlome between.

The brain arises from two pairs of ectodermic thickenings, the dorsal and ventral ganglia. The ventral longitudinal strands arise from two thickenings of ectoderm, each connected with the corresponding ventral ganglion by a slight ectodermic thickening. Behind the dorsal ganglia the dorsal longitudinal strands arise in a similar manner, but they soon cease to elongate, and finally coalesce with the dorsal ganglia.

The cerebral organs arise as invaginations of the ectoderm. The ectoderm is gradually differentiated into covering, flask-like, and other elements.

In a continuation of the paper the author compares his results with those of others, and discusses the systematic position of the Nemertines.

New Metanemerteans.*—Dr. T. H. Montgomery, jun., describes some American forms, beginning with *Zygonemertes virescens* Verr. g. n. (=*Amphiporus virescens* Verr., 1892). The rhynchocœl extends to the posterior end of the body, while the thickened proboscis (with the exclusion of its retractor muscle) does not extend quite half the length of the rhynchocœl. The basis of the central stilet is very large, considerably elongated, flattened, or slightly concave posteriorly; the basis is constricted near its posterior end. The central stilet is straight, massive, not half the length of its basis. There are ten or eleven longitudinal

* Zool. Jahrb. (Abth. Syst.), x. (1897) pp. 1–14 (1 pl.).

proboscis nerves. A few elongated subepithelial gland-cells occur in the head region. Numerous small ocelli lie behind the brain on the dorsal and lateral aspects of the lateral nerve-cords. On these grounds this form has been separated from *Amphiporus*.

Mr. Montgomery also describes *Proneurotes multioculatus* g. et sp. n. The lateral nerve-cords unite posteriorly below the intestine about 1 mm. from the hind end; both rhynchocœl and blood-vessels are continued for some distance behind the nerve-commissure, a condition which occurs in no other Metanemertean. Very characteristic are five unpaired diverticula of the voluminous rhynchocœl. It is otherwise, except in the very small size of its blood-vessels, related to *Amphiporus*. The author next describes *Amphiporus greenmani* sp. n., *Tetrastemma flagellatum* sp. n., and has notes on some other forms which are not new.

Nephridia of Stichostemma.*—Dr. T. H. Montgomery finds that the nephridia of *Stichostemma eilhardi* are very aberrant. Instead of one pair there are several pairs, from the anterior to the posterior end, but all have not ducts. Other peculiarities are the following: The terminal bulbs have a closed cavity, not in open communication with the lumen of the ductules; the presence of a closed cuticular structure immediately surrounding the cavity of the bulb, produced probably by the cells of the latter; the probable absence of a ciliary flame within the cavity of the bulb; the comparatively great length of the ductule connecting the bulb with the main ducts, and the absence of nuclei in its walls; and the presence of a cuticula, of considerable thickness, on the epithelium of the main ducts.

The explanation of these remarkable differences can probably be given only in terms of the adaptation of this descendant of marine ancestors to a life in fresh water. The occurrence of numerous separate nephridia cannot be regarded otherwise than as a secondary condition in Nemerteans.

Species of Ophryocotyle.†—Prof. A. Villot corrects some of the previous descriptions of this genus. The triple series of hooks is situated on the *anterior margin* of the sucker; there are *five* frontal suckers; there may be *over a hundred* proglottides. As to species:—*O. proteus* is quite distinct from *O. Lacazei*, but *O. insignis* Lönnberg is synonymous with *O. Lacazei*.

Trematodes of Freshwater Fishes.‡—Herr L. Hausmann has studied these in their faunistic and bionomic relations. The following are some of his general conclusions. All kinds of fishes, whether vegetarian or carnivorous, may be hosts of Trematodes; but the carnivorous forms contain the sexually mature stages, the vegetarian forms usually the immature stages only, while those which live on microscopic animals may contain both stages. The number of parasites varies with the time of year, diminishing, for instance, in the cold season, when the fishes eat little. There are also fewer during the spawning season when the nutrition is slight. When a fish is brought into conditions of captivity, it tends to lose its parasites. The prevalent parasites vary somewhat

* Zool. Jahrb. (Abth. Anat.), x. (1897) pp. 265–76 (1 pl.).
† Zool. Anzeig., xx. (1897) pp. 197–9.
‡ Rev. Suisse Zool., v. (1897) pp. 1–42 (1 pl.).

according to the habitat of the fish, a fact which probably depends upon the distribution of the intermediate hosts. There is an antagonism between different kinds of parasites, e. g. between *Distomum* and *Echinorhynchus*; and the number which one host can sustain seems to be limited. Experiments, like those made by Bunge, show that entoparasites require only a minimum oxygen supply. In the second part of his paper, Herr Hausmann describes a few new and rare species.

Entozoic Tuberculous New Formations.* —Dr. V. Diamare describes certain appearances in the internal organs of *Thalassochelys caretta* which are due to the presence of the ova of a small Distomum, *Mesogonimus constrictus*. The subserous tissue is studded all over with miliary nodules attached to the blood-vessels of the gastric and intestinal peritoneum. A closer examination shows that an egg occupies the centre of the nodule, the ovum or its remains being surrounded by a zone of giant-cells, and the whole included in a fibrous investment.

Two Forms of Distomum cygnoides.† — According to Dr. R. R. Bensley, it would seem that under the specific name *cygnoides*, Pagenstecher and Looss have confused two forms of *Distomum*. One form possesses an ovary divided into several lobes, nine testes, of which five are on the same side of the body as the ovary, four on the opposite side, and a vitellogen subdivided into several small lobules. The other possesses an undivided reniform ovary, two testes, and a much simpler vitellogen. It also attains a greater size, and is provided with a relatively smaller ventral sucker.

Eyes of Turbellaria and other Flat Worms.‡—Dr. R. Hesse finds great dissimilarity of structure even within narrow range; thus the eye of *Planaria torva*, which is taken as a starting point, is almost as different from the eye of Euplanarians as from that of Polyclads and Nemertines. In all cases, however, the eye is composed of sensory cells, which on part of their course are surrounded by a pigment cup, and are at this region specially modified for the perception of light. Thus the end towards the cup may bear fine filaments or fibrillar rods. These optic cells are always so disposed that the sensitive ends are turned *away from* the entrant rays of light. The differences between the various types depend mainly on the number and modification of the optic cells. In the case of the simplest eyes with one optic cell or with only a few, no power of image-forming can be thought of as possible. Quantitative and qualitative differences of illumination may, however, be perceived. Even in the eyes of *Dendrocœlum* and *Euplanaria* image-forming is not probable; for, owing to the arrangement of the optic elements, a ray must in many cases meet several elements. In Polyclads only do the rods lie in one plane, but they are not separated by pigment sheaths, and image-forming is very improbable. The author describes numerous types in detail.

Remarkable new Planarian.§—Dr. A. Willey found at Lifu a new type of Planarian, which he calls *Heteroplana Newtoni*. It presents

* Centralbl. f. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 459–65.
† Tom. cit., pp. 326–31 (1 pl.).
‡ Zeitschr. f. wiss. Zool., lxii. (1897) pp. 527–82 (2 pls, 3 figs.).
§ Quart. Journ. Micr. Sci., xl. (1897) pp. 203–5 (1 fig.).

externally a sub-symmetrical appearance, but in its structure it is characterised by what may be described as atrophy of the left half of the body. The left intestinal diverticula are aborted. The mouth is placed at the middle of the length of the body, but approximated to the left margin. The cerebral ganglion is also approximated to the left margin. Throughout the body, and especially prominent in the anterior and posterior regions, is a close reticulum of fine anastomosing tubules, probably genital.

The discoverer would place this remarkable form in the order Archiplanoidea which he suggested for the reception of *Cœloplana* and *Ctenoplana*.

The locomotion is usually conducted in a somewhat one-sided fashion, and the number of marginal eyes on the forward directed right lobe of the head is more than twice as many (56 : 24) as on the left lobe.

Three new Polyclads.*—Dr. Marianne Plehn describes three new forms. The first—*Polyporus cæcus* g. et sp. n., from Spitzbergen, is one of the Leptoplanidæ with a very tough broadly oval body, with the mouth about the middle of the ventral side, with pores from the intestinal branches on the margin all round, with separate genital apertures, with a second marginal opening to the female apparatus, and with no eyes. The second—*Leptoplana californica*—resembles the *Leptoplana* in most respects, but has a single genital aperture. The third, also from Monterey Bay, California, is named *Amblyceræus luteus* g. et sp. n. It is one of the Euryleptidæ, a large delicate form, with very high dorsal ridge, with the mouth in the anterior part of the pharyngeal pouch, but at some distance from the brain, with a pharynx tending to be collar-like, with numerous narrow intestinal diverticula, with small solid tentacles, and with eyes on the tentacles and anterior margin.

Incertæ Sedis.

Ptychodera.†—Dr. A. Willey found a *Ptychodera*, which may be probably identified with *P. flava* Eschscholtz, in great abundance near the low-tide mark on the small islet of Amédée, eight or ten miles inside of the great Barrier Reef of New Caledonia. "It occurred near the surface of the sand, chiefly underneath loose stones, often adhering to the latter, and creeping into the holes with which the coralline blocks are riddled." On the Isle of Pines it was equally abundant, often involved in the roots of the tussocks of seaweed. The individuals averaged in length from 1½ to 2 or even 3 inches; but, after the captive specimens got rid of the sand in their intestine, they sometimes stretched out to over 5 inches. The details as to the life of the animal are important; for this is the first time that an Enteropneust with a free pharynx has been studied alive.

Among the author's principal results are the following:—The presence of the genital pleura, of external liver saccules, and the length of the collar region, show that *Ptychodera flava* should be assigned, as has been done by Spengel, to the amended genus *Ptychodera*; and that it belongs to Spengel's sub-genus *Chlamydothorax*, is shown by the

* Jenaische Zeitschr. Naturwiss., xxxi. (1897) pp. 90–9 (1 pl.).
† Quart. Journ. Micr. Sci., xl. (1897) pp. 165–83 (1 pl.) *not* in this part.

ventral origin of the genital pleura, the diffuse gonads, and the free pharynx.

In the fact of the gill-slits being open directly to the exterior throughout their entire length, *P. flava* is more closely related to *P. bahamensis* than to any other described species. This is also indicated by the simple rows of paired liver saccules, as opposed to the irregular multiple arrangement in *P. erythræa.*

The genus or sub-genus probably represents an archaic type, as shown by the diffuse gonads, the free pharynx, and its littoral habitat.

"The gill-slits, branchial skeleton, and the temporary atrium formed by the apposition of the genital pleura in *Ptychodera*, offer a general homology to the corresponding structures in *Amphioxus* and the Ascidians." The differences are in many ways unimportant, and "such as might well be expected to occur in distinctly related forms with such totally different habits of existence, while others are to be accounted for by a wide interpretation of the principle of correlation between structure and function."

In an additional note Dr. Willey suggests that, until the form (Eschscholtz's) is really re-found in the Marshall Islands, his own find might be called *P. flava-caledoniensis*, or simply *P. caledoniensis.*

Ctenoplana.*—Dr. A. Willey discovered a distinct new species of *Ctenoplana* (*C. rosacea*) in the Eastern Archipelago of British New Guinea. It will be remembered that this remarkable genus, which presents affinities both to the Ctenophora and to the Turbellaria, was established by Korotneff in 1886. This is now the second record of its occurrence. Dr. Willey describes the expert crawling and swimming movements; the pinnate seizing tentacles, retractile within sheaths, perhaps belonging to the same category of structures as the proboscis of Nemertines and some Rhabdocœle Planarians; the double character of the circlet of sensory tentacles surrounding the otolith, the testes and genital ducts, &c. He maintains that the tentacle axis of *Ctenoplana* corresponds to the longitudinal axis of Planarians, the stomachal axis of the former to the transverse axis of the latter, and the main axis of the former to the dorso-ventral axis of the latter. The solid pinnate tentacles of *Ctenoplana* are not bilateral, but biradial; the ctenophoral plates, gastric lobes, gonads, gonaducts, and aboral sensory tentacles, are paired about the tentacle axis. The aboral sensory tentacles are homologous with the polar plates (*Polplatten*) of Ctenophora, and with the nuchal tentacles of Polyclades.

Willey proposes to erect a new order Archiplanoidea for the reception of *Cœloplana* and *Ctenoplana*; and he suggests a hypothesis as to the diphyletic origin of Bilateralia which may be thus summarised:—

○ .... { Archiplanoidea .... { Ctenophora / Plathelminthes
○ .... { Cerianthidæ .... { Anthozoa / Cœlomata

* Quart. Journ. Micr. Sci., xxxix. (1897) pp. 323–42 (1 pl.).

Echinoderma.

Asteroidea of the North Atlantic.*—M. E. Perrier describes some of the Asteroidea obtained by the Prince of Monaco from the North Atlantic. Thirty-five species were collected, representing 27 genera. Six of the species were new,—*Pedicellaster parvulus*, *Stolasterias neglecta*, *Prognaster Grimaldii*, *Calycaster monœcus*, *Sclerasterias Guernei*, and *Hexaster obscurus*. The last four should form types of new genera, and are discussed in some detail.

Deep-Water Ophiuridæ from the Indian Ocean.†—Dr. R. Köhler gives a preliminary summary of his examination of the deep-water Ophiuridæ collected by the 'Investigator' in the Indian Ocean. Fifty-five species were included in the collection, 51 Ophiuridæ and four Astrophytonidæ; and of these 39 are new. He directs particular attention to *Ophiotypa simplex* g. et sp. n., a remarkably simple form, in fact the simplest as yet known. It was also found at the Azores. Other remarkable new forms are—*Ophiopyrgus Alcocki*, the second species of this genus, *Ophiomastus tumidus*, *Ophiopyren bispinosus*, *Pectinura conspicua* with a very large disc, *Ophiochiton ambulator* with very long arms, &c. Atlantic forms were sparsely represented, but there were not a few already known Indo-Pacific forms. The absence of some widespread abyssal species, such as *Ophiomusium Lymani*, was striking.

Use of the Anchors in Synapta.‡—Herr Hj. Östergren has made a study of this problem. In 1842, Quatrefages suggested that the anchors of *Synapta* helped somehow or other in locomotion. Semper rejected this possibility, and asked whether they might not aid in tactile function. Cuénot showed that this could not be, but suggested that the anchors were raised (by pressure of the body-fluid) on the parts of the body which were for the time most stretched. But the fact is that the anchors on such parts are rather depressed than raised.

Östergren has examined about 30 species of *Synapta*, and believes that certain important structural characters of the anchors have been overlooked. As is well known, the anchors in *Synapta* are always connected with plates, the anchor resting with one end upon the plate which lies in a deeper stratum of the skin.

Each anchor has three main parts, the handle, the shaft, and the bow. The arms of the bow, as H. Lyman Clark also observed (1896), do not lie in the same plane as the shaft, but in one which forms an acute angle therewith, and always so that the points of the arms are directed outwards from the anchor-plate. In all the species examined, the anchors lay transversely to the longitudinal axis of the animal, parallel to the circular muscles.

The author proceeds to show in what seems conclusive detail that the anchors *do* assist very materially in locomotion by gripping the surface on which the animal moves. They also help in fixing the burrowing *Synapta*.

In *Ankyloderma*, the quite different anchors help in the attachment

* Résultats des Campagnes Scientifiques, fasc. xi. (1896) 57 pp., 4 pls.
† Zool. Anzeig., xx. (1897) pp. 166–70.
‡ Tom. cit., pp. 148–59 (7 pls.).

of the incrustations which mask the animal. The question whether the anchors may have a defensive function is left open.

New Zealand Holothurians.*—Prof. A. Dendy has re-examined the majority of the already known species of New Zealand Holothurians, especially with regard to the hitherto almost entirely unknown internal anatomy and spiculation. Four new species are described:—*Cucumaria Huttoni*, *Colochirus ocnoides*, *C. calcarea*, and *Psolus macquariensis*; and some corrections in the position of other forms have been made. The number of known species of New Zealand Holothurians stands now at 17, but four are doubtful, and two were obtained from deep water. It is remarkable that three of the New Zealand species, viz. *Cucumaria Huttoni*, *Colochirus alba*, and *C. ocnoides*, are provided with overlapping dermal plates, a condition which elsewhere does not appear to be at all common with the group. An interesting anatomical result is that *Chirodota dunedinensis* (probably identical with the 'Challenger' *Ch. australiana*) is shown to be unisexual, as opposed to the hermaphrodite condition supposed to be characteristic of the genus. A little-known type of spicule is described in a species of *Stichopus*; and some apparently new facts concerning the structure and development of the wheels of *Chirodota* are stated.

Cœlentera.

Classification of Antipatharia.†—Dr. L. S. Schultze proposes the following classification, differing in its general arrangement from that of Brook, which is duly discussed.

Family Antipathidæ Verrill (em. Brook).
- I. Sub-family: Dodekamerota (with 12 chambers).
  - *Leiopathes* Gray.
- II. Sub-family: Dekamerota (with 10 chambers) (em. Br.).
  - 1st Tribe, without peristomial folds.
    - 1. Subtribe Crustosæ, free only at ends.
      - *Savagliopsis*.
    - 2. Subtribe Ramosæ Br. (excl. *Leiopathes*), free and branched.
      - *Antipathes* Pall. (em. Schultze).
      - *Aphanipathes* Br.
      - *Parantipathes* Br.
    - 3. Subtribe Indivisæ, free and unbranched.
      - *Cirripathes* Blainv. (em. Br.).
      - *Stichopathes* Br.
  - 2nd Tribe, with two peristomial folds.
    - *Schizopathes* Br.
    - *Bathybathes* Br.
    - *Taxipathes* Br.
- III. Sub-family: Hexamerota (with six chambers).
  - *Cladopathes* Br.

The author discusses the possible relations of Antipatharia to Actiniæ, the genera of Ramosæ, and the spines of the skeletal axis. He

* Journ. Linn. Soc. (Zool.), xxvi. (1897) pp. 22–52 (5 pls.).
† Abh. Senckenberg. Nat. Gesellsch., xxiii. (1896) pp. 1–39 (1 pl.).

also describes some new species from Ternate:—*Antipathes delicatula*, *A. ternatensis*, *Aphanipathes thamnoides*, *Aph. spinulosa*, and *Parantipathes simplex*.

New Alcyonaria.*—Herr A. Schenk describes the new Clavulariidæ, Xeniidæ, and Alcyoniidæ in Prof. Kükenthal's Ternate collection. This included three new species of *Clavularia*, eight of *Xenia*, and five of *Sarcophytum*.

Prof. Kükenthal † deals with the Nephthyidæ and Siphonogorgiidæ, both very rich in new species. He describes five new species of *Nephthya*, nine of *Spongodes*, and *Ammothea carnosa* sp. n. The new genus *Paraspongodes* is established, resembling *Spongodes*, but without supporting bundles in the polypes. Two new species of *Siphonogorgia* are described. There are numerous taxonomic conclusions throughout the memoir, which ends with a discussion of the affinities of Nephthyidæ and Siphonogorgiidæ.

Gorgonacea of Ternate.‡—Dr. N. K. Germanos begins with a survey of the genus *Solenocaulon*. He finds it necessary to establish two subgenera—*Sclerosolenocaulon* (with a solid stem) for *S. tuberosa* Genth, *S. sterroklonium* sp. n., *S. diplokalyx* sp. n., and *Malacosolenocaulon* (without a solid stem), for *S. tortuosum* Gray, *S. akalyx* sp. n., and *S. grayi* Studer. Among Holaxonia, in the family Muriceidæ, *Echinomuricea coronalis*, *Acamptogorgia fruticosa*, and *Ac. acanthostoma*, are described as new species, and *Astromuricea* (with two species) as a new genus.

Actiniaria of Ternate.§—Herr C. R. Kwietniewski reports upon this part of Prof. Kükenthal's collection. The shore-fauna of Ternate is remarkably poor in Actiniæ, both as regards individuals and species, which may possibly be associated with the great abundance of other Actinozoa. Small though the collection was, its diversity was striking. Of the four forms, *Phellia ternatana* sp. n. belongs to the Sagartiidæ, *Radianthus Kuekenthali* g. et sp. n. to the Discosomidæ (Stichodactylinæ), *Thalassianthus senckenbergianus* sp. n. to a special tribe (Thalassianthæ), and *Parazoanthus dichroicus* Haddon and Shackleton to the tribe of Zoantheæ.

Craspedota.‖—Herr A. Ostroumoff describes the Cœlentera of the 'Atmanaï' expedition, including *Thaumantias mæotica* sp. n. (Thaumantidæ, Leptomedusæ), and *Mæotias inexpectata* g. et sp. n. (Petasidæ, Trachomedusæ).

Hydroids of Ternate.¶—Dr. B. v. Campenhausen begins his report with a general discussion of the basis of classification, which is so shifting and unsatisfactory as regards Hydroids. Among the peculiarities of the Ternate Hydroids may be noted the remarkable tendril-like structures which occur in many different types—*Aglaophenia macgillivrayi* Busk, *Pasythea hexodon* Busk, *Synthecium campylocarpum* Allm., *Calyptothujaria Clarkii* Markt., *C. opposita* sp. n., and *Caminothujaria moluccana* g. et sp. n. They serve, like the aerial roots of plants, for fixing the colony more securely, and like stolons for asexual multiplication.

* Abh. Senckenberg. Nat. Gesellsch., xxiii. (1896) pp. 41–80 (3 pls.).
† Tom. cit., pp. 81–144 (4 pls.). ‡ Tom. cit., pp. 145–87 (4 pls.).
§ Tom. cit., pp. 321–45 (2 pls.).
‖ Bull. Acad. Imp. St. Pétersbourg, iv. (1896) pp. 389–408 (1 pl.).
¶ Abh. Senckenberg. Nat. Gesellsch., xxiii. (1897) pp. 297–318 (1 pl.).

Another feature is the enormous size, as seen in *Hebella contorta* and *H. scandens.* Many forms are symbiotic; thus, on *Acanthella effusa* there sits a Sertularian, and on both *Hebella contorta* grows.

Ampullæ in Millepora.*—Prof. S. J. Hickson has found these cavities (in which he discovered a male medusiform gonophore in 1890), not only in *Millepora Murrayi*, but in other museum specimens, labelled *M. Schrammi*, *M. alcicornis*, *M. complanata*.

Porifera.

Lithonina.†—Prof. L. Döderlein describes *Petrostroma Schulzei*, representing a new group of Calcareous Sponges (Lithonina). The new form is Millepore-like or Polyzoon-like, and was found in deep water (200–400 m.) off the Japanese island of Enoshima. Only dry specimens were studied. The cortical layer consists of numerous free tetracts and triacts, besides dense bundles of peculiar forked spicules. In the deeper portions a connected framework has been formed by the fusion of tetracts with plump arms. It presents marked resemblances to the fossil Pharetrones, which are the only known calcareous sponges with a coherent skeleton. With these Dendy has also associated *Lelapia australis* Carter, in which forked spicules are united in rigid strands. But Döderlein points out that, in spite of the likeness of *Petrostroma* to certain Pharetrones, there is this great difference, that in the latter the spicules are united in bundles by some cementing substance, while in this new form a real fusion of spicules has occurred.

Protozoa.

Physiology of the Cell.‡—Dr. M. Verworn has continued his interesting observations and experiments on Protozoa. He has studied the phenomena of contractility and irritability in Red Sea Rhizopods—*Orbitolites complanatus*, *Amphistegina Lessonii*, *Hyalopus* (*Gromia*), *Dujardinii*, and a new form, *Rhizoplasma Kaiseri*. Among his conclusions we note the following:—(*a*) The transport of plasmic material in the cell is quite distinct from the propagation of a stimulus; (*b*) removal of oxygen acts first on the expansion of pseudopodia, secondly on their retraction, and ends in inducing paralysis of both; (*c*) the change from positive to negative thermotropism after a certain temperature is exceeded is due to the fact that the expansion and retraction phases have different limits. At 30°–32° C. for *Rhizoplasma* the expansion and retraction phase are equally stimulated; below this optimum of movement the expansion phase is most strongly stimulated, above the same optimum the contraction phase is most stimulated.

New Flagellata.§—Herr Hs. Meyer describes the following new species:—*Mastigamœba commutans*, *Dimorpha digitalis*, *D. bodo*, *Monas minima*, *M. amœbina*, *M. sociabilis*, *Ochromonas tenera*, *O. granulosa*, *O. variabilis*, and *O. chromata*. He also gives useful diagnoses of the

* Mem. and Proc. Manchester Lit. Phil. Soc., xli. part 2 (1897) Mem. 5, pp. 1–4.
† Zool. Jahrb. (Abth. Syst.), x. (1897) pp. 15–32 (5 pls.).
‡ SB. Akad. Wiss. Berlin, 1896, pp. 1243–54.
§ Rev. Suisse Zool., v. (1897) pp. 43–89 (2 pls.).

securely defined species in these four genera, and briefly discusses the Flagellata in general.

Protozoa of Salt Lakes.*—Dr. P. Butschinsky has studied the Protozoa found in two salt lakes or Limans near Odessa. They are more abundant in the lake with the less salinity, and they consist partly of freshwater and partly of marine species. The fauna of the two lakes is not the same, and in both cases very striking fluctuations occur.

New Radiolarian.†—Herr W. Karawaiew has secured another specimen of the remarkably simple new Radiolarian which he described last year, from Villafranca.‡ It has six diametral spicules in pairs, and is a spherical cell with a delicate external pellicle covered with minute papilliform elevations.

New Holotrichous Infusorian.§—Herr M. Rimsky-Korsakow describes *Dinobrya cylindrica* sp. n., found in the water tank of the Zoological Institute of St. Petersburg. The position of the mouth, the general shape, the ciliation, &c., point to its being a species of *Dinobrya*, of which *D. Lieberkühni* has been hitherto the only named form, though Lieberkühn and Eberhardt seem both to have observed the species under discussion. It differs from *D. Lieberkühni* in its cylindrical shape, in having 16 rows of 20–22 cilia instead of 20 rows of 16–18, and in the shape of the macro-nucleus, which is not spherical but slightly horse-shoe-shaped. The author refers the genus, as Schewiakoff does, to the family Cyclodina, in which it represents a first stage in the tendency to reduction of cilia.

Species of Trichodina.‖—Herr Hs. Wallengren describes *Trichodina pediculus* Ehrenberg, which he found on *Gastrosteus punzitius* and other freshwater fishes, as Zvennerstadt also did. The same form was found by H. James-Clark on *Hydra*, and minutely described. The previous description is in part amplified and in part corrected by Wallengren. He also describes *Trichodina mitra* v. Siebold from *Planaria lugubris*.

New Gregarine.¶—MM. A. Labbé and E. G. Racovitza describe *Pterospora maldaneorum* g. et sp. n., parasitic in *Leiocephalus leiopygos* and (?) *Clymene lumbricoides* at Roscoff. It is an acephalous pyriform Monocystid, with two groups of four digitiform retractile prolongations at the narrow end. Two individuals always occur together, united by the swollen ends. Spherical or oval cysts are formed after the encapsuling of two individuals. They do not sporulate separately. The cysts dehisce by simple rupture. The spores have dissimilar poles and eight (?) falciform sporozoites.

Coccidia of Myriopods.**—M. L. Léger finds in *Lithobius impressus* a new polysporous monozoic Coccidian parasite, allied to *Barroussia*. The genus *Coccidium*, characterised by a strong tetrasporous cyst with dizoic spores, is not quite confined to Vertebrates, as is usually believed;

* Zool. Anzeig., xx. (1897) pp. 194–7. † Tom. cit., pp. 193–4.
‡ Cf. this Journal, 1896, p. 427.
§ Biol. Centralbl., xvii. (1897) pp. 257–60 (1 fig.).
‖ Tom. cit., pp. 55–65 (6 figs.).
¶ Bull. Soc. Zool. France, xxii. (1897) pp. 92–7 (4 figs.).
** Comptes Rendus, cxxiv. (1897) pp. 901–3.

it is frequently represented in Centipedes. As to the trisporous forms and the genus *Bananella* of M. Labbé, an abortion of one of the tetraspores of the *Coccidium*-type may be sufficient explanation.

Life-Cycle of Coccidia.*—M. Louis Léger has studied various Coccidian parasites in Myriopods and Insects, and has come to the conclusion that in Arthropods the genus *Eimeria* does not represent a distinct parasite, but rather a stage in the life-cycle of a Coccidian. There seems to be no case known in which an Arthropod with Coccidia does not also include phases of an "Eimerian" cycle. The life-history of a Coccidian may thus be summed up:—"Eimerian sporozoite, encapsuled form, tetrasporous cyst (Coccidian), coccidian sporozoite (penetrating into the host), Eimerian budding, and then the Eimerian sporozoite again." The author proposes to show that the Eimerian sporozoite corresponds to the sporoblast of Gregarines, and the tetrasporous cyst of a Coccidian to the spore of Gregarines.

* Comptes Rendus, cxxiv. (1897) pp. 966–9.

BOTANY.

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

α. Anatomy.

(1) Cell-Structure and Protoplasm.

Influence of the Nucleus on the Formation of the Cell-wall.*—Prof. W. Pfeffer contests the statement of Palla † that an isolated non-nucleated mass of cytoplasm can form a cell-wall. This erroneous observation has arisen from overlooking connecting threads of protoplasm. From observations made on rhizoids and leaves of mosses, prothallia, *Chara*, leaves and hairs of flowering plants, pollen-tubes, &c., it would appear that the irritation necessary for the formation of a cell-wall is caused by the extremely fine protoplasm filaments which pass through the cell-wall and which constitute a living connection between neighbouring protoplasts. The same function belongs to masses of cytoplasm which lie in close apposition to a cell-wall, and which therefore maintain their connection with the protoplasmic filaments of the neighbouring cells. The existence and healthy life of an organism are dependent on the co-operation of the nucleus and cytoplasm.

Chromatin-reduction and Tetrad-formation in Pteridophyta.‡—Mr. G. N. Calkins describes the following phenomena in the formation of spores in *Pteris tremula* and *Adiantum cuneatum*, tracing their analogy to the corresponding processes in animals. The process of spore-formation can be divided into the three periods of division, growth, and maturation. The division period is the interval between the archespore and the 16-cell stage of the sporange. The growth period is the interval during which the 16 cells enlarge, and tetrads are formed. The maturation period includes the two successive divisions of the nuclei in the 16-cell stage and the formation of the spores. The cells of the division period are commonly known as the archesporial cells. For those of the growth-period the author proposes to replace the term spore-mother-cell by *primary sporocyte*, using also *secondary sporocyte* for the daughter-cells of the primary sporocyte. In the growth-period the chromatin forms a delicate moniliform spireme before the nucleole has disappeared. A much thicker spireme is subsequently formed from this moniliform thread. The thickened spireme then splits longitudinally. It next breaks up into half as many double spireme-segments as there are chromosomes in the somatic cells; each of these double elements forms a tetrad. Three types of tetrad-formation are found in each nucleus—the rod type, the ring type, and the cross type. In all three types, the tetrads are finally formed by a transverse division of the halves of the double spireme-segment.

Cell-Hypertrophies produced by Galls.§—M. M. Molliard describes the pathological hypertrophy of cells caused by the attacks of species of

* Ber. K. Sächs. Ges. Wiss. Leipzig, 1896 (1897) pp. 505–12.
† Cf. this Journal, 1890, p. 475.
‡ Bull. Torrey Bot. Club, xxiv. (1897) pp. 101–15 (2 pls.).
§ Rev. Gén. de Bot. (Bonnier), ix. (1897) pp. 33–44 (2 pls.).

Phytoptideæ on *Geranium sanguineum*, *G. dissectum*, species of *Bromus*, and *Galium Mollugo*. The changes which take place in the nucleus are especially striking. It is frequently increased enormously in size; and, in addition to the normal nucleole, contains a number of accessory or pseudo-nucleoles. In many of the cells attacked there are also bodies having the appearance of secondary nuclei. The nucleus frequently divides by simple constriction, without mitosis, or by a process of budding.

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

Oil in Leaves.*—According to researches made by Herr S. Rywosch on deciduous and evergreen flowering plants, Muscineæ, and Algæ, the oil contained in leaves (or other green organs) has an entirely different function from the oil contained in the stem, and cannot be regarded as a reserve food-material. Instead of being stored up in the winter and disappearing when the period of vegetative activity recommences, it remains, and even increases in amount, during the spring and summer, being very large even when the leaves have turned yellow in autumn. Its purpose appears to be to take up the xanthophyll. The diameter of the oil-drops usually varies between 5 and 18 μ, and there are most commonly several in a cell. The chemical nature of the oil, whether it belongs to the fatty or to the essential series, was not determined.

Volatile Reducing Substance in Green Cells.†—Herren T. Curtius and J. Reinke discuss the nature of the volatile reducing substance which is the first product of assimilation in green cells, and which they decide to be of the nature of an aldehyd. They propose for it the formula $C_7H_{11}O.CHO$, or occasionally $C_7H_9O.CHO$. Further details are given with regard to its chemical and physical properties.

Tannins in Fruits.‡—From experiments made chiefly on the fruit of *Diospyros*, M. C. Gerber concludes that one object of the presence of tannins in fruits is to prevent the formation of pectic substances, and hence the fermentation of their saccharine contents. The tannins finally disappear by oxidation, without giving rise to carbohydrates.

Production of Hydrocyanic Acid in the Pomeæ.§—M. L. Lutz states that amygdalin and emulsin are present in the seeds of plants belonging to the genera *Malus*, *Cydonia*, and *Sorbus*, but not in those of *Pyrus*, *Mespilus*, and *Cratægus*. In the Pomeæ emulsin was found in the parenchymatous cells of the cotyledons, especially in the neighbourhood of the vascular bundles, but not in the palisade-cells; none was found in the hypocotyl, plumule, or radicle. Amygdalin occurs in the cells of the cotyledons which contain emulsin, trituration giving rise to the odour of bitter almonds; it is also present in the hypocotyl, plumule, and radicle.

(3) Structure of Tissues.

Leptome of Angiosperms.‖—Herr F. Czapek describes the highly differentiated leptome of Angiosperms as consisting of three distinct physiologico-anatomical tissue-systems, viz. :—(1) The transport system,

* Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 195–200. † Tom. cit., pp. 201–10.
‡ Comptes Rendus, cxxiv. (1897) pp. 1106–8.
§ Bull. Soc. Bot. France, xliv. (1897) pp. 26–32.
‖ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 124–31.

composed of the sieve-tubes and the traces of the cambiform cells; (2) The absorption-system, consisting of the companion-cells, whose function is to take up the substances transported in the sieve-tubes, or to carry formative materials from the storing tissue, and to transfer them to the sieve-tubes; (3) The storing system, represented by the longitudinal parenchyme-traces of the leptome and by the leptome medullary rays, which store up in themselves the assimilated substances. The characteristic function of the leptome of the higher plants is the transport of both nitrogenous and non-nitrogenous formative materials; the conduction of the carbohydrates and oils taking place chiefly through the sieve-tubes and cambiform traces.

Formation of Periderm and Epiderm.*—From a series of experiments made by imbedding in gypsum on a number of different plants, Herr H. Tittmann finds a marked difference in their power of regeneration between the periderm and the epiderm. A regeneration of the periderm was found to take place in many cases under favourable circumstances, but not of the epiderm. The cuticle is, however, frequently re-formed afresh. A power of regenerating the layer of wax exists in some plants, but not in others. The process is independent of light.

Cork-Growths.†—Sig. E. Matteucci discusses the various kinds of cork-growth found in the leaves and other organs of plants, and classifies them, after Bachmann,‡ under two types, passing into one another by insensible gradations. In the first the cork-growth forms a prominent excrescence on the surface of the leaf, the cells being arranged in regular rows, with their walls parallel to the surface of the leaf. In the second type it extends deeper into the tissues of the leaf, and is of a spherical or hemispherical form, the cells arranged in rows radiating from the centre. The first type was the more frequent in the plants examined by the author. He supports the view of Bachmann and Borzì that these structures are morphologically and physiologically of the nature of lenticels.

Supernumerary Vascular Bundle in a Root.§—Dr. E. Paratore calls attention to the occurrence of this rare phenomenon in a secondary root of *Daphne melanophthalmus*. The bundle is intercalated between the elements of the secondary phloem, and was composed, in the example examined, of four dotted vessels, formed by the special activity of cambiform cells of the secondary phloem, and directly from cambial cells.

Anatomy of Chrysobalaneæ.‖—Dr. E. Küster describes the minute anatomy of a number of genera and species of this order, with special reference to the deposition of silica. This deposition of silica is, as a rule, strictly localised. In the greater number of genera the cell-walls are strongly silicified, and there are in addition minute granules of silica deposited within the cell. These occur in the leaves, especially in the neighbourhood of the veins, and in the axis. Other points of structure are also treated of in detail.

In another paper ¶ the author gives further particulars of the charac-

* Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) pp. 116–54.
† Nuov. Giorn. Bot. Ital., iv. (1897) pp. 224–43.
‡ Cf. this Journal, 1881, p. 74.
§ Malpighia, xi. (1897) pp. 82–4.
‖ Bot. Centralbl., lxix. (1897) pp. 46–54, 98–106, 129–39, 161–9, 193–202, 225–34 (1 pl.).
¶ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 134–8.

teristics of the two modes of deposition of silica, which he terms "Kieselkörper" and "Kieselfüllungen." The latter agree in character with the peculiar "tabaschir" of the Bambuseæ.

Structure of Diapensaceæ.*—Herr W. Grevel describes the anatomical and histological structure of several species belonging to this order of Ericales. Among the general characteristics of the order is the entire absence of secondary medullary rays in the stem. The primary vessels have, as a rule, but slightly thickened walls. The epidermal cells of the leaves have always wavy walls. The elements of the xylem, except the primary annular vessels, have, for the most part, bordered pits. No mycorhiza could be detected in the roots. The points of resemblance and difference with the allied orders of Ericales are pointed out.

Anatomy of Cissus gongylodes.†—M. H. Jumelle describes in detail the structure of this remarkable climber from Brazil, belonging to the Ampelideæ, of which the most striking characters are the broad winged stem, the red aerial roots springing from the nodes, and the tubercles formed at the ends of the branches, which become detached and serve to propagate the plant. These tubercles are modified internodes, in which are stored up large quantities of food-materials, especially starch and mucilage, The aerial roots, if uninjured, remain unbranched until they reach the soil, when they branch copiously. The exposure to the air has a tendency to increase the thickness of the central cylinder, with an increase of the size of the pith and of the medullary rays. In the light there is a large formation of calcium oxalate.

(4) Structure of Organs.

Influence of the Soil on the Colour of Flowers.‡—Herr H. Molisch has experimented on the influence of the chemical composition of the soil in changing the natural pink colour of the flowers of *Hydrangea hortensis* to blue. He finds that this change is invariably brought about by the presence of alum in the soil, and that the efficient constituent in the alum is aluminium sulphate, which has the same effect as alum. Ferric sulphate has a similar effect; while the result with other salts of iron was mostly negative. The blue colour is due to a chemical combination of the salts in question with the anthocyan, which is the cause of the natural red colour of the flowers. The most sensitive part of the flower to the change in colour is the filament.

Homology of the Anther.§—According to M. D. Clos, the filament of the stamen only very rarely represents the petiole of a leaf. In most Apopetalæ it corresponds to a linear petal, to the median vein, to a narrow longitudinal band of a broad sessile petal (Ranunculaceæ, Berberideæ), or to the claw of an unguiculate petal (Sileneæ, many Cruciferæ). In the Apopetalæ with polyadelphous stamens the staminal vessels are very frequently analogous to the veins of the petals, the number of these very often corresponding to that of the staminal phalanges. The anther, whether sessile, dorsifixed, or basifixed, is a

* Bot. Centralbl., lxix. (1897) pp. 257–67, 309–15, 342–7, 369–77, 401–11 (1 pl.).
† Rev. Gén. de Bot. (Bonnier), ix. (1897) pp. 129–49 (8 figs.).
‡ Bot. Ztg., lv. (1897) 1te Abt., pp. 49–61.
§ Comptes Rendus, cxxiv. (1897) pp. 808–10.

structure without analogy among vegetable organisms. It finds its nearest equivalent in the nucellus of the ovule; both structures being necessitated by their sexual functions.

The author further reminds botanists that he had anticipated van Tieghem in pointing out that in *Lepidoceras* (Loranthaceæ) the ovary is destitute of ovules, and that Decaisne had still earlier called attention to the absence of an ovarian cavity in the mistletoe.

Ovary of the Pomegranate.*—M. L. Gaucher describes the structure and development of the ovary of *Punica Granatum*. The chief peculiarity is that, in the course of development of the ovary, the receptacle undergoes a remarkable hypertrophy by which the loculi, at first horizontal, become basilar, and the axile placentation assumes the appearance of being parietal. An inferior row of three loculi is then formed below the original five ovarian cavities.

Ovule of Christisonia.†—Mr. W. C. Worsdell has followed out in detail the development of the ovule in this genus of Orobancheæ, and finds that it differs in no important respect from that in *Orobanche*. No tapetal cells were seen to be cut off from the archesporial cell. This cell first divides by a transverse wall into two equivalent cells. Each of these cells then divides again, so forming a row of four cells. Of these the hindermost, the one furthest from the apex of the ovule, alone increases in size, and gradually crushes and absorbs the three others. This is the young embryo-sac.

Seeds of Papilionaceæ.‡—Reverting to the structure of the seeds of *Vicia narbonensis*, Sig. L. Macchiati disputes the statement that they present no peculiarities of structure as compared with other allied species. The "twin tubercles" in the seeds of the Papilionaceæ are not correctly described as identical with a strophiole, although in many Phaseoleæ they present the appearance of two small projecting papillæ. In *Vicia Faba* the strophiole is rudimentary.

Symmetry of the Appendicular Organs.§ — M. A. Chatin calls attention to the importance of the symmetry of the appendicular organs as an indication of the degree of organisation. The general superiority of the Dicotyledones to the Monocotyledones is indicated by the rarity of verticillate leaves and the very frequent absence of a corolla in the latter. Among Dicotyledones a lower stage is indicated by the spiral arrangement of the carpels in some orders of Thalamifloræ (Ranunculaceæ). Further indications of a high type of structure are presented by the twisted or valvate æstivation of the corolla and the valvate æstivation of the calyx in some orders of Dicotyledones.

Red Spots on Leaves.‖—Sig. G. Mattej has investigated the nature of the red spots on the foliage-leaves, petals, and other organs of many plants, *Myrsine*, *Lysimachia*, *Oxalis*, &c. The pigment is composed essentially of a gum-resinous substance, coloured by a yellowish-red essential oil, its chemical constitution varying in different cases. They

* Journ. de Bot. (Morot), xi. (1897) pp. 121–4 (7 figs.).
† Journ. Linn. Soc. (Bot.), xxxi. (1897) pp. 576–84 (3 pls.).
‡ Bull. Soc. Bot. Ital., 1897, pp. 104–10. Cf. this Journal, 1893, p. 62.
§ Comptes Rendus, cxxiv. (1897) pp. 1061–8.
‖ Bull. Soc. Bot. Ital., 1897, pp. 83–8.

are not, as a rule, found in the earliest stages of the development of the organ, and are evidently formed by transformation from leucites. They are often surrounded by a membrane, and are always imbedded in the parenchyme, and surrounded by ordinary cells.

Dimorphic Branches of Castilloa.*—M. F. A. F. C. Went describes the peculiar habits of *Castilloa elastica*, a native of Java, belonging to the Urticaceæ, of producing, in addition to the ordinary branches, others which are cast off. These branches differ from the ordinary ones in their phyllotaxis, and bear no leaf-buds, although they may produce inflorescences in their leaf-axils. When the deciduous branches are thrown off, they leave a hollow in the stem. The purpose of the arrangement appears to be that the tree may form a crown of leaves at the summit of the stem.

Scales of the Bulbs of Allium.† — Dr. I. Baldrati discusses the morphological character of the hard scales found in the bulbs of certain species of *Allium* (*neapolitanum*, *Chamæmoly*, *roseum*), and determines them to be of an essentially foliar nature. They are always provided with a sclerotic stratum, and appear to serve a protective purpose to the remainder of the bulb. In *A. nigrum* all the stages of transformation can be followed, from the ordinary leaves to these fleshy structures, the green tissue being the first to disappear.

Underground Runners.‡—From observations made chiefly on *Erythronium americanum* and *Arisæma triphyllum*, Miss Ida A. Keller concludes that the production of underground runners or stolons in plants which possess these organs is in inverse proportion to the energy expended in the production of fruit and seeds.

Contractile Roots of Arum.§—Herr A. Rimbach describes the contractile roots which appear on the two-year-old rhizomes of *Arum maculatum*. The contractility is confined to the basal portion of the root, and may amount to as much as 50 per cent. of the length of this portion. The tendency is to drag the growing point further and further below the surface. A contraction to the extent of 18 mm. was measured on one root. On a mature rhizome only about one-half of the roots are contractile, and these are about double the diameter of the non-contractile ones. The contractile tissue is the cortical parenchyme; the central vascular cylinder and the outermost part of the cortex remaining passive.

Evolution of the Cyclamen.‖ — Mr. W. T. Thiselton-Dyer traces the development under culture of the various varieties of the *Cyclamen* from *C. persicum*; the most remarkable forms consisting in the fimbriation of the petals and in the appearance of a plumose crest on each petal. The author regards the general tendency of a plant varying freely under artificial conditions to be atavistic, i.e. to shed adaptive modifications which have ceased to be useful, reverting to a more general type.

* Ann. Jard. Bot. Buitenzorg, xiv. (1896) pp. 1–16 (3 pls.).
† Nuov. Giorn. Bot. Ital., iv. (1897) pp. 214–23 (1 pl.).
‡ Proc. Acad. Nat. Sci. Philadelphia, 1897, pp. 161–5 (1 pl.).
§ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 178–82 (1 pl.).
‖ Proc. Roy. Soc., lxi. (1897) pp. 135–47 (10 figs.); Nature, lvi. (1897) pp. 65–8 (10 figs.).

Structure and Affinities of the Grubbiaceæ.*—M. P. van Tieghem points out that this small order, composed of the two genera *Grubbia* and *Ophira*, usually included in, or placed near, the Santalaceæ, is not really nearly allied to that family. The bilocular ovary contains a true seed, and the order must be placed among the unitegminate apopetalous Seminatæ with inferior ovary; its nearest ally is the Bruniaceæ. The structure of the anther presents a fortuitous resemblance to that of the Hamamelideæ.

Vegetable Teratology.†—M. C. de Candolle classifies the various examples of vegetable teratology under two heads, *ataxinomic* and *taxinomic*. The former includes such abnormal structures as are not represented among plants in a normal condition, for example fasciation, torsion, chloranthy (when it does not result from the action of parasites), doubling of flowers (when resulting from the substitution of petals for stamens and carpels), and other less common abnormalities. The latter class comprises those abnormalities which correspond to taxinomic differences between species, such as the concrescence of leaf-sheaths usually distinct, the transformation of leaves or leaf-sheaths into pitchers, the formation of emergences or supernumerary laminæ, proliferation, the concrescence of cotyledons, synanthy, peloria, the arrest or abortion of some of the floral whorls, &c. The author points out that the general tendency of teratological structures is towards a greater simplicity of development.

β. Physiology.

(1) Reproduction and Embryology.

Embryogeny of Veronica.‡—Prof. A. Meunier has followed out the process of impregnation and the changes which take place during the development of the endosperm and the growth of the embryo and of the seed, in several species of *Veronica*. The embryo-sac is derived from the hypodermal cell at the summit of the ovule, the nucleus of which at once undergoes its first bipartition, followed, with great rapidity, by fresh divisions. When the pollen-tube enters the embryo-sac, the male nucleus penetrates the substance of one of the synergids, afterwards passing into the oosphere. After impregnation has taken place, the embryo-sac becomes completely divided into two parts by a constriction; the lowermost of these portions (which contains the antipodals) taking no part in the formation of the endosperm; and the same is the case with a portion which is divided off at the micropylar end of the sac. Of the eight nuclei which result from the third bipartition of the primary nucleus of the embryo-sac, only two take part in the formation of the endosperm, four remaining in the chalazal, and two in the micropylar portions of the sac, in which no endosperm is formed.

The variations in the further development of the embryo and of the seed are traced out in *Veronica hederæfolia*, *agrestis*, *persica*, *triphyllos*, and *arvensis*.

* Journ. de Bot. (Morot), xi. (1897) pp. 127–38.
† Arch. Sci. Phys. et Nat., iii. (1897) pp. 197–208.
‡ La Cellule, xii. (1897) pp. 297–334 (2 pls.). Cf. this Journal, 1894, p. 225.

Embryogeny of Salix.*—Mr. C. J. Chamberlain has followed out the development of the male and female organs and the process of impregnation in several American species of *Salix*. In the development of the pollen-grains, the division of the original nucleus into generative and pollen-tube nucleus takes place before the breakdown of the tapete. There is no dividing wall between the nuclei, as is the case in *Populus*. The cells of the tapete often contain two nuclei. The embryo-sac originates in a hypodermal cell at the apex of the nucellus. There are sometimes two or three archesporial cells, but it is rare for more than one to develop. The primary tapetal cell usually gives rise to a tier of three or four cells, but sometimes does not divide. The first division of the primary division of the embryo-sac is transverse. The antipodals apparently disappear at a very early period. The synergids have frequently a strongly developed "filiform apparatus." The egg-apparatus breaks through the wall of the embryo-sac, and projects into the micropyle. No tendency to chalazogamy could be detected, the pollen-tubes always entering the embryo-sac through the micropyle. The first division of the fertilised oosphere is always transverse; the second division is usually longitudinal, but sometimes transverse; the third is at right angles to the second.

Embryogeny of Conifers.†—Prof. J. M. Coulter publishes notes of a number of observations on the impregnation and embryogeny of Conifers, among which are the following:—In *Pinus Banksiana* there was observed, after the entrance of the apex of the pollen-tube into the oosphere, a peculiar bulging of the larger (female) in the direction of the smaller (male) nucleus, before conjugation. In *P. Laricio* a single embryo is frequently developed at the end of two, or even of four suspensors; occasionally two embryos at the end of a single suspensor. In *P. Banksiana* it appears to be the rule for the first one or two segmentations to be transverse.

Pollination by Bats.‡—Mr. J. H. Hart states that the flowers of *Bauhinia magalandra* sp. n., a large tree native of Trinidad, are pollinated by the agency of bats. The flower is white and strongly scented, and opens only in the evening, when it is visited by several species of bat, apparently not in search of the nectar, but of the insects which are attracted to the flower by its odour. They alight upon and hold fast to the protruded stamens, and appear to attack the erect and recurved petals, which are often completely destroyed; and in so doing carry the pollen from the anthers to the stigma.

Fertilisation of Spring Flowers.§—Mr. J. H. Burrill records the results of a long series of observations on the fertilisation of spring flowers on the Yorkshire coast, with a careful record of the visiting insects observed. As a general result he states that short-tongued flies predominate in early spring, and that they visit freely flowers with honey, whether hidden or exposed. Some early flowering species appear to derive no advantage from this precocity. Thus *Capsella bursa-pastoris*

* Bot. Gazette, xxiii. (1897) pp. 147–79 (7 pls. and 1 fig.).
† Bot. Gazette, xxiii. (1897) pp. 40–3 (1 pl. and 1 fig.).
‡ Bull. Misc. Information R. Bot. Garden Trinidad, iii. (1897) No. 10, pp. 30–1.
§ Journ. of Bot., xxxv. (1897) pp. 92–9, 138–45, 184–9.

frequently has abortive stamens; *Ranunculus Ficaria* is generally infertile; *Petasites vulgaris* is nearly always male; *Ulex europæus* and *Primula vulgaris* set but little fruit. In other cases the advantage of the early flowering is clearly in the flowers opening before the appearance of the leaves, which obstruct pollination, whether by wind or by insects.

Germination of Pollen-Grains.*—Prof. A. Hansgirg contests the opinion of Lindforss,† that those plants the pollen-grains of which perish in water, have their anthers and their stigmas protected in the flowers against the access of rain. He gives two long lists of plants whose pollen germinates readily in pure water; one of these lists being of species whose sexual organs are protected against rain, while in those of the other list there is no such protection. In a very large number of other plants the pollen-grains either do not germinate in water, or only with great difficulty.

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

Assimilating Energy of the Blue and Violet Rays of the Spectrum.‡—As the result of a series of experiments, chiefly on *Elodea* (*Anacharis*), Herr F. G. Kohl states the following general conclusions as to the part taken by the different rays of the solar spectrum in the evolution of oxygen from leaves. The assimilating energy of the red rays is about one-half that of undecomposed sunlight. The action of the blue rays is but little less than that of the red. The amount of oxygen given off in the green rays is not more than half that in the blue. The energy of the yellow rays is less, and that of the violet least of all. The author distrusts both the eudiometric method of measuring the energy of the process of assimilation, and the bacterium method of Engelmann. He prefers the results obtained by counting the bubbles of oxygen given off, and describes a process by which the actual volume of gas thus eliminated can be determined.

Reciprocal Influence of Stock and Graft on one another.§—M. L. Daniel records the results of grafting *Helianthus annuus* (annual and few-flowered) on *H. lætiflorus* (perennial and many-flowered) and *vice versâ*. He finds a direct reciprocal influence of stock and graft. The predominant effect of the stock is on the form of the assimilating tissue of the graft; it is also manifested in the flowering; the graft exercises an influence especially on the mode and duration of the development of the stock. In the passage of species of *Helianthus* to the latent state there may possibly be a substitution between lignification and the formation of tubers.

Influence of Chemical Reagents and of Light on Germination.‖—Dr. A. J. J. Vandervelde states that all chemical reagents used (salts of potassium, sodium, ammonium, barium, strontium, iron, and copper) have a prejudicial influence on the germination of seeds. Nitrates are more

* Oesterr. Bot. Zeitschr., xlvii. (1897) pp. 48–52. Cf. this Journal, *ante*, p. 138.
† Cf. this Journal, 1896, p. 437.
‡ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 111–24 (3 figs.).
§ Comptes Rendus, cxxiv. (1897) pp. 866–8.
‖ Bot. Centralbl., lxix. (1897) pp. 337–42.

injurious than chlorides ; sulphates less injurious than either. Salts of barium and strontium are less prejudicial than those of calcium. Potassium chromate and bichromate, cupric sulphate, and ferric sulphate, are especially poisonous.

Light appears to have no influence on the germination of seeds.

Influence of Light on Dorsiventral Organs.*—From observations made by Miss K. C. Burnett on leaves of *Salix alba*, it appears that when palisade tissue has once been formed on the surface of a leaf exposed to light, it cannot be changed, but that the parenchymatous tissue of the under surface, if exposed for a sufficiently long time to the action of light, will take on the characteristics of palisade tissue. Gemmæ of *Lunularia* will develop rhizoids on the morphologically upper surface when placed in contact with the soil, but only when the gemma is in a very young stage of development.

Assimilatory Inhibition.†—From a further series of observations made on a variety of plants, Dr. A. J. Ewart states that chloroplastids developed in darkness, whether they become green or are etiolated, may possess a fairly active power of assimilation corresponding to their size and depth of colour. The power of assimilation is absent whilst the etiolated leaf is quite young, and finally disappears again after the leaf has been kept for a long time in darkness. Etiolated leaves exposed to light in an atmosphere entirely deprived of CO_2 turn green, and may acquire an active power of assimilation, which, however, soon begins to weaken, and is in most cases rapidly lost. From experiments on *Chara* he finds that cells from which nearly all the chloroplastids had escaped could nevertheless still remain living, though incapable of regenerating fresh chlorophyll, for a period of a year.

Biology of Woody Plants.‡—Herr K. Reiche has investigated the structure and physiology of the wood of many plants belonging to widely separated natural orders, natives of Chile. He finds that the evergreen and the deciduous condition pass into one another by insensible gradations. They can, however, be classified into those which display an uninterrupted increase in thickness, and those in which the increase in thickness is periodically interrupted by periods of repose. The activity which brings about the increase in thickness precedes the unfolding of the leaves. When first formed, the new tissue is free from starch, while it is found abundantly up to the close of the previous period of growth.

Regeneration of Split Roots.§—As the result of experiments on plants belonging to widely separated natural orders—*Zea Mays*, *Vicia Faba*, *Philodendron robustum*, &c.—Herr G. Lopriore states that the regeneration of split roots always takes place by apical growth, the exact process being greatly dependent on the mode in which the section has been made. Regeneration may take place in all the tissues,—epiderm, cortex, and vascular system. A healing-tissue is formed in the inter-

* Bull. Torrey Bot. Club, xxiv. (1897) pp. 116–21 (1 pl.).

† Journ. Linn. Soc. (Bot.), xxxi. (1897) pp. 554–76. Cf. this Journal, 1896, p. 649.

‡ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) pp. 81–115.

§ Abhandl. K. Leopold.-Carol. Deutsch. Akad. Naturforscher, lxvi. (1896) pp. 209–86 (8 pls.).

cellular spaces of the layers of pith and cortex adjoining the wounded surface.

Transpiration of Tropical Plants.*—Herr A. Burgerstein gives the result of observations on the transpiration of plants growing in the hot moist climate of Java when protected both from direct insolation and from rain. He does not confirm the statement of Haberlandt that in these conditions the amount of transpiration is much less than in the temperate climate of Central Europe.

(3) Irritability.

Periodic Movements of the Leaves of Mimosa in the Dark.†—From a series of observations on the periodic movements of the leaves (chiefly of *Mimosa pudica*) in the dark, Herr L. Jost comes to the conclusion that they are dependent entirely on changes in temperature; the effect being the reverse of that which takes place in the case of flowers. An increase of temperature induces the nocturnal, a decrease of temperature the diurnal position. The phenomena are the same with etiolated as with green leaves.

Growth and Curvature of Phycomyces.‡—According to M. G. Bullot, the following laws govern the growth and curvature of the sporangiophores of *Phycomyces nitens*. At the commencement of the heliotropic or geotropic curvature, there is no accumulation of protoplasm on the concave or decrease on the convex side of the filament; these take place only at a later period of the curvature. When two mycelial filaments, at any period of their development, come into contact with one another, their growth is at once or very quickly arrested, and the apices of the filaments become gradually more slender. The sporangiophores grow more rapidly in a continuous light than in the dark.

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

Formation of Diastase.§—Prof. W. Pfeffer describes the result of experiments made for the purpose of determining the conditions under which diastase is formed in plants. The subjects were *Penicillium glaucum*, *Aspergillus niger*, and *Bacterium megaterium*. An increase in the amount of sugar in the substratum had always the effect of decreasing the production of diastase; but this result was not produced when the sugar was replaced by another carbohydrate or by glycerin or tartaric acid. The arrest in the production of diastase is not a purely chemical or physical phenomenon; it is rather a phenomenon of irritation exerted on the organism by a solution of sugar of a certain degree of concentration.

Germination of the Almond.‖—M. Leclerc du Sablon states that the changes which take place in the germination of the almond conform to those which are characteristic of oily seeds in general. The oil is gradually digested, a certain quantity of fatty acids being at the same time set at liberty. The chief product of the decomposition of the oil is a

* Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 154–65.
† Bot. Ztg., lv. (1897) pp. 17–48 (5 figs.).
‡ Ann. Soc. Belge Microscopie, xxi. (1897) pp. 61–93 (1 pl. and 1 fig.).
§ Ber. K. Sächs. Ges. Wiss. Leipzig, 1896 (1897) pp. 513–8.
‖ Rev. Gén. de Bot. (Bonnier), ix. (1897) pp. 5–16. Cf. this Journal, 1895, p. 551.

non-reducing sugar which may be included among the saccharoses, and which is, in its turn, transformed into a glucose which can be directly assimilated.

Fermentation produced by Moulds.*—Herr O. Emmerling states that by the action of *Mucor racemosus* on 100 grm. of sugar-cane in a solution containing 2 grm. potassium phosphate, 1 grm. magnesium sulphate, and 5 grm. potassium nitrate, in 1500 grm. of water, large quantities of CO_2 are produced, together with about 1·46 per cent. of ethylic alcohol.

Influence of Temperature and Nutriment on the Respiration of Fungi.†—As the results of a series of experiments on mould-fungi (*Sterigmatocystis nigra*), M. G. Gerber has demonstrated that the special value of the proportion $\frac{CO_2}{O}$ observed in the case of ripe fruits which are not acid, and of those which have lost their acidity in the process of ripening (less than unity), is due to the absence of a vegetable acid. The same is the case with acid fruits at a low temperature. The special property of malic acid—that of being consumed at a low temperature in the presence of sugar—is probably the reason why apples ripen at a lower temperature than oranges or grapes.

γ. General.

New Classification of Flowering Plants.‡ — M. P. van Tieghem proposes a fresh classification of Phanerogams, dependent on the structure of the seed. The first division is into the SEMINATÆ or PEROVULATÆ, and the INSEMINATÆ. The first of these, comprising the vast majority of flowering plants, furnished with true seeds, is again divided, according as the seed has one or two integuments, into the Bitegminatæ and the Unitegminatæ.

In the Inseminatæ the fruit does not contain any distinct seed which can be separated or which completely detaches itself at maturity. In order to germinate, the fruit must be sown entire. The embryo is formed only at a comparatively late period. These are again divided into 5 groups, the lowest being the Inovulatæ already described, which are entirely destitute of true ovules. The remaining 4 groups, the TRANSOVULATÆ, are furnished with transitory ovules. The lowest of these 4 groups is the INNUCELLATÆ; the other 3 being designated, according to the number of coats of the temporary ovules, the INTEGMINATÆ, UNITEGMINATÆ, and BITEGMINATÆ.

In the UNITEGMINATÆ or ICACININEÆ are comprised 10 orders—the Leptaulaceæ, Iodaceæ, Phytocrenaceæ, Sarcostigmataceæ, Icacinaceæ, Pleurisanthaceæ, Emmotaceæ, Strombosiaceæ, Ximeniaceæ, and Tetrastylidiaceæ; the first 7 comprising the ICACINALES in which the carpels are bi-ovulate, the remaining 3 the XIMENIALES with uniovulate carpels. The total number of genera is 52. They are all dichlamydeous, with anatropous ovules; the fruit is always a drupe, with endosperm and usually an oily embryo.

* Ber. Deutsch. Chem. Gesell., xxx. (1897) pp. 454–5. See Journ. Chem. Soc., 1897, Abstr., p. 223. † Comptes Rendus, cxxiv. (1897) pp. 162–4.
‡ Comptes Rendus, cxxiv. (1897) pp. 590–5, 839–44, 871–6, 919–26. Bull. Soc. Bot. France, xliv. (1897) pp. 99–139. Cf. this Journal, *ante*, p. 216.

The Bitegminatæ comprise at least 315 genera. Of the 7 orders included in it, the Coulaceæ, Heisteriaceæ, Cathedraceæ, Scorodocarpaceæ, Chaunochitaceæ, and Erythropolaceæ are dicotyledonous, and make up the family HEISTERINEÆ. They are all dichlamydeous; the pistil is composed of syncarpous carpels forming a plurilocular ovary, the carpels are uniovulate, and the fruit is a drupe with fleshy exocarp. The remaining (monocotyledonous) order is the Gramineæ, forming the family GRAMININEÆ.

The author further points out the inaccuracy of the accepted terms for the primary divisions of Phanerogams, the Angiosperms and Gymnosperms; seeing that in the Ephedraceæ, Welwitschieæ, Gnetaceæ, Araucarieæ, and Podocarpeæ, all of which are usually included in the Gymnosperms, the seed is as completely enveloped in an ovary as it is in the Angiosperms. He prefers a primary classification into those with and those without a stigma, the STIGMATÆ and the ASTIGMATÆ, the latter being identical with the Archegoniatæ; but even this character is not without exception, the Welwitschieæ being actually stigmatic and anarchegoniate.

Alternation of Generations.*—Right Hon. Sir E. Fry brings forward objections to the theory of an alternation of generations in the higher Cryptogams. He maintains, in the first place, that there is no fixed and impenetrable barrier between the oophore and the sporophore generations, one of them not unfrequently passing over into the other. The different generations in the life-history of any given plant are not separate organisms, but different parts or stages of the same organism. The reproductive energy operates in plants in such a variety of ways as to render it improbable that the facts of reproduction can, with our present knowledge, be reduced to any one scheme, or referred to any single archetype.

Plankton-Flora of the Swiss Lakes.†—Dr. C. Schröter gives a comparative account of the plankton-flora (Bacteria, Cyanophyceæ, Peridineæ, Diatomaceæ, Chlorophyceæ, Phanerogamia) of the lakes of Zürich, Constance, Lucerne, and Geneva. The conditions favourable or otherwise for the appearance of these organisms are discussed, and the variations which some of them exhibit in form and structure in the different lakes, and in others outside the limits of Switzerland.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Cheirostrobus a new Type of Fossil Cone.‡—Dr. D. H. Scott describes a remarkable fossil from the Calciferous Sandstone near Burntisland, which he makes the type of a new genus *Cheirostrobus*, from the palmate division of the sporophyll-lobes, the sporophylls themselves being arranged in crowded whorls. He regards it as most nearly allied to *Sphenophyllum* among the Pteridophyta.

* Nature, lv. (1897) pp. 422–7.
† Neujahrsbl. (1897) v. d. Naturf. Gesell. Zürich (60 pp., 1 pl., and 3 figs.).
‡ Proc. Roy. Soc., ix. (1897) pp. 417–24. Ann. of Bot., xi. (1897) pp. 168–75.

Muscineæ.

Archegone of Muscineæ.*—M. L. A. Gayot regards the archegone of the Muscineæ as altogether homologous with the same organ in the Vascular Cryptogams, and gives the following results of observations on its embryogeny.

The archegone of the Hepaticæ developes not only by intercalary, but also by terminal growth. In the Musci this terminal growth contributes greatly to the elongation of the female axis. The canal-cells are not derived from the terminal cell, either in the Hepaticæ or in the Mosses. The neck-canal-cells always have the same origin, viz. an initial detached from the mother-cell of the oosphere. The mode of development of the archegone differs in the Anthoceroteæ from that in the other families of Muscineæ. The archegone of the Sphærocarpeæ has 5 rows of neck-cells, as in the Jungermannieæ; they are sessile, like those of the Riccieæ. The pedicel cell is but little developed in the Targionieæ, indicating a passage from the Riccieæ to the Marchantieæ. The archegone of the Targionieæ is asymmetrical, like that of the Sphærocarpeæ and of many Marchantieæ. In the Marchantieæ the number of neck-canal-cells is 8, not 4. In *Marchantia* it is possible for the ventral canal-cell to be impregnated. In the thallose Jungermannieæ the neck of the archegone has as often 6 rows of cells as 5. In the Sphagnaceæ the ventral portion of the archegone has not always 4 layers of cells; the neck has usually only a single layer, except in its lowest portion. The archegone of *Anthoceros* has 4 canal-cells.

In the diœcious Muscineæ, the tufts of male and female plants are often at considerable distances from one another, fecundation being effected by animals.

Ochrobryum.†—M. E. Bescherelle gives a monograph of this genus of Leucobryaceæ, with the following diagnosis:—Theca in pedunculo brevissimo immersa, hemispherica, cyathiformis; operculo e basi conica longe subulato, rostrato; peristomio nullo; calyptra longissime anguste subulata, basi lacera laciniis breviter fimbriatis. Sixteen species are described, of which seven are new, from Asia, Africa, and America.

Gyrothyra, a new Genus of Hepaticæ.‡—Under this name Mr. M. A. Howe describes a new genus from California, nearly related to *Nardia*, with the following diagnosis. Stem creeping, foliose, somewhat branched. Leaves succubous; under-leaves free, bifid; walls of the leaf-cells with triangular thickenings at the angles. Antherids shortly stalked, in the axils of smaller saccate leaves, forming short median or at first terminal spikes. Involucral leaves in 2–4 pairs. Perianth terminal, confluent for half its length or more with the bases of the involucral leaves, the greater part of the calyptra, and the tissues of the stem, to form a thick-walled perigyne, with a small bulbous or saccate base. Perigyne erect or ascending, making, when mature, nearly a right angle with the stem. Capsule cylindrical, long-exserted, dehiscing spirally by four very long and slender valves; capsule-valves of two

* Comptes Rendus, cxxiv. (1897) pp. 781–5.
† Journ. de Bot. (Morot), xi. (1897) pp. 138–53 (7 figs.).
‡ Bull. Torrey Bot. Club, xxiv. (1897) pp. 201–5 (2 pls.).

layers of cells; the walls entirely destitute of spiral, semi-annular, or other local thickenings. Elaters free, bi-spiral, acute or bluntly pointed. Spores minutely papillose. Involucel of the sporogone-foot well developed.

Exormotheca.*—H. Graf zu Solms-Laubach has studied in detail the structure of this little-known genus of Hepaticæ from Madeira and Teneriffe, in which he includes also *Myriorhynchus* (*Riccia*) *fimbriatus* from Brazil, and corrects the descriptions of previous observers on several points. The systematic position of the genus he considers to be in the Marchantieæ, nearest to *Lunularia* in the structure of the carpocephalum. It presents also analogies with the Corsinieæ, and especially with *Boschia*; but the elaters are of quite normal structure.

Algæ.

Structure and Multiplication of Pyrenoids in Algæ.†—According to observations made by M. W. Chmilewskij, chiefly on *Spirogyra*, the pyrenoids of Algæ multiply exclusively by division. The granules of the starch-envelope are not separated from the pyrenoid by chromatophore substance; the two are in close apposition. The pyrenoid has a stellate form, its arms extending between the granules of the starch-envelope. This was observed also in other Conjugatæ, in *Œdogonium*, *Cladophora*, and many Protococcaceæ. After division of the nucleus and of the cell has taken place (in *Zygnema*), each daughter-cell contains a single chromatophore and pyrenoid. After about 1½ hours the chromatophore begins to divide centrifugally. The pyrenoid increases somewhat in size, and gradually divides, the nucleus becoming forced into the cavity thus formed in it; and the starch-envelope divides into two. In a very few instances the division of the pyrenoid preceded that of the cell. The division of the pyrenoid is followed by a longitudinal splitting of the protoplasm filaments which radiate from the nucleus. In the zygotes the pyrenoids of the female chromatophores are still to be detected, their starch-envelopes not having entirely disappeared.

Antherids of Taonia.‡—M. C. Sauvageau describes the male organs of *Taonia atomaria*, which agree, in essential points, with those of *Dictyota*. The plants which bear antherids are distinguishable, even at a distance, from those which produce tetraspores.

New African Genera of Freshwater Algæ.§—In a paper on the Freshwater Algæ of Africa, chiefly Angola, Messrs. W. and G. S. West describe a large number of new species, together with the following new genera:—

Psephotaxus. Thallus subfilamentosus, epiphyticus; fila brevissima, serie 3–7 cellularum formata, solitaria, subirregularia, et flexuosa, simplicia v. pseudoramosa, in muco firmo achroo nidulantia; cellulæ formarum et magnitudinum variarum, subglobosæ, ellipticæ, oblongæ

* Bot. Ztg., lv. (1897) 1te Abt., pp. 1–16 (1 pl.).
† 10 pp., 1896 (Russian). See Bot. Centralbl., lxix. (1897) p. 277.
‡ Journ. de Bot. (Morot), xi. (1897) pp. 86–90 (1 fig.).
§ Journ. of Bot., xxxv. (1897) pp. 1–7, 33–42, 71–89, 113–22, 172–83, 235–43 (5 pls.).

v. subpyriformes, sæpe curvatæ; membrana cellularum crassissima et insigne lamellosa; contentum cellularum granulosum. Incrementum plantarum bipartitione cellularum intercalari. Under Ulotrichaceæ.

Temnogametum. Cellulæ vegetativæ ut in *Mougeotia*, cylindricæ, chromatophoro elongato complanato, pyrenoidibus uniseriatim dispositis. Propagatio zygosporis, conjugatione scalariformi lateralive cellularum brevium specialium abstrictarum format's. The type of a new family of Conjugatæ, TEMNOGAMETACEÆ, characterised by the conjugation taking place only between cells specially abstricted.

Pyxispora. Cellulæ vegetativæ ut in *Zygnema*, conjugatione scalariformi; zygosporæ tubam conjugantem totam inter filamenta complentes; zygosporæ e parte solum contenti cellularum formatæ, elliptico-oblongæ v. ellipsoidæ, cum porca cingente in planitie diametrorum brevissimorum et rima circumscissa secundum porcam. Under Zygnemaceæ.

Ichthyocercus. Cellulæ cylindrico-fusiformes, subelongatæ, ad medium leviter constrictæ; a fronte visæ lateribus subparallelis, apicibus basibusque semicellularum in latitudine subæqualibus (nonnunquam apicibus paullo angustioribus v. paullo latioribus), depressione late minime profunda ad apices per latitudinem totam, spina brevi leviter divergente ad angulum unumquemque instructæ; a vertice visæ subcirculares. Among Desmidieæ, near *Tetmemorus* and *Euastrum.*

Athroocystis. Plantæ aquaticæ, familias parvas formantes, in strato denso pulverulento aggregatas; familiis e cellulis numerosissimis compositis, intra tegmentum tenuissimum firmum non mucosum dense confertis. Propagatio ignota. Placed in Palmellaceæ.

Conjugation of two Zygotes.*—Herr C. P. Lommen has observed the conjugation with one another of two zygotes in a fertile filament of a *Spirogyra* sp.

Calcareous Algæ.†—Miss J. E. Tilden enumerates and describes the algæ which live in a calcareous or siliceous matrix found in Minnesota. One side of a tank was found to be covered by a calcareous incrustation exhibiting various colours, and permeated by three algæ (Protophyta) belonging to the Cyanophyceæ, *Dichothrix calcarea*, *Lyngbya martensiana calcarea*, and *L. nana.* With them is associated a fungus corresponding to the chlamydospore-filaments of *Pseudohelotium granulosellum.* The other three sides of the tank were covered by a coating of *Chætophora calcarea*, together with a *Lyngbya*, the two appearing to carry on a kind of symbiotic existence. The five algæ have apparently, either alone or in combination, the power of causing the precipitation of calcium carbonate from the water. On white sandstone cliffs above the Mississippi river, and imbedded in the rock to the depth of at least half an inch, was found another remarkable alga, *Schizothrix rupicola.*

Chlorogonium.‡—Herr R. H. Francé describes the structure of this little known genus of Algæ. The chromatophores form, in the simplest case, a regular or irregular annular band, which may split into a single or double spiral. The chromatophores of the swarm-cells and those

* Arch. Mikr. Anat., xlix. (1897) p. 462 (1 fig).
† Bot. Gazette, xxiii. (1897) pp. 95–104 (3 pls.).
‡ Természetrajzi Füzetek, xx. (1897) pp. 287–308 (1 pl.). See Bot. Centralbl., lxx. (1897) p. 197.

of the microgametes exhibit no essential difference. The cell-wall is striated, the striation consisting of two intercrossing systems of lines. The cilia are inserted in a tubular sheath. The pulsating vacuoles remain for a time in the zygotes. The author unites with *Chlorogonium* Dangeard's genus *Cercidium*.

New Gongrosira.* — Under the name *Gongrosira trentepohliopsis*, Herr W. Schmidle describes a new species of this genus with two different forms of zoosporange, one of which bears a close resemblance to those of *Trentepohlia*. Different species of *Gongrosira* are regarded by algologists as stages of development of species belonging to *Vaucheria*, *Cladophora*, and other species of algæ.

Uroglena.†—Mr. G. T. Moore gives the following amended description of the remarkable organism *Uroglena americana*, which he considers (if a plant) to belong to the multicellular Chrysomonadaceæ of the class Syngeneticæ:—Cœnobe irregularly spherical, varying greatly in shape and size, averaging 200–300 μ; no peripheral canals nor internal network of threads; revolving slowly through the water by means of the cilia of individual cells; individual cells spherical or occasionally slightly elliptical, never produced into an appendage at the end towards the centre of the colony; two cilia of unequal length, 15–20 μ and 2–4 μ respectively, the longer one with decided undulatory motion; a red spot at the base of the cilia, and a single chromatophore of a yellowish-green colour, usually occupying one side of the cell and clinging close to its wall; nucleus, non-contractile vacuoles, and numerous oil-globules present. Under certain conditions it is possible for an individual cell to lose its cilia, and to go into a resting stage, often forming a thick gelatinous wall. No mode of sexual reproduction was observed.

Coccospheres and Rhabdospheres.‡—Mr. G. Murray and Mr. V. H. Blackman record the dredging of these organisms, which they regard as incrusted Algæ, from the West Indian seas. In the coccospheres the calcareous scales or coccoliths overlap each other. This arrangement, unlike that of diatoms, admits of the growth of the organism. Each coccolith is attached to the cell by a button-like projection on its inner surface. In the rhabdospheres with projecting rods, the plates do not fit into each other, but their bases are imbedded in the surface of the cell, each by itself without contact. A granular protoplasmic substance was detected within both the coccospheres and the rhabdospheres, but no colouring matter.

Fungi.

Endophytic Mycorhiza.§—M. J. M. Janse has examined the roots of 75 species of plants (including Gymnosperms, Pteridophyta, and one liverwort) in the forests of tropical Java, and finds 69 of them infested with an endophytic mycorhiza, the arborescent species examined affording no exception. The filaments offer a close resemblance in all cases; and the author discusses the resemblances and differences between

* Oesterr. Bot. Zeitschr., xlvii. (1897) pp. 41–4 (1 fig.).
† Bot. Gazette, xxiii. (1897) pp. 105–12 (1 pl.).
‡ Nature, lv. (1897) pp. 510–11 (8 figs.).
§ Ann. Jard. Bot. Buitenzorg, xiv. (1896) pp. 53–201 (10 pls.).

the structure of these and that of *Bacillus caucasicus*, *Rhizobium*, *Frankia*, and *Clostridium Pasteurianum*.

With the exception of the tubercles of *Lycopodium cernuum*, the filaments of the parasite always enter the tissue by perforating the external wall of an epidermal cell. The roots thus attacked are usually, though not always, destitute of root-hairs. It is most commonly the younger parts of the roots that are attacked, but the position of the tissue chiefly infected differs in different cases. The intercellular spaces may also be attacked, or may be left free. The attacking hyphæ are in some cases characterised by the formation of "vesicles," apical swellings which appear to assist in their penetration of the tissues. Within the cells of the internal layers of the infected tissues, they also form bodies which the author terms "sporangioles," globular structures varying in diameter from 2·5 to 23 μ, filled at first with a hyaline substance which subsequently becomes granular, and is composed of spherical corpuscles, which he designates "spherules," varying between 1·5 and 6 μ in diameter.

The author regards the connection of parasite and host as one of true symbiosis, the parasite furnishing to the host nitrogenous food-materials, which it obtains by assimilating the free nitrogen of the atmosphere, while it receives protection in return, as well as food-material in the form of carbohydrates. It is in fact a facultative aerobe, which penetrates living tissues for the purpose of avoiding oxygen.

Laboulbeniaceæ.*—Mr. R. Thaxter publishes a monograph of this remarkable family of Fungi, belonging to the Ascomycetes, but displaying singular affinities with the Florideæ. They are all parasitic on living insects, mostly aquatic, and are for the most part American. Of the 28 genera only 9 have at present been found in the Old World. The genera are arranged in two groups—the Endogenæ, in which the antherozoids are formed endogenously in antherids, 26 genera; and the Exogenæ, in which the antherozoids are formed exogenously, 2 genera. The Endogenæ are again divided into the Peyritschielleæ, 11 genera, with compound antherids, and the Laboulbenieæ, 15 genera, with simple antherids. Each of these orders includes monœcious and diœcious genera.

The main body of the fungus is usually quite simple in structure, composed of several cells, and is attached by a disc-like base to the chitinous integuments of the insect; there is no mycele in the body of the host. Towards the summit of the filament are filamentous appendages which bear the antherids; lower down is the procarp, a multicellular structure containing a carpogenic cell, and bearing a trichogyne. After fertilisation the carpogenic cell divides several times, and develops the asci; while these are being differentiated, the sterile cells of the procarp form the wall of the perithece. The perithece is usually a flask-shaped body, opening by a pore at the apex, and resembling in many respects the cystocarp of the Florideæ. The ascospores are usually discharged in pairs from the perithece. The antherozoids (pollinoids) are very minute, and are often rod-shaped; they attach themselves in large numbers to the trichogyne, but the actual fusion has not been observed. The trichogyne may be simple or much branched, and may consist of a

* Mem. Amer. Acad. Arts and Sci., xii. (1896) pp. 187–429 (26 pls.). See Bot. Gazette, xxiii. (1897) p. 216. Cf. this Journal, 1896, p. 218.

single cell, or may be a compound multicellular structure. It is never attached directly to the carpogenic cell; the fertilising process must be carried through one or through several cells before it reaches the carpogenic cell. The cells of the trichogyne communicate with one another through strands of protoplasm; and the author believes that the nucleus of the antherozoid must pass the length of the trichogyne from cell to cell before finally fusing with the female nucleus of the carpogenic cell.

New Genera of Fungi.*—M. N. Patouillard describes, under the name *Cyclostomella*, a new genus of Hemi-hysteriaceæ from Costa Rica, with the following diagnosis:—Stromata foliicola, orbicularia, dimidiato-scutata, centro adfixa; perithecia radiantia, in stromate circulariter disposita, ostiolis hysterioideis donata; sporidia ovata, simplicia, brunnea; mycelium superficiale nullum.

Cryptophallus g. n. is separated from *Ithyphallus* by Mr. C. H. Peck,† on the ground of the volva rupturing in a somewhat circumscissile manner, the upper part of it being carried up and remaining on the pileus, persistently concealing the stratum of spores. It consists of a new American species, *C. albiceps*.

Mr. J. D. Ellis and Mr. F. D. Kelsey ‡ separate from *Æcidium* a new genus *Æcidiella*, distinguished by its uniseptate spores. Several species are described.

From Java, M. E. de Wildeman § has obtained a new genus of Mucorini, which he names *Massartia*, with the following diagnosis:—Mycele ramifying in the substratum (the mucus of terrestrial Algæ); zygospores produced in a ball of interwoven filaments, which are thicker than the other portions of the mycele, globular, formed by the fusion of the apices of two mycelial branches; membrane which separates the zygospore from the mycelial filaments often thickened; zygospores smooth, with a comparatively thick wall. Sporanges unknown.

Endophytic in the roots of a *Celtis* in the forests of Java, M. J. M. Janse ‖ finds a fungus, which he regards as the type of a new genus of Elaphomycetaceæ, and names *Celtidia duplicispora*. The genus differs from others of the order in its (probably) parasitic habit, and in its septated spores, which do not occur in any other member of the Tuberaceæ.

Tubeuf's Parasitic Diseases of Plants.¶—An English edition has now appeared of this standard work on the Cryptogamic diseases of Plants. The 1st part is divided into 9 chapters, viz.:—The Parasitic Fungi; Reaction of Host to parasitic attack; Relation of Parasite to substratum; Natural and artificial infection; Disposition of Plants to disease; Preventive and combative measures; Economic importance of diseases in plants; Symbiosis: Mutualism; and Symbiosis: Nutricism. The 2nd part is devoted to a Systematic Arrangement of the Cryptogamic

* Bull. Herb. Boiss., iv. (1896) pp. 655–6.
† Bull. Torrey Bot. Club, xxiv. (1897) p. 147.
‡ Tom. cit., p. 208.
§ Ann. Soc. Belge Microscopie, xxi. (1897) pp. 25–7 (1 pl.).
‖ Ann. Jard. Bot. Buitenzorg, xiv. (1896) pp. 202–6 (1 pl.).
¶ 'Diseases of Plants induced by Cryptogamic Parasites,' by Dr. Karl Freiherr v. Tubeuf; English edition by W. G. Smith. London, 1897, xvi. and 598 pp. and 330 figs.

Parasites; all the known species being fully described:—the higher and lower Fungi; the Pathogenic Slime-Fungi (Myxomycetes); the Pathogenic Bacteria; the Pathogenic Algæ. The book is admirably illustrated; and there is a copious index. It may be regarded as a complete monograph of the Fungi and other cryptogamic parasites which are pathogenic to plants.

Rusts of Corn.*—Herr J. Ericksson sums up the present state of our knowledge respecting the species of *Puccinia* parasitic on corn-crops. There are now known 10 forms belonging to 5 rĕputed species, viz.: (1) *P. graminis*, one form on rye and barley, another on oat, and a third on wheat; (2) *P. dispersa*, one form on rye and another on wheat; (3) *P. glumarum*, one form on rye, another on wheat, and a third on barley; (4) *P. simplex*, on barley; (5) *P. coronata*, on oat. Of these 10 forms it is only those of *P. graminis* on rye and barley which occur also on other kinds of grass, viz. both of them on *Triticum repens*, *T. caninum*, *Elymus arenarius*, *Bromus secalinus*, *Hordeum jubatum*, &c.; the latter also on *Dactylis glomerata*, *Alopecurus pratensis*, *Milium effusum*, *Avena elatior*, *A. sterilis*, &c. He confirms observations already made as to the *mycoplasm*-condition assumed by certain parasitic fungi.

New Conidial Form of Chætomium.†—On a Brazilian bark, M. E. Boulanger finds a hitherto undescribed fungus, which he names *Dicyma ampullifera*. Under certain conditions of culture, this fungus can be reduced to an atrophied *Sporotrichum* form, while its most perfect form is a *Chætomium*, which will develop only on banana-leaves or on wood. The perithece produced in this form is that of a Pyrenomycete belonging to the family of Sphæriaceæ. The author names it *Chætomium Zopfii*, *Dicyma ampullifera* being its conidial form.

Venturia and Fusisporium.‡—Dr. R. Aderhold gives a *resumé* of the species of this family of Pyrenomycetes, the perithecial forms of which are known as *Venturia*, and establishes the connection with the respective conidial forms which comprise the genus *Fusicladium*. Several new species are described, including *V. Tremulæ*, of which both forms are found on the leaves of the aspen, and *V. Fraxini*, both forms of which occur on leaves of the ash.

Mycele of Æcidium Magellanicum.§—Herr P. Magnus has traced the growth of the mycele of this fungus in the wood, cortex, and pith of the "witch-broom" of the barberry, as well as that of the haustoria, and confirms previous statements as to the intercellular growth of the hyphæ. It was not found in the cambium.

Relation of Yeasts to Malignant Tumours.‖—Dr. A. R. Defendorf, after reviewing the literature of cancer-bodies, most of which have been noticed in this Journal, considers that it is justifiable to draw certain conclusions as to the relationship of fungi to malignant tumours in man. The first is that the parasitic Protozoa described by numerous investi-

* Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 183–94. Cf. this Journal, *ante*, p. 61.

† Rev. Gén. de Bot. (Bonnier), ix. (1897) pp. 17–26 (3 pls.). Cf. this Journal, 1895, p. 557.

‡ Hedwigia, xxxvi. (1897) pp. 67–83 (1 pl.). Cf. this Journal, *ante*, p. 152.

§ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 148–52 (1 pl.).

‖ Trans. Amer. Micr. Soc., xviii. (1897) pp. 219–45.

gators during the past eight years are probably yeast-fungi. The second is that yeast-fungi have been found in man and in lower animals affected with malignant tumours. These, when isolated, grown on nutrient media, and, when inoculated into other animals, gave rise to malignant tumours which showed the same characteristics as the original tumours.

Origin of Lichens.*—Mr. F. Clements criticises very unfavourably Reinke's view that Lichens must be regarded as a distinct class of Cryptogams, independent of the Fungi. They may, he considers, be traced back in all cases to distinct Fungus-ancestors. The Ascolichenes, to which the great majority belong, were derived from the Ascomycetes at an earlier period than the Hymenolichenes from the Hymenomycetes. Their great specialisation and the interval of time that has elapsed, have, however, to a considerable extent, obscured the points of departure.

Pertusarieæ.†—Herr O. V. Darbishire gives a monograph of the German species of this family of lichens, 31 in number, belonging to 7 genera, viz.:—*Pertusaria*, *Pionospora*, *Ochrolechia*, *Variolaria*, *Megalospora*, *Varicellaria*, and *Phlyctis*. He then enters into a full description of various points in their anatomical structure, especially the formation of the soredes and of the apotheces. In *Variolaria* and *Ochrolechia*, and probably also in all the other genera, the sorales, or clusters of soredes, appear to be metamorphosed apotheces.

Structure of Agaricus (Pleurotus) ostreatus.‡—M. L. Matruchot has followed out the development of this fungus in various media, with the following results:—There are three different modes of fructification: —by budding carpophores; the cauliflower fructification; and the coralloid fructification. The cystids appear to be deformed basids. The normal basids, the hymenial cystids with 1, 2, or 3 sterigmas, the extra-hymenial cystids or pseudo-conids, and probably also the normal conids, must be regarded as differentiations from a single elementary type.

Calostoma.§—Mr. C. E. Burnap gives a review of the American species of this genus of Gasteromycetes, and sums up in favour of its affinity with *Tulostoma* rather than with *Geaster*. In both *Calostoma* and *Tulostoma* the spores are borne laterally on the basids, which is not the case with *Geaster*, nor with any other genus of Gasteromycetes.

Presence of an Oidium in Pseudo-lupus vulgaris.‖—Mr. T. C. Gilchrist and Mr. W. R. Stokes report the discovery of an oidium in the diseased tissue taken from a case of pseudo-lupus of eleven years duration. Sections showed hypertrophy of the epidermis, abscesses, and, in the deeper parts of the corium, tuberculoid nodules. In the abscesses round and oval cells 10–20 μ in diameter were observed. Many of these cells showed buds, a doubly contoured membrane, and occasionally vacuoles. Very few giant cells were noticed. From the pus was cultivated, on glycerin-agar and on potato, an oidium, having at

* Amer. Naturalist, xxxi. (1897) pp. 277–84. Cf. this Journal, 1895, p. 82.
† Engler's Bot. Jahrb., xxii. (1897) pp. 593–671 (39 figs.).
‡ Rev. Gén. de Bot. (Bonnier), ix. (1897) pp. 81–102 (1 pl. and 19 figs.).
§ Bot. Gazette, xxiii. (1897) pp. 180–92 (1 pl.).
‖ Bull. Johns Hopkins Hosp., vii. No. 64. See Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 692–4.

times a short mycele. The colonies were at first grey, afterwards becoming white and granular. Another characteristic feature was the formation of a membrane which gradually spread over the surface of the medium. Experiments made on animals with the affected skin were negative, but injections resulted in the formation of growths in the abdominal cavity, lungs, and bronchial glands. Pure cultures were obtained from the deposits.

Association of Chætophoma oleacina and Bacillus Oleæ.*—Under the name of *Chætophoma oleacina*, M. P. Vuillemin had described a hyphomycete usually found in company with *Bacillus Oleæ*; the two appearing to play a similar part in causing the disease of olive trees to that played by *Mycogone rosea* and *Tricholoma terreum*—that is to say, the fungus paves the way for the bacteria into the host-plant. Recently the author has verified the existence of *Ch. oleacina* and of *B. oleæ* in cankered ash trees of France and Germany. This is another example of the commensalism of a schizomycete and a hyphomycetous fungus on trees.

Fossil Fungi.†—From the evidence drawn from the remains of Fungi found in the different geological formations, Herr M. Staub supports the view that the aerial forms have sprung from marine ancestral types belonging to the Phycomycetes. The oldest known fungus, *Palæoachlya penetrans*, was a parasite on coral in the Silurian period. Other Phycomycetes were abundant in the Carboniferous period; and remains of Discomycetes also occur. A *Rhizomorpha*, an *Æcidium*, and members of various families of Ascomycetes, are found in the Chalk. The fungi of the Cænozoic period present a very close resemblance to those which exist at the present time.

Myxomycetes.

Vilmorinella, a new Genus of Myxomycetes.‡—Parasitic on the mucus of several species of *Micrococcus* on gangrenous potatoes, M. E. Roze finds an organism which he regards as the type of another new genus of Myxomycetes characterised by its extreme simplicity. It consists of a naked spherical rudimentary plasmode, which, under certain conditions, becomes encysted.

Myxobotrys.§—Recurring to his account of this genus, Herr H. Zukal admits its identity with *Chondromyces*. He maintains, however, in opposition to Thaxter,|| that the genus belongs to the Myxomycetes, and not to the Schizomycetes.

Protophyta.

a. Schizophyceæ.

Rhizosolenia.¶—Under the name *Rhizosolenia Peragalloi*, Count Abbé F. Castracane describes a new species of this genus from the

* Bull. Soc. Mycol. de France, xiii. (1897) pp. 44–5. See Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) p. 256.

† SB. K. Ung. Naturw. Gesell. Budapest, Feb. 12, 1897. See Bot. Centralbl., lxix. (1897) p. 267.

‡ Comptes Rendus, cxxiv. (1897) pp. 417–8.

§ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 17–8. Cf. this Journal, *ante*, p. 154.

|| Cf. this Journal, 1893, p. 370.

¶ Atti Accad. Pont. Nuovi Lincei, l. (1897) pp. 53–8.

Atlantic, characterised by having four terminal setæ; and points out that West's monotypic genus *Attheya* has been erroneously regarded as nearly allied to *Rhizosolenia*, whereas, in reality, the former genus belongs to the Raphideæ, the latter to the Cryptoraphideæ.

Movements of Oscillatoriaceæ.—Herr R. Kolkwitz * describes in detail the nature of the oscillating movements in several species of *Spirulina* and *Oscillatoria*. These are of two kinds, a movement of nutation and a movement of rotation; the two movements may be exhibited in the same filament, one end of which may rotate, while the other nutates.

Herr C. Correns † offers a somewhat different explanation, from observations made chiefly on *Oscillatoria princeps*. The outer wall of the cells exhibits a distinctly reticulate structure. The outer layers have a marked positive tension. No movement could be detected in the cytoplasm. The direction of the torsion may be to the right or to the left, but is constant in the same species. The funnel-formation at the end of creeping filaments is due to a curvature (often very slight) of the extremity, combined with the resistance of the water. The author never observed any movement of nutation. The filaments move only when closely attached (not merely in contact) to a solid substance. External granules remain but slightly attached to the filament, and may move along it, the movement being quite as rapid along isolated dead cells. The author concludes that the filaments excrete a colourless jelly, which surrounds them in the form of a very soft sheath. They never swim freely in the water, the sheath taking no part in the movement. The filament may consist of active and inactive zones. The movements cannot, he considers, be attributed either to cilia, to a peripheral layer of protoplasm, or to the expulsion of water.

β. Schizomycetes.

Behaviour of Bacteria to Chemical Reagents.‡—Herren Th. Paul and B. Krönig made experiments for the purpose of testing the effects of various acids, bases, oxidising agents, and metallic salts, on bacteria, the bacteria employed being *Staphylococcus pyogenes aureus* and the spores of *Bacillus anthracis*. The salts of mercury, gold, and silver were found to exert a specific poisonous effect, while those of platinum had little, if any action. The disinfecting action of metallic salt solutions, in which the metal is present as a complexion, is very small. The effect of mercuric chloride is greatly decreased by the addition of sodium and other chlorides, but is not affected by other salts, such as sodium nitrate. The acids only act as disinfectants in concentrations of the gram molecular weight per litre, and exhibit a specific action which is not proportional to the concentration of the hydrogen ions. The weak organic acids appear to act according to the degree of dissociation. The action of the hydroxides of lithium, sodium, and potassium is about equal, and that of ammonium very slight. Of the ordinary agents, nitric acid, chromic acid, chloric acid, and permanganic acid, act in the order stated. The halogens have

* Ber. Deutsch. Bot. Gesell., xiv. (1896) pp. 422–31 (1 pl.).

† Op. cit., xv. (1897) pp. 139–48.

‡ Zeit. Physikal. Chem., xxi. (1896) pp. 414–50. See Journ. Chem. Soc., 1897, Abstr. p. 155.

also a specific action, which is most powerful in the case of chlorine. Phenol acts better in 5 per cent. solution than at higher concentrations, and the effect is increased by the addition of metallic salts, especially sodium chloride; it is diminished if mixed with alcohol, and is never as great as that of mercuric chloride.

Plurality of Morbific Products from a single Pathogenic Microbe.*— M. A. Charrin contends for the plurality of morbific products from a single pathogenic microbe, asserting that the present notion which assigns the power of a micro-organism over the animal body to a single product, a toxin, is insufficient to explain the phenomena. The contention is supported from experiments made with cultures of *B. pyocyaneus*. The substances precipitated by alcohol induce emaciation, enteritis, and fever, and also act as excito-motors of the spinal cord. The substances which are soluble in alcohol principally affect the heart; while the volatile aromatic principles act as constrictors on the capillaries.

Besides the foregoing, there is some evidence of the presence of a ferment which is capable of decomposing asparagin. The fact that the *B. pyocyaneus* consumes much oxygen which is necessarily drawn from our tissues, and that it elaborates ammoniacal compounds and traces of methylamin, points in the same direction. The part played by the blue or green pigment, though inconsiderable, cannot be overlooked. From the foregoing considerations, and while admitting that there is a principal toxin, usually albuminoid, more important than the rest, it is none the less true that other morbific agents are called into existence by a single microbe. Such data afford an easy explanation of the multiplicity, the variety, and the occasional predominance of certain symptoms.

Microbic Agents of Cheese-Ripening.†—Experiments made by M. E. de Freudenreich relative to the maturation of cheese tend to show that the lactic ferments are endowed with the power of attacking casein and of transforming it into soluble albuminoid substances and amides.

Taking into consideration the enormous increase in the number of lactic ferments in cheese during the process of maturation, it becomes evident that this variety of bacteria plays the most important part in the ripening of cheese, at any rate of hard cheese. In soft cheese, *Oidium lactis* and yeasts are equally active. It is further pointed out that in ripening cheese the lactic acid ferments are quite different from those in spontaneously coagulated milk; hence it would seem possible that there exists a special class of ferments which, in virtue of their less intense lactic acid formation, are specially adapted for decomposing casein.

Bacteria and the Decomposition of Rocks.‡—Mr. J. C. Branner discusses the question whether bacteria are important agents of rock decay, a notion promulgated by Muntz in 1890. This writer stated that the nitrifying organism was always present in decomposed rocks; and this view was generally accepted. From a review of numerous observations made by competent persons, the author is of opinion that it is quite improbable that bacteria are responsible for any considerable part of the

* Comptes Rendus, cxxiv. (1897) pp. 1047–9.

† Ann. de Micrographie, ix. (1897) pp. 185–93; and Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 231–5. Cf. this Journal, 1896, p. 224.

‡ Amer. Journ. Sci., iii. (1897) pp. 438–42.

decay. For, in the first place, it is now known that nitrifying bacteria do not penetrate the soil to a depth of more than three or four feet, and, secondly, that granite rocks are often decomposed to depths of more than 100 feet.

Bacteria in Ice.*—A bacteriological examination of ice sold in Padua, made by Dr. G. Catterina for the purpose of testing its purity, showed that there were about 10,000 bacteria per ccm. of the ice water. Numerous non-pathogenic water bacteria were isolated, and one organism with the biological and morphological characters of *B. coli commune*. In addition to the Schizomycetes, Algæ, Protozoa, Vermes, and larvæ of certain dipterous insects were also observed.

Bacteriaceæ of Bogheads.†—According to M. B. Renault, Boghead coal contains large numbers of micrococci, often difficult to distinguish owing to their smallness and the slight difference between their colour and that of the surrounding substance. The cocci are found scattered about irregularly in the broken down and disorganised thalli, or arranged along the course of the median membranes, the invasion having proceeded step by step from the periphery to the centre.

To the different micrococci of Bogheads the name *M. petrolei* is given, the varieties being distinguished by the letters A to F. The description of the species is :—Spherical cells measuring from 0·4–0·5 μ, the walls being visible under magnification of 1000–1200 diameters; colourless or only faintly coloured, often resembling bright highly refracting spherules imbedded in the surrounding medium, or, at a different focus, as hemispherical cavities of the same diameter.

Evolution of Mucus in Cancer Cells.‡—Prof. Quenu and M. Landel draw the following interesting and novel conclusions relative to the formation of pathological mucus, from a histological investigation of a "colloid" cancer of the rectum. Two epitheliums of different form and origin may co-operate to form a single tumour by the simultaneous production of similar elements. The presence of mucus in cancerous elements is not to be regarded as indicative of degeneration, but as a normal function of these elements, not lessening their vitality in the least. In cancer cells derived from squamous epithelium, the formation of mucus is due, not to an alteration or secretion of cytoplasm, but to a transformation of the chromatic elements of the nucleus into a substance having the characters of mucus. The authors point out that Lukjanow had observed precisely the same kind of transformation under normal conditions, viz. in the goblet-cells of the intestine of the salamander.

Plague Bacillus.—Dr. R. Abel § records the results of an exhaustive investigation into morphological and cultural characters of the plague bacillus. In size the bacillus varies from 1 to 4 or 5 μ in length, and is about 1 μ broad. In old cultures involution forms are frequent. It is quite motionless, and is easily stained with the usual anilin dyes, but not by Gram's method. Neither capsule nor spore formation was observed. Cultures were successful in the ordinary fluid and solid media ; the best

* Atti Soc. Veneto-Trentina, Padua, iii. (1897) pp. 221–9.
† Comptes Rendus, cxxiv. (1897) pp. 1315–8.
‡ Ann. de Micrographie, ix. (1897) pp. 145–65 (3 pls. and 35 figs.).
§ Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 497–517.

being a 2 per cent. pepton solution, with 1 or 2 per cent. of gelatin. The optimum temperature was 37°, and growth took place under aerobic and anaerobic conditions. Cultures were fatal to mice and guinea pigs, but not to pigeons, the animals dying from pyogenic septicæmia. Experiments as to the resistance of the plague bacillus showed that the best method for disinfecting was moist heat at 100°, i. e. steam.

According to Dr. W. M. Haffkine,* the plague bacillus is easily recognised by a stalactite growth in broth. The broth, richly inoculated with the bacillus, must be kept in an absolutely quiet position, as the slightest jar destroys the reaction. In from 24–48 hours flakes appear underneath the surface, forming little islands of growth; from these long stalactites grow downwards, the liquid always remaining clear. If after 5 or 6 days the flask be shaken, the whole growth falls to the bottom, the islands retaining their form, while the stalactites are perfectly disintegrated. The bacillus is also recognisable by involution forms on agar. The medium must not contain glycerin, must not be freshly prepared, the surface must be perfectly dry, and the reaction alkaline. The surface must be inoculated abundantly. In usually from 3 to 4 days the individual microbes swell up, forming large round, oval, or pear-shaped bodies, which eventually are quite unstainable. The bacilli become unrecognisable, acquiring the appearance of a yeast cell or an alga. The swelling may continue until the body is twenty times larger than the original bacillus. Similar forms are demonstrable in the tissues of animals dead of the disease, and then they resemble modified blood-corpuscles, or disintegrated tissue-cells, or stained drops of albumen.

Epidemic of Botulism.†—By means of a bacteriological examination of fragments of sausages suspected of causing an outbreak of botulism among troops in a Belgian artillery barrack, Dr. Dineur isolated three varieties of *coli* bacillus, one of which (variety A) was also isolated from the body of a mouse fed on the same sausages. By continued cultivation the virulence of this variety A was reduced and even abolished. The source of the bacteria was probably the flesh of an infirm or diseased animal, from which the sausages were made.

Bacteria normal to Digestive Organs of Hemiptera.‡—Prof. S. A. Forbes gives a preliminary account of the cæcal appendages of certain Hemiptera, which were found to be invariably loaded with myriads of bacteria, differing in genus and species in the different insects, but always confined to these organs. The bacteria were cocci and bacilli; they responded to the ordinary stains, and were cultivated in fluid and on solid media.

Variation of Bacteria from Age.§—Dr. H. G. Dyar replanted the "new species" of bacteria described by him after intervals varying from one to two years, for the purpose of ascertaining if there had arisen any differences of form and function. The conclusions arrived at from these replantings are:—(1) species under long cultivation tend to be constant in their characters; (2) some species lose in vigour; (3) some gain

* Brit. Med. Journ., 1897, i. p. 1461.
† Bull. Soc. Belge de Microscopie. xxiii. (1896–7) pp. 47–66.
‡ Bull. Illinois State Lab., iv. (1895) pp. 1–7.
§ Trans. New York Acad. Sci., xv. (1895–96) pp. 148–53.

in vigour, exhibiting certain characters more strongly, or even acquiring new characters. Cultures of 9 species died; of 6 became less vigorous; of 14 were constant; while 9 became more vigorous, with more positive or new characters.

Bacillus capsulatus aerogenes.*—Prof. E. K. Dunham records five fatal cases of infection with *B. capsulatus aerogenes*, the special symptoms of which are mortification attended with blackening of the affected parts, considerable emphysema from decomposition gas, and the absence of pus. The bacillus is a large straight rod about $0 \cdot 9\,\mu$ in diameter, with rounded ends. It is easily stained. In the subcutaneous fluid of animals it possesses a capsule, but not on artificial media. It is a motionless anaerobe which produces gas (about two-thirds H and one-third CO_2). On blood-serum it forms spores, which cause a central bulging of the rodlet. It coagulates milk in 24 hours, producing gas and souring the milk. It grows well in bouillon to which 1 per cent. of glucose is added. Experiments on animals with pure cultures gave positive results, the animals dying within 24 hours, with development of much gas in the tissues and organs.

Action of Currents of High Frequency on the Virulence of Streptococci.†—M. L. Dubois shows that electrisation of cultures of *Streptococcus* reduces the vitality and virulence of this microbe. The apparatus used for electrising the serum cultures was that employed by d'Arsonval and Charrin. After eight daily exposures of 20 minutes, the effect of inoculating 2 ccm. of culture was practically nil. The effect produced was due to attenuation of the toxin, and not to the formation of antitoxin.

Thermophilous Cladothrix.‡—Herr Kedzior describes a species of *Cladothrix* which grows between the limits of 35° and 65°, the optimum temperature being 55°. It forms spores which are very resistant to heat, insolation, desiccation, and disinfectants. The original source was sewage water. Cultivated in equal bulks of the water and bouillon at 55°, it turned the medium turbid, and in 16 hours formed flakes from which the thermophilous bacteria could be isolated by plate cultures.

Bacteria of Conjunctivitis.—According to Dr. Th. Axenfeld,§ conjunctivitis is commonly of three kinds, viz. the acute, caused by the Koch-Weeks bacillus, the gonorrhœal, and the chronic, produced by a diplobacillus. The latter organism, with which the author is principally concerned, is about $2\,\mu$ long by $1\,\mu$ broad, usually occurs in pairs, has much resemblance to the bacillus of Friedlaender, and is easily stained, though decolorised by Gram's method. It grows best at incubation temperature in media having a distinctly alkaline reaction and containing some human body-juice, such as ascitic, hydrocele, or ovarian fluid. It is essentially aerobic, is devoid of movement, does not form spores, and liquefies the medium, though slowly. Experiments made on the human subject gave positive results, the incubation period being four days.

* Bull. Johns Hopkins Hosp., viii. (1897) pp. 68–74.
† Comptes Rendus, cxxiv. (1897) pp. 788–90.
‡ Arch. f. Hygiene, xxvii. No. 4. See Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) p. 154.
§ Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 1–9 (1 pl.).

Dr. S. Stephenson * confirms the observations of Weeks, Moran, and Beach relative to contagious ophthalmia. In all such cases a bacillus $0 \cdot 75 \mu$–1μ long is demonstrable, the numbers of the organism present being directly proportional to the severity of the case. This bacillus is found in and upon the cells of the discharge, and also free in the liquor. It is easily stained with alkaline methylen-blue, but is decolorised by Gram's method. The most suitable cultivation medium was found to be Kanthack and Stephens' serum-agar.

Actinomycetic Form of the Tubercle Bacillus.†—According to MM. V. Babès and C. Levaditi, the bacillus of tubercle should be definitely placed in the same group as *Actinomyces*. This view is based on observations made on the brains of rabbits which had been infected by sub-virulent cultures of human tubercle. In these, clumps of bacilli were found to have undergone a peculiar modification. The centre of the clumps, when stained by the Ehrlich method, showed a network of filaments resembling in general appearance a mycele of tubercle bacilli. The central mycele is surrounded by a zone of clubs, not infrequently connected with the ends of the mycele. The clubs do not stain by the Ehrlich method, and are about the same size as those of *Actinomyces*. The clubs are resistant to the action of acids and alkalies, and can be stained by the methods adopted for demonstrating the clubs of *Actinomyces*.

Serum Diagnosis with Agglutination Reaction in Typhoid Fever.‡—The agglutination reaction, say Prof. F. Widal and M. A. Sicard, is nothing else than a reaction of the infection period, and is usually manifested during the first days of the malady; and, though sometimes delayed, is but rarely wanting. Moreover the agglutination phenomenon is not a vital reaction, at least as far as the microbes are concerned. When a negative result is obtained from the examination of a suspected case, the probability is against typhoid; but the examination should be repeated on several consecutive days. The probability against typhoid increases directly with the duration of the disease; that is to say, a negative result at a late period is final. On the other hand, a positive result should be considered as a certain sign of typhoid.

Presence of the Agglutinative Property in the Blood-Plasma and other Body-Juices.§—MM. Ch. Achard and R. Bensaude made experiments which tend to show that the agglutinative property of blood-plasma does not reside in the leucocytes. The blood used was rendered incoagulable by means of leech extract, and then filtered through cotton-wool. The cotton-wool was washed with normal serum, and the fluid thus obtained was found to contain 3000 white to 6000 red corpuscles per cubic millimetre. This fluid, so rich in leucocytes, was not found to possess a stronger agglutinative action than the serum devoid of white corpuscles.

Ætiology of Rabies.||—Dr. G. Memmo isolated from the cerebro-spinal fluid, from the parotid, and from saliva of man and animals,

* Lancet, 1897, i. pp. 1531–3. † Comptes Rendus, cxxiv. (1897) pp. 791–3.
‡ Ann. Inst. Pasteur, xi. (1897) pp. 353–432.
§ Comptes Rendus, cxxiii. (1896) pp. 503–5.
|| Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 657–64 (1 pl.).

a Blastomycete which is cultivable in bouillon containing glucose and tartaric acid, and also on solid media with an acid reaction. The acidity of the culture medium is an interesting feature, inasmuch as the reaction of central nervous tissue is acid. Injection of pure cultures into animals (guinea-pigs, dogs, rabbits) proved fatal after a lengthy incubation period. The symptoms of the disease resembled those of rabies, the most prominent phenomenon being paralysis.

Cattle Malaria.*—Herren A. Celli and F. S. Santorini describe a disease affecting cattle in the Roman Campagna, which is characterised by fever, anæmia, occasionally by hæmoglobinuria, and always by the presence of endoglobular parasites in the blood. This disease is apparently identical with Texas fever (Smith, Kilborne), hæmoglobinuria (Babès), and hæmatinuria (Sanfelice). The parasite appears under two forms, one exhibiting merely local movements within the red corpuscles, the other manifesting amœboid movements. The former is from 1–1·5 μ in size, and the latter two or three times as large. The amœboid form often exactly resembles the *Pyrosoma bigeminum* (Smith). The exact relationship between the two forms and the reproduction stages were not clearly made out.

Classification of Malaria Parasites.†—Dr. X. Lewkowicz divides the hæmosporidia of malaria into two groups. In Group I. the developmental stage of the sporidia lasts for 2 to 3 days; development is endoglobular, and the adult form spheroidal. The species of this group are *H. tertianæ*, having a developmental period of 2 days, and *H. quartanæ*, with one of 3 days.

In Group II. the developmental period is more than 3 days, and development is extraglobular, the adult being crescent-shaped. Four species of this group are enumerated:—*H. undecimanæ*, with a developmental period of 10 days; *H. sedecimanæ*, of 15 days; *H. vegesimo-tertianæ*, of 22 days; and *H.* (?), with an undetermined period of sporidia development, the adult form of this variety being cigar-shaped.

Microbes of Yellow Fever. — Prof. G. Sanarelli ‡ has isolated from the blood of persons affected with yellow fever a bacillus varying in size from 2–4 μ, and as a rule twice or thrice longer than broad. Its ends are rounded, it is very pleomorphous, and is mostly found in little groups in the capillaries of the kidney, liver, &c. The best way to demonstrate it is to begin by incubating a piece of fresh liver at 37° C. for 12 hours. The bacillus grows well on gelatin, which is not liquefied. Agar cultures afford an important means of diagnosis; for when incubated at 37°, the colonies are roundish, grey, smooth, and transparent; but if grown at 20°–22°, the colonies are like drops of milk, opaque, prominent, and with pearly reflections. The bacillus is a facultative anaerobe, stains well, ferments sugar, but does not coagulate milk; it strongly resists drying, dies in water at 60°, but lives for a long time in sea water, and is killed in 7 hours by sun-rays. It is pathogenic to most domestic animals, except birds, the chief lesions found after death being fatty degeneration of the liver, hæmatogenous gastro-enteritis,

* Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 561–72 (1 pl. and 56 figs.).
† Tom. cit., pp. 129–33.
‡ Brit. Med. Journ., 1897, ii. pp. 7–11; and Ann. Inst. Pasteur, xi. (1897) pp. 433–514 (9 pls.).

splenic tumidity, and parenchymatous nephritis. The toxin, which is prepared by simply filtering broth cultures 24 days old, when injected into some animals, gives positive results, and in man reproduces typical yellow fever (amarillism). The toxin is scarcely affected by heating to 70°, though boiling sensibly attenuates it. The toxic power of cultures sterilised with ether is markedly increased. *Bacillus icteroides*, as the organism is named, is able to live on or in company with Hyphomycetes. This remarkable feature is easily demonstrable in cultures which are apparently quite dead.

Dr. Havelburg * has found in the contents of the stomachs of persons dead of yellow fever at Rio de Janeiro a bacillus 1 μ long and from 0·3–0·5 μ broad. It is easily stained, but not by Gram's method. It grows easily on gelatin, which is not liquefied. The growth is white on gelatin, and also on agar. Bouillon becomes turbid in 24 hours, with the formation of a grey cloudy sediment. Saccharated media are fermented, with the formation of gas. Milk is coagulated in 24 hours.

Parasites of Vaccinia and Variola.†—M. P. Salmon infers, from his researches into the nature of the infective agent of vaccinia and variola, that the appearances observed by himself and others merely simulate a parasite, and that this pseudo-parasite is nothing but a ball of chromatin more or less condensed and of no particular form. The pseudo-parasite is not of endogenous, but of extra-epithelial origin, being derived from the migratory polynuclear leucocytes, the nucleus of which becomes transformed into the vaccinia granules. A table giving the colour reactions of the epithelial cell, the parasitic corpuscles, and the polynuclear leucocyte, shows that the two latter bodies invariably exhibit identical colour appearances, and that the nucleole of the epithelial cell not infrequently corresponds.

* Lancet, 1897, ii. pp. 59–60; and Ann. Inst. Pasteur, xi. (1897) pp. 515–22.
† Ann. Inst. Pasteur, xi. (1897) pp. 289–307 (1 pl.).

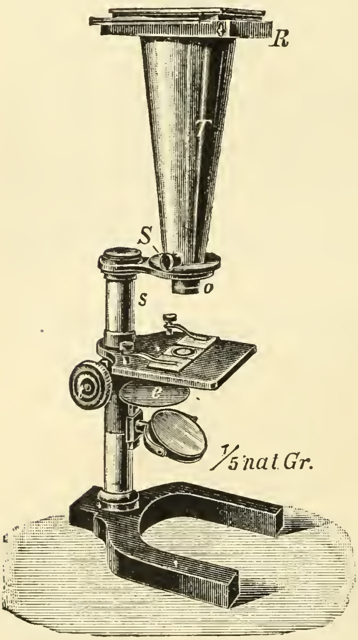
MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Evolution of the Microscope.†—Mr. E. M. Nelson, on behalf of a sub-committee of the Quekett Microscopical Club, proposes in a series of articles:—(*a*) to investigate a good type of instrument; (*b*) to give a study of modern instruments, showing wherein, and why, they either follow or depart from the selected type; (*c*) to collate the other material bearing on the development of modern Microscopes, though not falling within the limits of *a* and *b*. For the type, Powell's No. 1 is to be taken, since to this the best modern Microscopes are more and more conforming; and, as it has remained in its present form for upwards of twenty years, it is a permanent type.

FIG. 21.



In the present paper several old forms, which are of importance in the evolution of the Microscope, and which have probably influenced the design of Powell's No. 1, are described. Figures are given of the instruments of Jansen (about 1660), Descartes (1637), Hooke (1665), Divini (1667), Chérubin d'Orléans (1671), Bonanni (1691), Hartsoeker (1694), and John Marshall (1704). Of importance are Hooke's, Bonanni's, and Marshall's.

Simple Microscope for Direct Observation and for Photography.‡—Herr C. Leiss describes the instrument shown in fig. 21, which is made by Fuess. The arm *o*, supporting the lens, is rigidly fixed to the foot, and the stage and mirror are made movable. Above the lens the small camera T may be fixed by the screw S. For direct observation, and for photographs which need not be very sharp, ordinary Steinheil lenses are used; but for better photographic work, two photographic objectives of 41 and 25 mm. focus are supplied; these fit into the arm *o*.

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

† Journ. Quekett Micr. Club, vi. (1897) pp. 349–56 (9 figs.).

‡ Zeitschr. f. angew. Mikr., iii. (1897) pp. 39–40 (1 fig.).

The stage has an aperture of 35 mm. diameter, and a smaller diaphragm can be laid over it if wished. A blackened disc *e* shuts off or admits light when photographing. A table of the focal lengths of the lenses used, amplifications, times of exposure, &c., is given.

Hand-Microscope.*—The accompanying fig. 22 represents a Hand-Microscope made by C. Reichert; it is simpler and more convenient

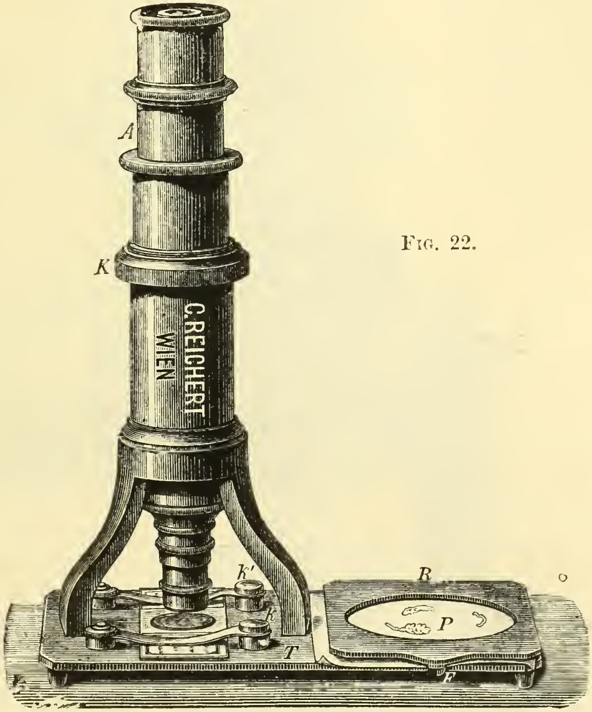


FIG. 22.

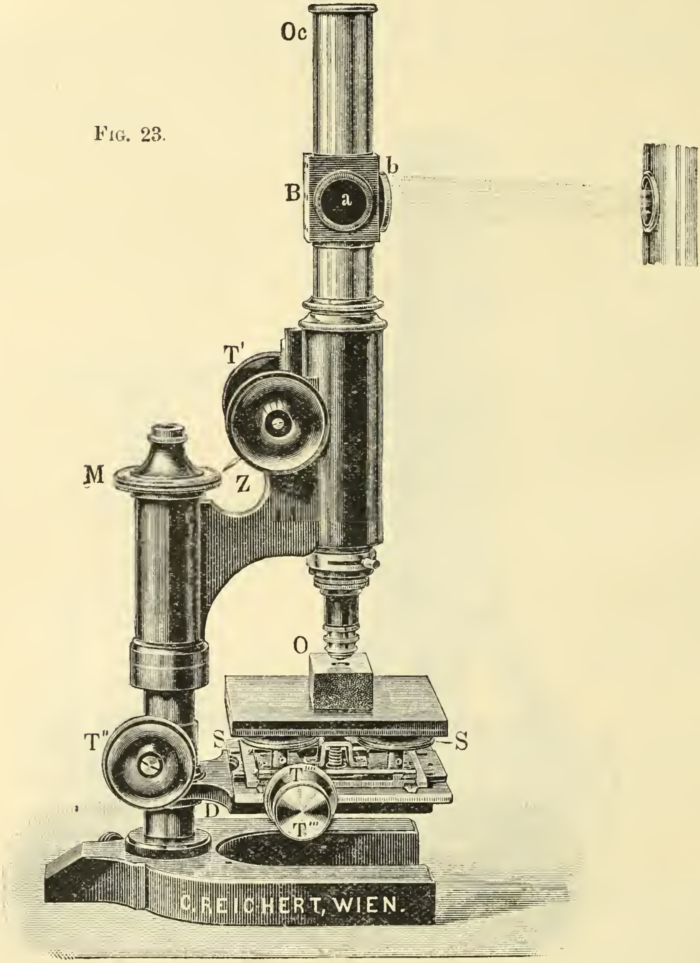
than many other demonstration instruments to be handed round in an audience. The tube slides easily in the sleeve, and, if necessary, can be replaced by another giving higher magnification. The extension of the stage is for carrying a drawing of the object shown.

Stand and Illuminating Apparatus for Opaque Objects.†—Herr C. Reichert describes the instrument shown in fig. 23. The stand, with coarse and fine adjustment, is hinged to the heavy foot; the stage is of white glass, with a white background. Light passes through the tube

* Zeitschr. f. angew. Mikr., iii. (1897) pp. 44–5 (1 fig.).
† Tom. cit., pp. 40–1 (1 fig.). The same instrument is also described by Prof. A. Rejtö, Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 1–4 (1 fig.).

b, which is fitted with an iris-diaphragm, and is reflected by a mirror at *a* on to the object. The instrument is especially designed for

Fig. 23.



studying the structure of etched and fractured surfaces of metals and alloys; it will also be useful for observing the surface characters of minerals, rocks, &c.

(3) Illuminating and other Apparatus.

Improved Illuminating Apparatus.*—Herr C. Reichert describes an improved form of the Abbe substage illuminating apparatus, of

* Zeitschr. f. angew. Mikr., iii. (1897) pp. 33-5 (4 figs.). Cf. this Journal, 1896, p. 373.

which several modifications have been made since it was first introduced. The special point of the present form is that it is independent of the mirror; it can also be swung to one side and other accessories attached.

Fig. 24.

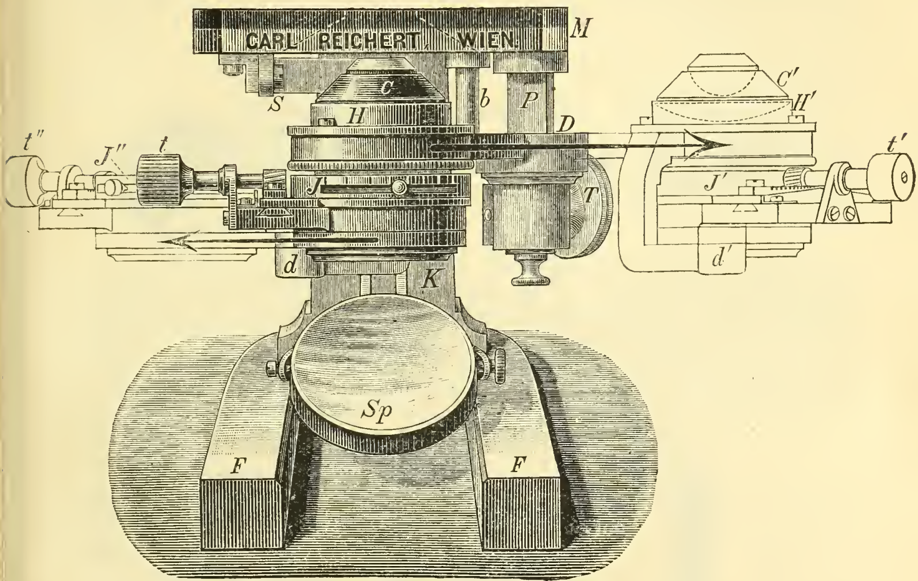
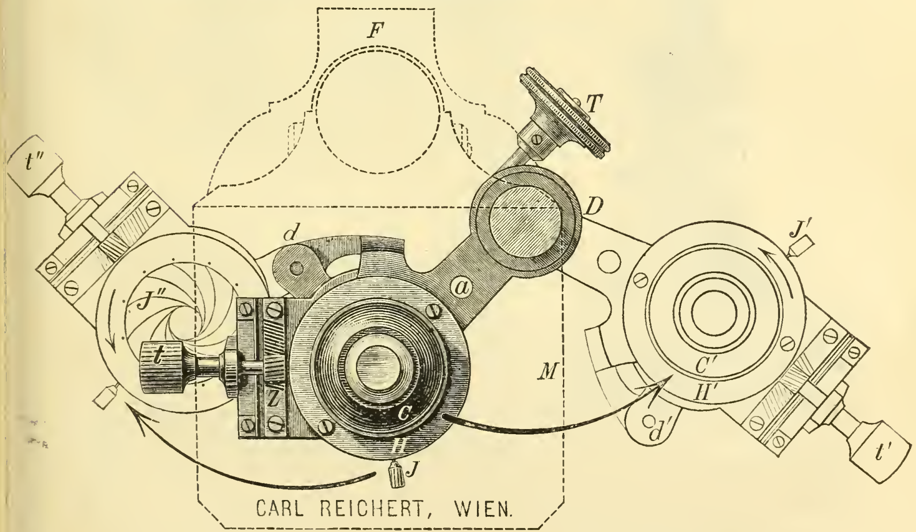


Fig. 25.



The whole apparatus swings about the axis D (figs. 24 and 25), as shown by the outline drawings to the right, and it has a vertical motion by means of gearing T. On the upper part of the main arm is a sleeve into which the condenser C, or other accessory, fits. On the under side of the same arm the iris-diaphragm is carried by the pivoted arm *d*, and can be swung out of position as shown on the left. For oblique illumination the diaphragm may be moved from side to side by the rack

Fig. 26.

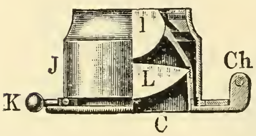
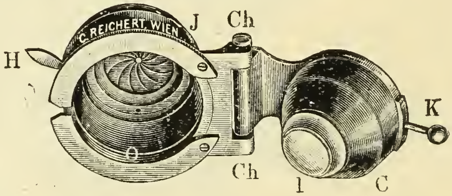
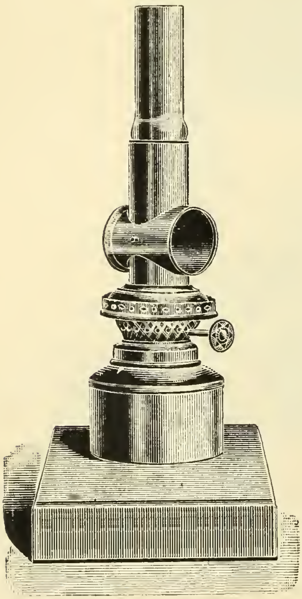


Fig. 27.



and pinion *t*. The whole apparatus is held in a central position by a pin, which projects from the under side of the stage, fitting into the hole *a*, when the apparatus is screwed upwards by the arrangement T. In cases where it is necessary to quickly change from convergent to parallel light, the condenser and diaphragm are hinged together, as is shown in figs. 26, 27. Owing to the size of the apparatus, it can only be fitted to the larger stands.

Fig. 28.



Coloured Illumination.* — Mr. J. Rheinberg describes a new form of "substage differential colour illuminator," consisting of a box containing nineteen metal slides, which can be moved in or out independently of one another by means of small handles. Each slide has two circular apertures, one of which is fitted with a colour disc or other stop. The kind of stop is indicated on the handle. When the slides are pushed in, only the blank apertures are in the path of the light, but when pulled out, one or other of the stops is brought into use. The stops for giving coloured backgrounds, and for illuminating the object with various stops, include a dark-ground stop, various colours, parti-coloured stops, stops for oblique light, several annuli, and a ground-glass stop. The various combinations of stops which can be brought into use are almost endless.

Portable Microscope Lamp.† — Mr. W. Goodwin has designed a lamp made by Mr. Hinton (fig. 28). The metal chimney has two circular apertures 1 in. in diameter, one of which is glazed with signal green and the

* Journ. Quekett Micr. Club, vi. (1897) pp. 346–7. † Tom. cit., p. 345 (1 fig.).

other with steel-blue glass. The cylindrical reservoir is 2 in. diameter, and the total height of the lamp is 7 in. A blotting-paper wick is used.

Simple Instrument for Inclining a Preparation in the Microscope.*—Mr. T. A. Jagger, jun., has devised an instrument for use in petrography, especially in connection with the optical methods of Michel-Lévy and Fedorow for the determination of felspars; it will also be of use in cases where it is necessary to examine the edges of objects in reflected light. The object-holder clip is supported by a ball-and-socket joint on a foot-plate, which may be fitted to the stage of the Microscope. This allows the object to be turned into any desired azimuth, and the various minerals in rock sections can then be brought into definite orientations, as is done in the more complicated "universal stage" of Fedorow. The optic figures seen in convergent polarised light may also be brought into the centre of the field of view.

Modification of the Automatic Gas-Stop for Extinguishing the Burner of Incubators.†—Dr. B. Schürmayer has devised a modification of the gas-stop to incubators which prevents the escape of gas and the danger of its exploding. The supply tube is fitted with a metal spiral lever which acts on a stopcock, so that if there be any fault in the working of the apparatus beyond this point, and the gas supplied to the burner fail, the lever acts on the stopcock, and thereby prevents further access of gas to the apparatus. The most important feature of the invention is that all the parts of the apparatus are of metal.

Slide and Cover-Glass Holders.‡—Herr S. Robertson has devised holders for slides and cover-glasses, the construction of which may be

Fig. 29.

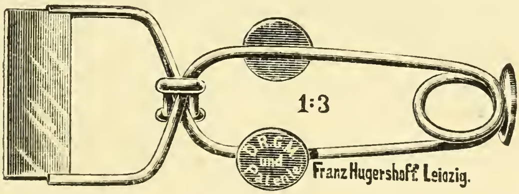
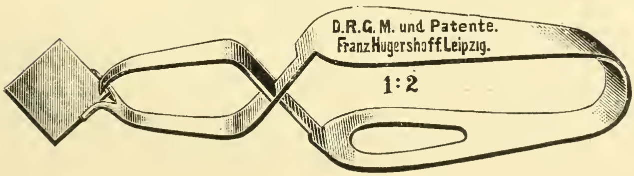


Fig. 30.



grasped from an inspection of the illustrations (figs. 29 and 30). The former is merely a spring-forceps made of nickelled wire, the inside of the fangs being grooved for the reception of the slide. The cover-glass

* Amer. Journ. Sci., iii. (1897) pp. 129–31 (2 figs.).
† Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 400–1 (1 fig.).
‡ Tom. cit., pp. 589–91 (2 figs.).

forceps has a trifurcate lower fang between which the slip is inserted. The two upper teeth of the fang are grooved, and are set at a right angle, so that a square cover fits in accurately, and is held firmly by the upper fang.

(4) Photomicrography.

Photomicrography.*—Mr. T. J. Bray considers the practical employment of ordinary objectives in photomicrography; he shows that for ordinary work it is not really necessary to have specially corrected lenses, and that with ordinary objectives of low power good results can be obtained. The objective he finds most useful is Bausch and Lomb's student's 3 in. to 6 in. variable; this with a long bellows camera gives a wide range of amplification, which may be further increased by the usual methods of photographic enlargement of the negative. For large negatives a dark room takes the place of the camera, the Microscope and light being arranged outside. With the long bellows camera, the focusing arrangement of Dr. Mercer is adopted. This consists of a wire from the back of the camera, which is connected by a vertical lever to a horizontal extension of the pinion shaft of the Microscope coarse-adjustment. The picture is focused, with the aid of a 2 in. eye-piece, on thin cover-glasses cemented on the ground-glass screen of the camera, as is done by Walmsley. Many details can only be brought out by using a colour screen; this is a bichromate cell, as is used in cloud photography. Photographic details are given in the paper.

Acetylene Gas in Photomicrography.†—Mr. W. H. Walmsley has previously suggested the use of acetylene gas as an illuminant in photomicrography.‡ The light which it gives is white, very brilliant, and absolutely steady; there is little heating and no smell; it is portable, simple, cheap, and safe, and is always ready for use. All these advantages are not combined in sun, lime, magnesium, electric, or other lights. The flame, which consumes one-tenth to one cubic foot of gas per hour, is enclosed in a metal case with a glass front; the flat flame is placed end on, or pencil flames are placed behind each other with diaphragms between. The author, for his own use, renders the light monochromatic by means of a cobalt blue cell placed in the substage of the Microscope.

The use of an acetylene flame as a standard unit of light is suggested. An automatic machine for generating the gas from calcium carbide is supplied by Walmsley, Fuller & Co., of Chicago.

Astronomical Photography with Photomicrographic Apparatus.§—Dr. A. C. Mercer obtained photographs of the partial eclipse of the sun seen at Syracuse, N.Y. on Oct. 20, 1892. The heliostat and a portrait lens of 8 in. focus were arranged to throw a stationary image of about 1/12 in. diameter of the sun's disc in the plane usually occupied by the object on the stage of the Microscope. This image was projected by a $1\frac{1}{2}$ in. Microscope objective to form a second image, $2\frac{3}{8}$ in. diameter, on the ground-glass of the camera. As far as compactness is concerned, this arrangement is more convenient than telescopic methods, but it is inferior in illumination and separating power. The results obtained are

* Trans. Amer. Micr. Soc, xviii. (1897) pp. 107–16. † Tom. cit., pp. 136–41.
‡ Cf. this Journal, 1896, p. 126.
§ Trans. Amer. Micr. Soc., xviii. (1897) pp. 132–5 (2 figs.).

compared numerically with those obtained with the Lick photographic objective.

Photomicrograph v. Microphotograph.*—Dr. A. C. Mercer, in the present note on his paper of 1886, points out that the word photomicrograph was first used in 1858. An account of its origin is to be found in the 'Liverpool and Manchester Photographic Journal' (now 'British Journal of Photography'), August 15, 1858, pp. 203 and 414; also in 'Sutton's Photographic Notes,' iii. pp. 205 and 208.

Advances in Photomicrography.†—Herr G. Marktanner-Turneretscher collects together under this title a series of abstracts of recent papers relating to Photomicrography; these have already been noticed in this Journal.

(5) Microscopical Optics and Manipulation.

Multiple Images in Mirrors.‡—Mr. W. B. Stokes explains the origin of multiple images seen in plate-glass mirrors. The brightest image is due to reflection from the silvered back, another to reflection from the front glass surface, and others are due to more than one reflection within the glass. When the mirror is rotated in its own plane, these images will change their position, owing to the fact that the surfaces of the plate are not truly parallel. For a particular angle of inclination of the two surfaces of the plate, the first two images may be made to coincide.

B. Technique.§

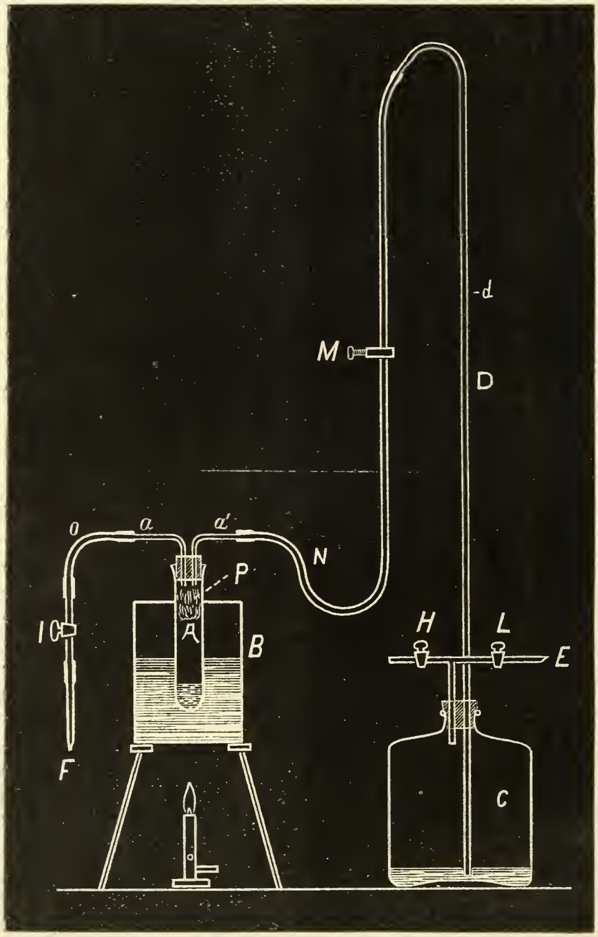
(1) Collecting Objects, including Culture Processes.

Apparatus and Method of Manipulation for the Preparation of Roll Cultures of Anaerobic Organisms.‖—In using the apparatus invented by Mr. E. E. Ewell (fig. 31), the tube is inoculated with the requisite number of organisms in the usual way, and is placed in the water-bath B, the temperature of which is kept at some convenient degree between the solidifying point of the medium and the thermal death point of the organism to be cultivated. The cotton plug P is pushed into the tube to make room for the rubber stopper carrying the glass tubes *a* and *a'*. The stopper is carefully sealed with sealing-wax, and the connections made with the thick rubber tubes N and O, the latter being secured with wire. E leads to a vacuum service pipe, or to some form of vacuum pump; F leads to a hydrogen gas generator. I and H being closed, open L until the air is removed, then close L and open H. The mercury contained in the bottle C passes up the tube D until an equilibrium is established where the point at which it comes to rest is marked. If all parts of the apparatus are tight, the column of mercury will remain stationary; if it falls, all the connexions must be re-examined. In order

* Trans. Amer. Micr. Soc., xviii. (1897) p. 131. Cf. this Journal, 1887, p. 665.
† Jahrb. f. Photographie u. Reproductionstechnik, 1897, 12 pp. and 4 figs.
‡ Journ. Quekett Micr. Club, vi. (1897) pp. 322–4 (3 figs.).
§ This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.
‖ Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 188–90 (1 fig.).

to remove all possibility of leakage around the stopper A, the flame of a Bunsen's burner is applied to the sealing-wax until it is sufficiently softened for the pressure of the atmosphere to force it into any crevice that it has not reached. When the column of mercury in D becomes stationary, admit hydrogen by means of I, until the vacuum in A is

FIG. 31.



destroyed. Close I and H and open L until exhaustion is complete; close L and open H and I successively. The alternate exhaustion and filling are repeated until there is no possibility of any air remaining in A, when the tubes *a* and *a′* are drawn apart and sealed in the flame. In order that the pressure within A may be only very slightly different from that of the atmosphere, H is not opened after the last exhaustion.

I is opened, and when the acid reaches the same level in both parts of the gas generator, quickly close M, and then close I just as soon as the change of level in the generator shows that there is a slight excess of pressure in A. After sealing, the tube is transferred to the ice block and rolled until the agar or gelatin is solidified. In case of agar, the rolling must be very rapid to ensure good results. The apparatus is also of service for displacing the air from other forms of anaerobic culture apparatus. If the vacuum pump used is capable of giving a column of mercury 635 millimetres high in the tube D, five-sixths of the gases in the tube A will be removed at each exhaustion. A simple calculation will satisfy the operator in regard to the number of exhaustions necessary.

Preparation of Culture Media and their Sterilisation.*—Mr. R. C. Reed recommends the following methods for the preparation of nutrient media.

Peptonised Bouillon.—To 1000 grm. of finely divided meat, add 2000 grm. of distilled water, and place in an agate or iron dish, and then heat in a water-bath at from 60°–65° C. for two hours, or allow it to macerate in a cool place for 24 hours. Strain through a coarse cloth, and bring the amount of liquid up to 2000 ccm., adding water if necessary. Then add 0·5 per cent. pepton, and 0·5 per cent. sodium chloride; and, if a neutral or alkaline medium be desired, add enough of a 1 per cent. solution of caustic soda. Boil in a water-bath for half an hour. Cool, and filter through ordinary filter paper, and distribute in sterilised flasks.

Nutrient Agar.—Dissolve 5 grm. of finely cut agar in 100 ccm. of water, and then add it to 500 ccm. of bouillon and boil for 20 minutes. Cool down to 45°–50° C., and add the whites of two eggs. Return to the water-bath and boil for 20 or 30 minutes. In this way the clot will be got rid of, and a perfectly clear liquid left. Filter through ordinary filter paper while hot, and distribute into sterilised tubes.

Nutrient Gelatin.—To 500 ccm. of bouillon add 50 grm. of gelatin, and heat in a water-bath until the gelatin is dissolved. Cool to about 45° C., and then add the whites of two eggs, mixing the lot thoroughly. Boil in a water-bath for about 20 minutes. Filter, and distribute in sterilised tubes. Care must be taken not to boil the gelatin too long, lest it will not set when cold.

The author goes on to point out that lengthy discontinuous sterilisation may be overdone; for he has found that sterilising for one day for 30 minutes usually suffices. All that is necessary is to incubate afterwards for several days, and then reject the few tubes which are contaminated.

Rapid and Easy Method for Preparing Nutrient Agar.†—Herr E. S. London prepares agar in 33 minutes in the following way:—To 1 litre of meat water are added 5 grm. of salt, 10 grm. of pepton, and 15 grm. of agar, and the mixture placed in a flask which is heated in an autoclave until the temperature rises to 130°. The steam is then gradually slacked off, and when the temperature has sunk to 100° the

* Amer. Monthly Micr. Journ., xviii. (1897) pp. 149–54.
† Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 686–7.

flask is removed, and its contents filtered through a Diakonow's apparatus. The clear filtrate is then poured into flasks and neutralised. For Diakonow's apparatus may be substituted a simple arrangement consisting of a flask, the neck of which is closed by a caoutchouc plug with two holes. One of the holes receives the stem of a filter; the bottom of the hopper is covered with a piece of gauze upon which is placed a layer of glass wool and then a layer of fine sand. To the second hole is fitted a bent glass tube connected with an exhaust pump.

Apparatus for Cultivating Yeasts on Plaster Blocks.*—M. H. Schionning has, by combining the advantages of the plaster block and a Hansen's flask, devised an ingenious apparatus for obtaining pure ascosporous cultures of yeasts. A cylindrical block of plaster, reaching to about two-thirds up the flask, and made by mixing 2 volumes of plaster with 3/4 volume of water, is fixed to the bottom of the flask. The top of the plaster pillar is slightly hollowed for the reception of the yeast. The side tube having been plugged with cotton-wool, the apparatus is sterilised at 115° for an hour and a half. When cooled, the cap is removed and the culture placed in the hollow on the top of the pillar. The cotton-wool plug is then removed, and through the lateral tube sterilised water is introduced in quantity sufficient to reach half-way up the plaster cylinder. When the top of the pillar shines from imbibition of water, the whole apparatus is incubated at a temperature favourable for the production of spores. A piece of rubber tubing is previously fitted on the lateral tubulure, its free end being plugged with cotton-wool. By this procedure, perfectly pure cultures, quite free from bacteria and other contamination, are easily possible.

Amœba Cultures.†—Dr. O. Casagrandi and Dr. P. Barbagallo report on the different kinds of media suitable for Amœba cultures, on the reaction of the substrata, on the necessity for the presence of organised constituents therein, and on cultivable and non-cultivable Amœbæ. With regard to fluid media, there is no doubt, they say, that Amœbæ will develop in hay, straw, and hemp infusions, on decoction of fæces, and in thin albumen; but it is practically impossible to obtain a pure cultivation, partly owing to the difficulty of sterilising the medium, and partly on account of the impurity of the inoculation material. Of solid media, egg-albumen with some pepton and carbonate of soda was found extremely serviceable.

Media composed of the above mentioned infusions solidified with agar or gelatin were failures. A medium containing 5 per cent. of *Fucus crispus* was found to possess the advantages of inhibiting the growth of bacteria, and of affording opportunity to the Amœbæ of completing the stages of their life-cycle.

The most suitable reaction was found to be slightly alkaline to neutral; strongly alkaline or acid reaction being unfavourable. Acidity of the medium did not, however, prevent certain species, such as *A. coli*, from becoming acclimatised to the reaction. With regard to the association of protozoa, bacteria, fungi, and yeasts, with Amœba in the cultures, which some observers seem to regard as necessary and irremov-

* Ann. de Micrographie, ix. (1897) pp. 194–8.
† Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 579–89.

able evils, the authors, while acknowledging the difficulty of obtaining pure cultivations, do not seem to consider this as impossible. From fæces were obtained cultures of *A. coli*, *A. guttula*, *A. spinosa*; from *Blatta*-excrement, *A. blattarum*; from muddy water, *A. guttula*, *nodosa*, *diffluens*, *arborescens*, *gracilis*, *spinosa*, and *oblonga*; from damp earth in unhealthy places, *A. guttula*, *spinosa*, and *arborescens*; from beer yeast, *A. guttula* and *spinosa*.

Culture Medium for Algæ and Amœbæ.*—Dr. N. Tischutkin recommends 1 per cent. aqueous solution of agar for the cultivation both of Algæ and of Amœbæ.

Crystal Formation in Culture Media.†—Dr. Marion Dorset regards the early formation of crystals in freshly prepared agar as a special characteristic of *Bacillus pyocyaneus*. Other bacteria produce crystals in culture media, but only when the media are old, and therefore partially dried.

(2) Preparing Objects.

Methods for Demonstrating the Continuity of Protoplasm.‡—In discussing the various methods adopted for demonstrating the continuity of protoplasm, Herr A. Meyer first makes a few remarks on fixation of the tissue. For this 1 per cent. osmic acid is recommended, though strong iodopotassic iodide (iodine 3, iodide of potassium 3, water 20) and potassium-bismuth iodide solutions give favourable results. For softening membranes sulphuric acid is the best agent (H_2SO_4 1 vol. to 0·5–3 vols. water). A very strong solution of iodine made by dissolving 1 vol. of iodine and 1 of iodide of potassium in a few drops of water, and then adding 200 ccm. of water, is useful occasionally for staining the threads of protoplasm. By staining with Hoffmann's blue or Bavarian blue, the continuity of the protoplasmic processes was rendered distinctly visible. The sections were placed for a few minutes in a solution of 1 grm. of pigment and 150 grm. of 50 per cent. spirit, and examined in glycerin. Permanent preparations can be made from tissue fixed and hardened in osmic acid or alcohol by over-staining the sections in Delafield's hæmatoxylin (24 hours), and, after washing in 60 per cent. spirit, decolorising in 0·5 per cent. HCl. The sections must then be immersed in 60 per cent. spirit rendered alkaline by the addition of ammonia (10 drops to 100 ccm.). After this they are transferred to absolute alcohol, xylol, and mounted in balsam. A method for staining after mordanting with iodine is described at some length. The reagents required are:—(1) Iodopotassic iodide solution (iodine 1, iodide of potassium 1, water 200); (2) sulphuric acid (1–3), which has been saturated with iodine by standing over some iodine; (3) a solution of 1 grm. of pyoktanin cœruleum (Merck) in 30 ccm. of water. The sections are immersed in solution 1 for some minutes, and then placed on a slide and covered with a slip. Solutions 2 and 3 are added at the side of the cover; and having been allowed to act for about three minutes, the slide, section and cover-glass are immersed in a large quantity of water. Having been quickly washed, the section is placed on a clean slide and examined in glycerin.

* Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 183–8.
† Op. cit., 1te Abt., xxi. (1897) pp. 473–4.
‡ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 166–77.

If the staining has been successful, the membrane is pale blue, while the protoplasm and its connections are blackish blue.

Rapid Method of making Permanent Specimens from Frozen Sections by the Use of Formalin.*—The method described by Dr. T. S. Cullen is as follows:—A piece of the fresh tissue is sectioned on an ether freezer, and the sections placed in 5 per cent. solution of formalin for 3–5 minutes, then in 50 per cent. alcohol for 3 minutes, and in absolute alcohol for 1 minute. Wash in water; stain in hæmatoxylin for 2 minutes; decolorise in acid alcohol; rinse in water. Stain with eosin; transfer to 95 per cent. alcohol; then pass through absolute alcohol, creosote or oil of cloves, and mount in balsam.

Or as an alternative method, should it be desired to retain the blood in the sections, a piece $1 \times 5 \times 2$ cm. is placed in 10 per cent. formalin for 2 hours, after which the procedure is as before.

(3) Cutting, including Imbedding and Microtomes.

Simple Microtome for Biological Work.†—Mr. A. Flatters describes an improved form of the simple microtome originally designed by him. The carrier is moved upwards in the cylindrical well by a screw carrying at its lower end a notched disc, against which works a clicking arrangement; three of these discs with different numbers of notches may be used, so that sections of any desired thickness may be cut. The aperture of the razor plate is, on the under-side, of the same diameter as the well, but on the upper side it is slightly less, this being for the purpose of firmly holding the imbedded mass in position as it is screwed up. The razor plate, which is held in position over the well by a clamp, may be swung on one side to enable the uncut material to be removed. For larger or longitudinal sections a special razor plate, with a rectangular aperture and a corresponding holder, may be fitted to the instrument.

(4) Staining and Injecting.

Simple Method for Contrast-Staining Micro-Organisms.‡—Dr. Claudius stains microbes on covers and in sections by the following procedure. The reagents used are (1) 1 per cent. aqueous solution of methyl-violet; (2) 1 vol. of saturated aqueous solution of picric acid plus 1 vol. of water; (3) chloroform; (4) oil of cloves.

Cover-glass preparations are stained in the methyl-violet solution for 1 minute, washed in water, mopped up on blotting-paper, immersed in the picric acid solution for 1 minute, washed and mopped up again, then decolorised in chloroform, and, after having been dried, mounted in Canada balsam. Sections are stained and treated very similarly, but the two solutions are used for two minutes instead of one; and, after having been very carefully mopped up, are decolorised by means of oil of cloves, after which they are passed through xylol, and then mounted in balsam. Twenty-six species were tried by this method: 17 were stained and 9 were not; among the latter being *B. typhi*, *B. coli com.*, *Sp. choleræ asiat.*, *Pneumobac. Friedlaenderi.*

* Bull. Johns Hopkins Hosp., viii. (1897) pp. 108–9.
† Pharmaceutical Journ, lviii. (1897) pp. 485–6 (4 figs.).
‡ Ann. Inst. Pasteur, xi. (1897) pp. 332–5.

Staining Vegetable Sections.* — Prof. F. D. Kelsey recommends that vegetable sections should be stained with pigments dissolved in clove oil. After staining, remove to pure clove oil or Gage's fluid, and mount in balsam. It is hardly necessary to point out that the section must be perfectly dehydrated before it is immersed in the clove oil stain. A dilute clove oil stain acts better than a concentrated one.

Method of Staining the Malaria Flagellated Organism.† — Dr. P. Manson has succeeded in staining the flagellated malaria parasite by the following method, which shows the pigment and certain details of structure with ease and certainty. Thirty or forty strips (3 by $1\frac{1}{2}$ inches) of thick blotting-paper, each having an oblong hole (1 by $\frac{5}{8}$ inch) cut lengthwise in its centre, are prepared. They are then slightly moistened with water and laid in rows on a sheet of window glass. A droplet of blood, the size of a large pin's head, is then obtained by puncturing the finger of a person in whose blood the crescent form of the malaria parasite abounds. A Microscope-slip is then breathed on once, and the droplet of blood dabbed on the centre of the breathed-on surface. The blood is then spread out with a needle so as to cover an area of $\frac{3}{4}$ by $\frac{1}{2}$ inch, and the slip immediately inverted over a blotting-paper cell. The slip is then pressed down, care being taken to prevent the blood coming in contact with either the wall of the cell or the floor of what is now a very perfect moist chamber. In from half to three-quarters of an hour the slips are removed, and dried by gently warming them over a spirit-lamp. When dry, the films are fixed with absolute alcohol. After five minutes the alcohol is dried off, and a few drops of acetic acid (10–20 per cent.) are laid on the film, and left long enough to dissolve out the hæmoglobin. The slips are then washed in water and dried. After this they are stained with 20 per cent. phenol-fuchsin, the stain being dropped on and the slip covered with a watch-glass. After six hours it is washed off, the slide dried, and a cover-glass applied with xylol-balsam. Most of the slides will show numbers of spheres and several or many well-stained flagellated bodies. Very few crescents remain untransformed. If the slips are removed and dried in from five to ten minutes after being placed on the blotting-paper cells, only crescents, ovals, and spheres will be found; if left for more than three-quarters of an hour, free flagella and spent pigment may be found.

Staining Diphtheria Bacilli.‡—Dr. C. F. Craig states that Crouch of Denver has found that, if 24 hours old culture of diphtheria be treated for a few seconds with 1 per cent. methyl-green solution, the majority of the bacilli will be faintly stained green, and will show at both ends a well defined round body of a distinctly red colour. The following solution was found to be very serviceable :—1 per cent. methyl-green, 5 parts; 1 per cent. solution of dahlia, 1 part; distilled water, 4 parts. Only a second is required for staining; if left in longer, the staining is too intense.

Combination of Weigert's Fibrin Method and the Tubercle Bacillus Stain.§—Herr Roloff stains tubercle bacilli and fibrin in the same section

* The Microscope, v. (1897) p. 69.
† Brit. Med. Journ., 1897, ii. pp. 68–70 (15 figs.).
‡ Trans. Amer. Micr. Soc., xviii. (1897) pp. 274–5.
§ Arb. a. d. Pathol.-Anat. Inst. zu Tübingen, ii. (1896) p. 261. See Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) p. 749.

by the following procedure. The sections are stained for twenty-four hours in an incubator in carbol-fuchsin, and then decolorised with Ebner's fluid. After having been washed in 70 per cent. spirit, they are transferred to acetic acid vesuvin solution (Kahlbaum) for some hours. Next they are washed in water and in 70 per cent. spirit, and are then stuck on a slide, after which they are stained by Weigert's method. The anilin-xylol should be allowed to act for some time, otherwise the nuclei will be blue instead of brown. If the differentiation be successful, the nuclei are brown, the fibrin blue, the tubercle bacilli red, and other bacteria blue.

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

To Prevent Freezing of Formol.*—Dr. A. Milani finds that the addition of 25–35 parts of glycerin to the formol solution prevents the danger of freezing.

(6) Miscellaneous.

Rapid and Improved Method for Counting Plate Colonies.†—Dr. H. J. van't Hoff has devised the following method for counting bacterial colonies on plates:—On the middle of a gelatin plate having a diameter of about 15 cm. is dropped about 0·2 ccm. of water. The water is then distributed over the surface of the gelatin by merely rolling the capsule about, care being taken to prevent the water from reaching the side. Distributed in this way, the colonies develop quite separately, and so rapidly that in two days it is possible to obtain a better quantitative result by this method than in five or six days by the ordinary procedure.

Method for Examining Malarial Blood.‡—Dr. N. Macleod uses strips of ordinary note-paper 0·5 in. wide and about 1½ in. long for smearing cover-glasses with malarial blood. The straight edge is drawn its full half inch through a drop of blood not larger than a pin's head, and then the edge drawn across the cover-glass. In this way a thin film which dries very rapidly may be spread on cover-glass or slide. The film must be mounted dry. With a 1/4-in. objective crescents and the larger pigmented parasites, and with a 1/12 oil immersion the smaller pigmented forms, can be easily seen. The method, however, cannot be relied on for the detection of unpigmented forms without very considerable experience, and should be supplemented by staining, or the examination of fresh undried films.

Bacteriological Diagnosis of Leprosy.§—The method advocated by Messrs. Johnston and Jamieson for the bacteriological diagnosis of leprosy is extremely simple, and consists in smearing a cover with a drop of serum obtained by scraping one of the leprosy nodules. This is stained with carbol-fuchsin, and decolorised with sulphuric acid and methylen-blue. The bacilli of leprosy are found in large numbers, and this fact alone is sufficient to distinguish leprosy from tubercle bacilli. Lepra bacilli also stain readily with simple anilin dyes, while tubercle bacilli do not.

* Zool. Anzeig., xx. (1897) pp. 206–8.
† Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 731–3 (1 fig.).
‡ Lancet, 1897, ii. pp. 85–6.
§ Montreal Med. Journ., 1897. See Epit., Brit. Med. Journ., 1897, p. 92.

Diagnosis of Smegma and Tubercle Bacilli.*—Herren R. Bange and A. Trantenroth state that the only satisfactory method for distinguishing the smegma from the tubercle bacillus is the following:—Immersion in absolute alcohol for not less than three hours, in 5 per cent. chromic acid not less than 15 minutes, in phenol-fuchsin, acid. sulph. dil. 2–3 minutes, and in saturated alcoholic solution of methylen-blue at least 5 minutes.

Notes on the Agglutination Phenomenon of Typhoid Serum.—According to Widal and Sicard,† the agglutination phenomenon can be obtained with dead bacilli killed by heat (57°–60°), or better still with certain chemical agents, such as formalin. By adding a drop of formalin to 150 drops of 1–2 days old typhoid culture, the bacilli are killed, though they perfectly retain their sensitiveness to the serum for a week. These authors also state ‡ that from a drop of blood drawn from the finger and received into a sterile tube, a qualitative and quantitative test can be made.

Ferrand § cites a case wherein the agglutination reaction with typhoid culture was obtained from the serum of a person who died of streptococcus septicæmia, and Nicolas ‖ states that the same phenomenon occurs in patients who have been treated with antidiphtheritic serum.

Dr. M. W. Richardson ¶ finds that dried typhoid serum acts well for the purpose of diagnosing typhoid cultures from those of *B. coli communis*, *B. pyogenes fœtidus*, and mouse typhoid. It is only necessary to take blood from the heart of a person dead of typhoid fever, and after obtaining the serum, pour it through a filter paper and dry it.

Dr. W. Johnston ** confirms the value of Pfahl's modification of Widal's test; in this the dried blood of a patient suspected of enteric fever is dissolved in water.

Kolle †† states that the virulence of the culture should always be taken into consideration, as normal serum in dilutions of 1–10 or 15 often produces an agglutinative effect on cultures which are but slightly virulent.

Photometric Determination of Heliotropic Constants.‡‡—Prof. J. Wiesner recommends that the measurement of the heliotropic source of light should be determined by the photochemical method and the Bunsen-Roscoe unit of measure. In this way the intensity of those rays which act on silver chloride may be measured. The values obtained are generally comparable; for they hold good for gaslight, electric light, and daylight. By this method it was determined that organs very little heliotropically sensitive will even react to a fraction of a millionth of the Bunsen-Roscoe unit.

* Fortschr. d. Med., 1896, Nos. 23 and 24. See Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 353–4.
† La Semaine Méd., 1897, p. 38.
‡ Tom. cit. p. 69.
§ Tom. cit., p. 30.
‖ Tom. cit., p. 37.
¶ Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 445–6.
** Tom. cit., pp. 523–6.
†† Deutsche Med. Wochenschr., 1897, No. 9. See Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 484–5.
‡‡ Bot. Centralbl., lxix. (1897) pp. 305–9.

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on the 16th of June, 1897, at 20 Hanover Square, W., The President (E. M. Nelson, Esq.) in the Chair.

In the absence of both the Hon. Secretaries, the minutes of the meeting of May 19th last were read by Mr. J. J. Vezey, and having been duly confirmed, were signed by the President.

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

	From
A. C. Abbott, M.D., The Principles of Bacteriology. (3rd edition, 8vo, Philadelphia, 1895)	*Rev. W. Arthur Bird.*
Aanteekeningen van de Sectie-Vergaderingen 1896. Verslag der Algemeene Vergaderingen 1896 ..	*La Société provinciale des Arts et Sciences établie à Utrecht.*

The President said the Fellows would remember that they had already had two exhibition meetings—in April and May—which he believed were very much appreciated by those who were present; the success of those meetings was due in no small degree to the fact that a large number of excellent Microscopes were then placed at the disposal of the Society by Messrs. Beck and Mr. Baker; on the present occasion the Microscopes upon the table had been provided by Messrs. Watson & Son; and he thought the Fellows present would be very pleased to join in passing a very hearty vote of thanks to the members of these firms for bringing down so large a number of good instruments, and in this way enabling the Society to give such fine exhibitions.

The motion having been put from the chair, was carried by acclamation.

The President said he had brought down to the meeting a few things which he thought might be of interest to those present. The first of these was a series of photographs of microscopic objects enlarged from some of his own negatives, the point about them being that they were all enlarged to make pictures of the same diameter, the magnifying power being indicated below each. Most of them had stood this amplification fairly well, but they began to go off a little after from 7000 to 7500 diameters had been reached.

The next thing was one of his lens-mirror loups; this was practically the same thing as he had previously exhibited, so far as its optical construction and magnifying power were concerned, but it had the mirror added, and this rendered it very effective and useful when illuminated by daylight, or by the flame of a paraffin lamp. Unfortunately, it was of little use in that room, as the incandescent filament of an electric lamp was quite unsuitable for this kind of illumination.

The other item which he had brought to show them was a new Microscope lens, viz. a semi-apochromatic 1/10 of 1·3 N.A. by Leitz corrected for the long tube. The optical index of this lens was 13, against 10 of the old semi-apochromatic 1/12, and 17 of Zeiss' apochromatic 1/8 of 1·4 N.A.

He said that, in looking back upon the past, it will be readily conceded that the greatest revolution in the history of the Microscope was caused by the introduction of achromatism; but if the period was limited to the recent past, it might be said that a new epoch began with Prof. Abbe's invention of apochromatism. His own opinion, however, was that the production of the new Jena glasses which enabled semi-apochromatics to be constructed, was of equal, if not greater, importance to microscopists than the introduction of apochromatism.

Apochromatism under present conditions required the use of fluorite, a rare mineral, and one difficult to work, consequently apochromatics were expensive; but here we had a lens before us, the optical qualities of which were only slightly below those of the best apochromatics in existence, and yet its price was 3*l.* 15*s.*

Of course the resolving power of this lens was less than that of the 1·4 apochromat in the proportion of 13 to 14, but he doubted whether there was any ordinary test-object which a 1·4 apochromat would resolve, that this objective would not resolve also. The introduction of such an excellently corrected semi-apochromat encouraged him in the hope that before very long he would be able to announce to them that the word "semi" might be omitted from the title of this class of objective.

He had given this lens an exhaustive testing, and there were only one or two excessively difficult secondary diatomic structures in his possession which it failed to resolve.

They could remember that a little time back he announced the discovery of a difficult structure on the hoop of a *Navicula major*; that structure, which was so difficult with an apochromat of 1·4 N.A., was strongly shown by this lens. This indicates not only the advance made by the lens itself, but also the improvement in the methods of using modern wide-angled oil immersions.

Mr. Vezey said that it had frequently happened at the last meeting of the session that they had no paper upon the Agenda. This was the case on the present occasion; but they had upon the table for exhibition a large number of specimens of palates of Mollusca selected from the collection presented through Mr. Rousselet at the last meeting; these being shown, as the President had already mentioned, under Microscopes kindly provided for the occasion by Messrs. Watson and Son.

He also intimated that the Rooms of the Society would be closed from Monday to Wednesday, June 21st to 23rd inclusive, and that they would be closed for the usual vacation from August 13th to September 13th.

Mr. Vezey also gave formal notice on behalf of the Council that the next meeting would be made special, to consider the desirability of adding the following bye-law to those in existence:—

Bye-law 65 to read:—"The Council shall, at the Annual Meeting, propose a Fellow of the Society to act as curator of the instruments, tools, and such other objects as may from time to time be confided to his care; he shall be elected by the Society, and shall make an annual report of the condition of the objects under his charge."

The President, again reminding the Fellows that this was the last ordinary meeting of the session, wished them a very pleasant vacation, and hoped they would not only greatly benefit by their holidays, but would also endeavour to benefit the Society by obtaining materials for some good papers, and by doing what they could to induce new Fellows to join the Society when they met again in October.

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

The President:—A series of Photographs of Microscopic Objects enlarged from some of his own negatives. A Lens-mirror Loup, power 10. A 1/10 in. oil-immersion semi-apochromatic Objective by Leitz, N.A. 1·3, corrected for the long tube.

The Society:—The following slides of Palates of Mollusca:—*Ampullaria fasciata*, ditto sp., *Bullia digitalis*, *Chiton siculus*, ditto *spiniger*? *Chlorostoma brunneum*, *Cypræa caput-serpentis*, ditto *cervinetta* (young). *Doris tuberculata*, *Helix Hopetonensis*, *Janthina rotundata*, *Labio zebra*, *Livona pica*, *Neritina punctulata*, *Paludomus phasicanus*, *Patella vulgata*, *Polydonta radiata*, *Siphonaria Zealandica*, *Trochus lineatus*, *Urosalpinx cinerea*.

New Fellows:—The following were elected *Ordinary* Fellows:—Mr. S. C. Mahalanobis, Mr. Frank Orfeur, and Dr. Ezra H. Wilson.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

OCTOBER 1897.

SUMMARY OF CURRENT RESEARCHES

Relating to Zoology and Botany (*principally Invertebrata and Cryptogamia*), Microscopy, &c., *including Original Communications from Fellows and Others.**

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Recapitulation.‡—Mr. J. T. Cunningham discusses the recapitulation-doctrine, which he regards as "a hasty generalisation." He begins with a brief note—too brief as regards von Baer—on the history of the idea, and then turns to Sedgwick's recent criticism. A number of particular cases are discussed as tests of the recapitulation-theory,—the life-history of Amphibia, the development of the tail in fishes (whereon a considerable digression from the theme), and the development of flat fishes—and it may be allowed that the theory in its usual form does not stand the test very well. Finally, Mr. Cunningham discusses the "recapitulation" of the eye in the development of the more or less blind animals which live in caves or in similar conditions. The recapitulation is very imperfect and incomplete. "The following conclusions," at least so the author says, "follow necessarily from the facts."

(1) "The blindness of cave animals has certainly not been produced by the selection or survival of individuals in which the eyes were defective from their first development. If it is due to selection at all, it is the selection of individuals in which the eyes underwent progressive deterioration after the commencement of independent life."

(2) "The eyes, even in the stage in which they are most developed, are far from being as well developed as in the ancestors which lived in

* 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.

‡ Science Progress, i. (1897) pp. 483-510.

daylight, but are only somewhat more developed than in the adult animal. Recapitulation does not therefore occur except when the external condition to which the ancestral structure was adapted continues to act at an early period of life."

The article is a very interesting one, but we cannot silence the wish that expert embryologists, such as the writer, would, in writing on recapitulation, bring the discussion to a more definite focus. Is this recapitulation-doctrine, with its long pedigree going back far beyond von Baer, who was as much its critic as its exponent, and with its prolonged and surely not wholly disastrous influence on embryology, an entirely mistaken interpretation? If not, what precisely is wrong with it, and what restatement may for a time fill its place? If yes, do we not require a franker confession of ignorance as to the meaning of such structures as the gill-slits of Mammals, and a more strenuous physiological embryology?

Regeneration of Organs in Amphibia.*—Prof. W. Kochs has experimented with tadpoles of *Rana fusca* and *Bombinator igneus*, and also with salamanders and newts. He found a platinum needle and galvanic cautery the most serviceable instrument. Immediately after the operation the tadpoles swam about as if nothing had happened, and on the second day they ate white bread and frog-flesh as usual.

When an eye was wholly destroyed, no hint of regeneration could be observed, even after three months. Kochs generalises this result in the conclusion that regeneration of an organ occurs only when a portion of the organ is left.

The author cites some interesting historical notes from a paper by V. Colucci which seems hardly to have received the attention it deserves. Thus Bonnet and Blumenbach proved the regeneration of the newt's eye when a remnant was left in connection with the optic nerve; Philippeaux (1880) showed that no regeneration occurred (in 40 cases) when no remnant was left; Colucci (1891) has priority over Gustav Wolff and Erik Müller in demonstrating the regeneration of an extirpated lens from a centre of formation situated in the anterior border of the iris.

The experiments which Kochs himself made on this interesting question of lens-regeneration lead him to the suggestion that the new lens may arise from epidermic cells brought into the interior of the eye by the operation. He thinks it unlikely that the iris could remain quite *uninjured* by the operation, as Erik Müller maintains. This result is certain, that in tadpoles the lens is regenerated as it is in newts; but a secure conclusion as to the precise formative tissue of the new lens is still to seek.

In general, Kochs concludes that in regeneration a *restitutio in integrum* never occurs, the regenerated part being always smaller; that in forms other than larvæ there is during regeneration a hypertrophy of the part which compensates for that which has been removed; that reproductive power is greater and more rapid when only small parts of the extremities are amputated. The appearance of extra parts is more probable, as Barfurth has shown, the nearer the amputation is to the proximal end of the appendage.

* Arch. f. Mikr. Anat., xlix. (1897) pp. 441–61 (1 pl. and 3 figs.).

Maturation and Fertilisation in Amphioxus.*—Dr. J. Sobotta has been able to make an essentially complete series of observations on the fertilisation-process in the eggs of *Amphioxus lanceolatus*. He also gives a detailed account of the formation of the second polar body, but is unable to contribute anything to the question of reducing divisions. The fertilisation processes conform to the usual plan; the centrosomes of the fertilised ovum are wholly of paternal origin; the chromatin is in half paternal and in half maternal; no hint of a centre-quadrille or the like was to be seen. The author finds his results very different from those reached by O. Van der Stricht, and believes that this careful Belgian investigator worked unconsciously with markedly polyspermic ova.

Germinal Vesicle and Polar Bodies in Batrachia.†—MM. J. B. Carnoy and H. Lebrun began a study of these structures in 1887, and they speak of their patient work as ten years of hard labour. They start with a general essay on the structure of the cell, especially of the nucleus, comparing their own observations and conclusions with those of others. There are two other general chapters in the memoir, one entitled "the karyoplasm and the cytoplasm," and one dealing with nucleoli.

The first type discussed is *Salamandra maculosa*, in the eggs of which they find four types, characterised by the different resolutions of the nuclear filament. In order of frequency these types are:—(1) *Résolution serpentine*, (2) *Résolution en boudins*, (3) *Résolution filamenteuse étoilée*, and (4) *Résolution en plumeaux*. The second type discussed is *Pleurodeles Waltii* Mich. Here there are three types, characterised by the nucleolar figures of the first period.

Ovary and Ovarian Ova in Marine Fishes.‡—Mr. J. T. Cunningham deals especially with the development of the yolk. In fishes with pelagic ova and an annual spawning period, the formation of yolk commences some months after the close of the preceding spawning season. The active development of the annual crop of ova does not take much more than six months. The formation of yolk always begins near the surface of the cytoplasm, and extends inwards. If there are separate oil-globules, a few small ones are present before the yolk begins to be formed, except in the mackerel. In immature sole, turbot, brill, &c., examined during the spawning season, the largest ova in the ovaries contain scattered oil-globules. The same is true in the largest transparent ova in spent ovaries of these species. When the formation of yolk takes place in such eggs, the oil-globules form a zone internal to the yolk.

The essential peculiarity of the spent ovary is the presence of ruptured follicles; the follicular epithelium seems to disintegrate and dissolve; the cavity is obliterated by the contraction of the follicle, which forms a mass of cells and fibres, and is finally absorbed soon after yolk begins to be formed in the eggs of the following season. Some eggs which have never matured die, and are absorbed *in situ*. In the fresh state they are seen as opaque amorphous masses. The same is true in unripe ovaries where spawning has never occurred.

The vitelline nucleus is first seen as a stained corpuscle in contact

* Arch. f. Mikr. Anat., l. (1897) pp. 15–71 (4 pls.).
† La Cellule, xii. (1897) pp. 191–295 (5 pls.).
‡ Quart. Journ. Micr. Sci., xl. (1897) pp. 101–63 (3 pls.).

with the germinal vesicle; it is probably identical with the centrosome which remains in the ovum after the last division of the germ-cell. In ova of plaice and flounder it moves to the inner border of the yolk-layer, and becomes surrounded with yolk. In *Syngnathus acus* there are often two or more vitelline nuclei in one ovum.

The germinal vesicle in Teleostean ova shows at first a single large nucleolus, a nuclear network, and a membrane. At the next stage the vesicle is larger, and there are several peripheral nucleoli; in still larger ova the nucleoli are still peripheral, but there is a central region with separate feathery fibrils, the centrosomes of Rückert. After the formation of yolk has begun, the nucleoli are found around and among the central fibrils; and in the turbot there are hints that the substance of the nucleoli is absorbed into the central fibrils to form the chromosomes of the polar mitoses.

Development of Spermatozoa in Salamander.*—Dr. F. Meves has reinvestigated the much studied development of the spermatozoon in *Salamandra maculosa.* He attended particularly to the rôle of the central corpuscle and the sphere in the formation of the spermatozoon. That there is some relation between the middle part of the spermatozoon and the central corpuscle has been quite clear for several years. For in numerous cases it has been shown that after the spermatozoon enters the ovum, a radiate system develops around the middle part. From this the inference has been drawn that the middle part of the spermatozoon contained the centrosome. What Meves claims to have proved is that the middle part is formed wholly of centrosome-substance.

Spermatogenesis in Selachians.†—Prof. Armand Sabatier has published a lengthy memoir on the spermatogenesis of Selachians, as exhibited by *Scyllium*, *Acanthias*, and *Raja.* He compares his results throughout with those obtained in his study of Crustaceans.

The origin of the germ-cells is the same in the two cases. They occur in groups or nests of nuclei lying in a plasmodium. These primary nests are formed by the direct division of the nuclei of the germinal connective tissue. Secondary nests are formed by the direct division of flattened nuclei contained in the connective membrane of the acinus or testicular cul-de-sac.

The direct division occurs by pulverisation of the nuclein and by cleavage. The undivided protoplasm is disorganised.

The nuclear germs are transformed into protospermatoblasts, each acquiring a zone of protoplasm. By indirect division the protospermatoblasts give rise to deutospermatoblasts, and these to tritospermatoblasts. There are thus two successive mitoses.

The head of the spermatozoid and its cap arise from the nucleus, which is differentiated in two directions. The middle part and caudal filament of the spermatozoid arise from the reticulate protoplasm of the tritospermatoblast, but there is in this some "nuclein-dust," and at the posterior end of the middle part there is a special "caudal granule."

There is, of course, in this long memoir, much more than we have been able to summarise; we have merely noted some of the essential points.

* Arch. f. Mikr. Anat., l. (1897) pp. 110–41 (2 pls.).
† Mem. Acad. Montpellier, ii. (1896) pp. 53–238 (9 pls.).

A Two-headed Tadpole.*— Mlle. M. Loyez describes a tadpole of *Rana temporaria* hatched with two heads. These were at first equal and symmetrical, and each bore on its outer side the usual external gills. When the external gills were replaced by the internal set, only one spiracle was formed—to the left side. Very soon the left head began to gain the preponderance. There were four adhesive organs, but the tadpole was never seen to fix itself. It swam well enough, and lived for three weeks. It ate by its left mouth only, at least after the inequality began to be apparent. Its size at death was less than that of the others of the same brood.

Blood-formation in the Lamprey.†—Dr. E. Giglio-Tos finds that the hæmatopoetic organ of the larval lamprey is the so-called spiral valve of the intestinal wall. The parenchyma of this fold includes three kinds of cells :—(*a*) the mother-cells, which give rise to (*b*) hæmocytogenous cells, from which are derived (*c*) the elements of the blood, the erythroblasts and the leucoblasts. Thus the red and white cells have in this case a common origin. Mitosis is the mode of division of all the elements as long as they are included in the stroma of the valve; the erythroblasts do not contain hæmoglobin in their early stages when they are within the stroma of the valve; the pigment begins to be produced when they reach the plasma of the blood.

Development of Dental Enamel.‡—Dr. R. R. Andrews gives an account of his researches on the development of dental enamel and a criticism of the results reached by Dr. J. L. Williams.§ In the conclusion of his paper he expresses his belief that the formation of the enamel is in a sense a secreting process, though he does not believe that secreting papillæ have been found in the *stratum intermedium* in all cases. This requires further investigation. There are two distinct products of the enamel-forming layers. One of these products, from which the enamel-rods themselves are built, is formed in the ameloblasts, but not by nuclear formation. In the formed enamel-rod the globular bodies are nearly or quite melted into one another at their extremities.

As the globular bodies pass from the ameloblasts, they are placed in a network of what appear to be epithelial fibres, which pass within, between, and across the globular masses. Around the scaffolding thus formed the protoplasmic exudate flows, thus supplying the cement substance. Calcification then takes place, and enamel is formed.

Mesoderm of the Anterior Region of the Head in the Duck.‖ — Prof. H. Rex has made a contribution to this difficult subject. It is not easy to make a summary intelligible without the author's figures, but the main—though tentative—result is as follows. The *Anlagen* of the paired pre-mandibular head-cavities (and the canal connecting them) are formed as lateral outgrowths from the degenerate and solidified apical part of the anterior region of the gut. The hollowing out of these rudiments

* Bull. Soc. Zool. France, xxii. (1897) pp. 146–8 (4 figs.).
† Atti R. Acc. Torino, xxxii. (1897) pp. 362–76 (1 pl.).
‡ Internat. Dental Journal, April 1897, 20 pp., 12 figs.
§ Cf. this Journal, *ante*, p. 261.
‖ Arch. f. Mikr. Anat., l. (1897) pp. 71–110 (1 pl. and 12 figs.).

is effected only after the notochord-rudiment associated with the above-mentioned *Scheitelrest* has been differentiated, and is probably to be regarded as the reappearance of the cavity which originally traversed the *Scheitelrest*.

Development of Excretory Organs in Bdellostoma.*—Mr. G. C. Price was fortunate enough to secure a few embryos of *Bdellostoma stouti* Lockington. The "mesonephros" forms, as is known, the functional excretory organ of the adult, and has 26–31 tubules opening into the relatively large segmental duct; the part called the pronephros lies on each side in the pericardial cavity, but in the adult the lumen of its central duct has lost continuity with the lumen of the segmental duct. As in other Vertebrates, the rudiments of the pronephric segmental tubes grow into the rudiment of the segmental duct, and the lumen of the duct is formed in continuity with the lumina of the tubules; in *Bdellostoma*, however, this is true not only of the pronephric part, but of the entire system, which is therefore primitive in a much more fundamental sense than has hitherto been supposed. The author finds in the development and structure of *Bdellostoma* strong evidence in favour of Rückert's theory that primitively the excretory system consisted of segmental tubules, which opened independently of one another along the side of the body, and that the segmental duct has been formed from these tubules.

Further Researches on Metamorphosis of Muraenoids.†—Prof. B. Grassi and Dr. S. Calandruccio are now able to say that they know the larval and semi-larval forms of all the Mediterranean Muraenoids except the very rare *Chlopsis bicolor* and the occasional *Muraenesox savanna.* They have followed the metamorphosis of *Leptocephalus brevirostris* into adults, and note that the *Leptocephalus* stage of *Myrus vulgaris* is very like that of *Ophichthys hispanus* (syn. *O. remicaudus*), and that the "Tiluri" are probably referable to *Serrivomer*.

Development of Eels.‡—Prof. G. B. Grassi and Dr. S. Calandruccio have a note on two transitions between *Leptocephalus brevirostris* and the young eel. The one had the dental teeth still intact; the other had lost them, but had not acquired the final set.

Development of Hypochorda and Ligamentum longitudinale ventrale in Teleostei.§—Dr. K. Franz corroborates, in reference to trout and salmon, what other investigators have stated, that the hypochorda develops from the endoderm. It separates from a ridge springing from the dorsal wall of the gut. The separation is associated with the formation of segmentally arranged bridges, similar to those which Stöhr has described in the frog. No lumen is ever demonstrable in the hypochorda.

The ligamentum longitudinale ventrale arises from the cells of the axial mesoderm without the elements of the hypochorda taking any share in its formation. The hypochorda disappears (more rapidly in the salmon than in the trout) without contributing to any organ.

* Zool. Jahrb. (Abth. Anat.), x. (1897) pp. 205–26 (2 pls.).
† Atti R. Acad. Lincei (Rend.), vi. (1897) p. 43.
‡ Tom. cit., pp. 239–40 (2 figs.).
§ Morph. Jahrb., xxv. (1897) pp. 143–55 (1 pl. and 2 figs.).

Morphological Nature of the Hypochorda.*—Prof. H. Klaatsch has studied this enigmatical structure in embryos of *Torpedo* and *Pristiurus*, and, comparing these with *Amphioxus*, comes to the conclusion that the hypochorda of Craniota is a rudiment of the epibranchial groove, which is functional in the lancelet. Both have an endodermic origin on the dorsal wall of the gut beneath the notochord and between the paired aortæ. The occurrence of a hypochordal groove in development is also noteworthy.

In the adult lancelet the organ is restricted to the pharyngeal region; in young forms it extends further back. In higher forms the rudiment is extended far back over the gut; but this is regarded as a secondary character. There is no warrant for deriving the hypochorda from metameric dorsal diverticula of the gut. As to its degeneration from a functional groove to a mere band in part elastic, the modification of the respiratory pharynx may have something to do with it; and it should also be noticed that its reduction makes the development of an unpaired aorta possible.

Gastrula of Amphioxus.†—Prof. H. Klaatsch has studied this stage, especially in relation to the concrescence theory. The main result is that the blastopore of the lower Chordata is not closed by the concrescence of lateral parts, that there is as little of a gastrula-raphe in *Amphioxus* as in the higher Vertebrates. What occurs is a gradual narrowing of the blastopore, wherein the "instreaming" of cell-material plays its part, as Kopsch has shown for Amphibia.

Skeletal Cartilage of Outer Ear in Monotremes.‡—Prof. G. Ruge has made an interesting discovery in connection with this. The cartilaginous skeleton of the external ear in *Echidna* is closely associated with the hyoid arch. In *Ornithorhynchus* the condition is confirmatory, though more primitive. Thus the hyoid arch, before forming the rudiment of the stapes by the separation of a dorsal portion, manifests its formative activity in giving origin to the cartilaginous external ear in the Promammalia.

Development of Gymnophiona.§—Dr. A. Brauer has studied the development of *Hypogeophis rostratus* and *H. alternans* from the Seychelles. The segmentation, unlike that of other amphibian types, is meroblastic. One side of the egg showed several layers of blastomeres; the other parts showed nuclei with cell boundaries visible peripherally; these nuclei are derived from blastomeres which wander into the yolk. A segmentation cavity was represented merely by gaps between the deeper cells.

In the next stage, in the laid eggs, some of the blastomeres form a superficial epithelial layer, while the others are scattered in the enlarged segmentation cavity. The former (the "animal" cells) arrange themselves more regularly, and assume a cylindrical form at the future posterior end of the embryo. At the posterior margin a broad transverse groove is formed, and there the animal cells are turned downwards and forwards. The lower "animal layer" thus formed grows forwards, and

* Morph. Jahrb., xxv. (1897) pp. 156–169 (1 pl.).
† Tom. cit., pp. 224–43 (1 pl. and 4 figs.). ‡ Tom. cit., pp. 202–23 (6 figs.).
§ Zool. Jahrb. (Abth. Anat.), x. (1897) pp. 389–472 (4 pls. and 26 figs.)

a cleft appears between it and the yolk. At this stage there are therefore two cavities, the anterior segmentation-cavity, and the quite distinct posterior cavity formed as above, and opening at the blastopore. The two come together by a rupture of the separating partition, and an archenteron is formed. The roof of the archenteron usually gives clear evidence of its twofold origin in the different structure of its two sets of cells. In fact, the anterior and posterior regions of the roof do not lose their distinctness of character. The anterior (vegetative) layer grows backwards from the line of contact, insinuating itself beneath the posterior layer, and forming the definitive epithelium of the gut.

Before the beginning of this undergrowth, the margin of inturning shows a posterior curvature of its edges, so that an anterior blastopore-lip and two lateral walls are formed. A posterior lip is formed after the complete incurving and coalescence of the two outermost ends of the margin of inturning. Round the whole of the blastopore margin the ectoderm passes into the mesoderm; the latter forms a unified rudiment, which (before the above-described undergrowth of the endoderm) constitutes part of the roof of the archenteron. From this region, as the endoderm grows under, the rudiments of the notochord and the lateral plates are formed. At the same time the medullary plate, groove, and canal appear successively. The closure of the blastopore takes place from in front backwards; by the closure of the anterior part the external communication of the neurenteric canal is shut off; the internal communication with the archenteron remains open for a considerable time; the most posterior part of the blastopore becomes the anus directly.

Present Position of Darwinism.*—Herr G. Wolff has under this title published a lecture, which is almost wholly concerned with a criticism of Weismann's 'Neue Gedanken zur Vererbungsfrage,' an emphatic compliment to the Freiburg professor, with whose views the lecturer finds himself much at variance. After emphasising the fact that Darwinism postulates as data *quantitative*, rather than qualitative variations, Wolff seeks to show that Weismann's doctrine of Panmixia is inconsistent with the Darwinian postulate, since Panmixia cannot be an effective factor except in regard to *qualitative* variations. It appears to us, however, that a way out of this apparent dilemma has been already indicated by several writers on Panmixia, and by one at least—the late Mr. Romanes.

Herr Wolff proceeds to a criticism of the Panmixia idea, resting his argument very largely on the alleged fact that the ontogeny of dwindling structures points not to weakened development of the rudiments, as the doctrine of Panmixia might lead us to expect, but rather to a retrogressive metamorphosis. We must confess our inability to see any obvious difficulty; and as to the case he selects—the occurrence of rudiments of teeth in modern birds—we think any authentic cases of this are far to seek.

In support of Panmixia, Weismann has made use of the conclusion that unfavourable variations are more frequent than favourable variations; but Wolff points out that there is no reason to believe that this is true of purely quantitative variations, such as Darwinism postulates. To avoid this difficulty Weismann has restricted the conclusion as to the

* 'Der gegenwärtige Stand des Darwinismus,' Leipzig, 8vo, 1896, 30 pp.

greater frequency of unfavourable variations to quantitative variations among the parts of an organ, and has committed himself to the sentence that "an organ at the height of adaptation cannot vary in the direction 'better,' for every independent deviation of its parts must have the import of 'worse.'" But this seems to Wolff to be sawing at the branch which supports the whole Darwinian theory of progressive evolution. What applies to the disappearance of an organ must also apply to its establishment; Weismann postulates for both no longer a fortuitous crop of variations, but a definite variation-tendency towards *plus* when an adaptive character is being evolved, towards *minus* when it is disappearing.

But even this concession may, according to Weismann, be made to consist with Darwinism; he tries to effect this by an ingenious combination of his Germ-plasm theory with Roux's theory of the struggle of Parts. Of these two theories Wolff then gives a short account.

The main idea of germinal selection is that the determinants, like other parts of the organism, are subject to struggle and intra-selection, in the course of which the stronger become stronger (in assimilative power, &c.), and the weaker become weaker, so that an internal tendency is established which emphasises lines of variation already started and sanctioned by the ordinary selection of individuals.

To this Wolff answers as follows:—(1) The theory leaves the *beginnings* of the "adaptive variation-tendency" unexplained, thus resembling Darwinism in general, the fundamental error of which is that it works only with continuations, not with beginnings. But this is an old story.

(2) Supposing that a smaller determinant corresponds to a smaller organ, does it follow that the determinant is weaker in assimilative power? Smallness and atrophy cannot be identified. If smaller organs arise from determinants which have been weakened in their assimilative power, then, according to Weismann, this assimilative power must continually decrease. But how then can we understand that a small organ persists at all, and may in certain cases even increase again? Moreover, by what conceivable process—functioning, trophic stimulus, &c.—can the assimilative power of the primarily stronger determinants be further increased?

(3) Finally, Wolff asks what are the real competitors or combatants in the alleged process of germinal selection. Are they the component parts of the germ-plasm? But these stand in a quite different relation to one another from that occupied by individual organisms in nature, or even by the parts of the body. The factor of "over-production" is inapplicable to the germ-plasm, in which the essential parts of the future organism are represented only once.

The author ends by expressing his conviction that the attempt to find a "mechanical" explanation of adaptive variation has proved a failure. That may be; but we miss in this lecture any indication of how the author himself proposes to meet the acknowledged difficulties of the evolution-problem.

Correlated Variation.*—Messrs. C. B. Davenport and C. Bullard have studied the variations in the Müllerian glands that are found on

* Proc. Amer. Acad., xxxii. (1896) pp. 87–97.

the wrist of the fore-legs of swine. These glands occur, when there are several of them, in a linear series, the number of which is variable. Reduction in number takes place generally from the distal end, rarely in the middle of the series. When the number is large, some of them occur outside the main row, either in a row parallel with the main one, or at right angles to it. The highest total number observed in one leg is 10, never more than 9 in a row. The total number of swine examined was 4000, 2000 of each sex, 8000 fore-legs. The index of variability is the average departure in the number of glands of any set of legs from the mean number of that set. Galton's method of finding the index of correlation was used.

Results. The average number of glands is tolerably but not strikingly close on the two fore-legs and in the two sexes. The glands are nearly 1 per cent. more abundant in the male than in the female. The variants are distributed in close accord with the probability-curve. The variability in the two legs is very similar, especially in the male. The males are 2·5 per cent. more variable than the females. The glands are 0·8 per cent. more variable on the left side than on the right side. The relative variability of the same leg in the different sexes is about 1·6 per cent. greater than that of the two legs in the same sex. The degree of correlation in the variability of the right and left legs is about 0·777.

b. Histology.

Blood-Vessels in Epithelium.*—Prof. F. Maurer found on examining the buccal mucous membrane of Amphibians (frog, newt, &c.), that the capillaries do not end in the sub-epithelial layer, but pass between the cells of the basal layer, and sometimes (in *Anura*) even through the middle layer, to the basal surface of the superficial ciliated cells. In the region of the jaw-margin there is neither sub-epithelial nor intra-epithelial capillary plexus.

The facts have a threefold interest. (1) They complicate our histological conception of epithelium. (2) To the comparative morphologist the intra-epithelial vascular plexus above described is suggestive, since respiratory organs in Vertebrates are associated with the anterior part of the gut. (3) Maurer believes that the intra-epithelial plexus is primarily concerned with the nutrition of the several layers of the epithelium, but that it may come to have secondarily a respiratory significance, e.g. in the lungless Amphibians studied by Wilder, Camerano, and Lönnberg.

Uterine Mucosa of Bat during Gestation.†—M. Pierre Nolf ends his memoir on this subject with a comparative survey. (1) In Insectivores, Carnivores, Rodents, and Bats, the essential phenomenon observed in the uterine mucosa during gestation is the destruction of a more or less important part—a destruction often preceded by a phase of hypertrophy. (2) There is a rapid destruction of the lining epithelium of the uterus, which may be preceded by a very short phase of proliferation. (3) In Carnivores, the modifications induced by gestation affect especially the superficial part of the glandular tubes; the mucosa

* Morph. Jahrb., xxv. (1897) pp. 190–201 (1 pl.).
† Arch. Biol., xiv. (1896) pp. 561–693 (7 pls.).

remaining, as Duval has shown, normal through the gestation. (4) In Insectivores the destruction of the mucosa is almost complete during gestation, and the reaction varies with the genera, being sometimes mostly epithelial, sometimes mostly dermic. (5) In Rodents there is a rapid disappearance of the glands (after a short phase of hypertrophy in the rabbit), and the modifications of the dermis are most prominent. Here again the destruction extends into the deep dermic layers (Duval). (6) In bats (*Vespertilio murinus*), the hypertrophy affects the dermis, and the necrosis penetrates through the whole thickness of the dermis, except to some elements intimately applied to the musculature. (7) In the bat there is a complication. A limited portion of the dermis, in immediate contact with the external placentar surface, differentiates from the deep layers, and undergoes independent modification. It forms a vascularised para-placentar layer. (8) When there is a notable difference between the volume of the fertilised ovum and the uterine cavity, and when the swelling of the mucosa is strongly marked, the ovum is surrounded in a reflected decidua.

Cell-Bridges in Unstriped Muscles.*—Dr. H. Triepel notes that many investigators have described intercellular bridges in the unstriped muscle of Mammals. He has added to the list of cases by finding them very distinctly in the longitudinal intestinal musculature of the ox. He fixed his material in 4 per cent. formol solution, and stained with hæmatoxylin and neutral orcein. The appearance of bridges is not due to longitudinal ridges, for there are none; but a longitudinal striation or fibrillation does occur in the cells. He observed spiral ridges with two or three turns on a cell, but these are contraction phenomena. The intercellular bridges are not to be confused with marginal irregularities which correspond to the spiral ridges, nor with certain long threads, which are probably due to insinuated connective tissue elements.

Comparative Histology of the Liver.†—Herr J. F. Holm has compared *Myxine*, *Ammocœtes*, *Petromyzon*, and *Scyllium*, as regards the structure of the liver. As long as the liver is directly secretory, it has the character of a tubular gland, as is plainly seen in *Myxine*. In the larval lamprey the same condition occurs, but it is lost as the secretory function ceases. In the dog-fish there does not seem at first sight much hint of a glandular character, but this comes out when embryonic stages are observed. The primitive state of the liver was doubtless that of a tubular gland.

Permeability of the Skin.‡—Margherita Traube-Mengarini has experimented on the osmotic permeability of the skin. There can be but little, else fresh-water animals would swell up and marine animals would shrink. Only in parasites which live in a solution of constant osmotic pressure is the skin markedly permeable. Thus a living *Opalina* may be readily penetrated by eosin, if the medium is otherwise suitable. In Metazoa, the intestinal tract alone shows osmosis. Thus, if frogs swallow the coloured water in which they are placed, they are gradually coloured through and through; but if the mouth

* Anat. Anzeig., xiii. (1897) pp. 501–3.
† Zool. Jahrb. (Abth. Anat.), x. (1897) pp. 277–86 (2 pls.).
‡ Rend. Acc. Lincei, v. (1896). See Biol. Centralbl., xvii. (1897) pp. 29–30.

remains shut, none of the colouring matter passes below the outermost epithelial layer. In special cases, e.g. frogs in 5 per cent. salt solution or patients in mineral baths, water may diffuse outwards through the skin; but this is abnormal.

Structure and Development of Cartilage in Cyclostomes.*—Herr J. Schaffer begins by discussing the soft or "blue" cartilage as seen, for instance, in the branchial skeleton of *Ammocœtes*. Its ground-substance is a simple honeycomb or alveolar system separating the cells; and these component cells or chondroblasts are able not only to secrete cartilaginous substance around themselves, but also to assimilate the adjacent tissue, and to modify it into chondrogenic substance. In *Ammocœtes*, the primary cement-substance and the capsular substance produced by the cells are quite indistinguishable. In the soft or grey cartilage of *Myxine*, however, the intercellular septa show, in some places at least, a distinction between the primary cement-substance and the secondarily deposited capsular substance. Schaffer places this kind of cartilage between the branchial and the cranial cartilage of the larval lamprey.

In the hard or "yellow" cartilage of *Myxine*, Schaffer interprets the capsular substance which fills the alveoli of the cement-substance, as the analogue of a cell-chamber, since acid anilin stains demonstrate an internal well-defined zone, the capsule proper, and an external unstained layer. By regressive changes, however, the capsules may be changed into ground-substance. The variety of cartilage, even in the same animal, is probably due to the diverse development of the components,—primary cement-substance, capsule-proper, and cell-chamber.

As to the development, the author emphasises the assimilatory function of the chondroblasts. In the metamorphosis of the lamprey, the new cartilage is not formed by direct change—metaplasis—of the larval tissue, but there is new formation or immigration of chondroblasts which form the new cartilage. Schaffer compares his results in detail with those of Studnicka who has recently worked at the same subject.

Nerve-Endings in Tactile Hairs of Mammals.†—Herr E. Botezat has studied the innervation of the tactile hairs in mouse, rat, cat, pig, and other forms, chiefly by means of the methylen-blue method. His most important new results are the following:—

(1) The nerve-fibres of the deep plexus of the inner hair follicle penetrate the vitreous or homogeneous membrane (between the outer root-sheath and the internal follicle), and form tactile menisci internal to it. These menisci occur not only in the lower part of the root-sheath swelling, but also in the deeper parts of the root-sheath which reach down to the papilla and form no swelling.

(2) The real endings of the sensory hair nerves are the terminal fibres into which the sensory menisci pass. These project into the interior of the root-sheath and end freely between its cells.

(3) From the annular plexus (of epidermic and follicular nerves), which occurs in several animals, processes of the axis-cylinders penetrate the vitreous membrane and form free endings internal to it.

* Arch. f. Mikr. Anat., l. (1897) pp. 170–88. † Tom. cit., pp. 142–69 (2 pls.).

Thus the external root-sheath of the tactile hairs is seen to be much more richly innervated than has been hitherto recognised, and the terminal sensory apparatus expands within the entire vitreous membrane.

Structure of the Neuroglia of the White Matter of the Spinal Cord.*—Herr Fr. Reinke concludes that the framework of the supporting substance or neuroglia in the white matter of the adult human spinal cord consists of both cells and fibrils.

A. The *cells* have numerous partially branched protoplasmic processes, which run in part transversely and obliquely, but for the most part vertically, parallel with the nerves. They are well shown by Golgi's method.

B. The *fibrils* are morphologically, physically, and chemically, quite different from the cells and their protoplasmic processes. They are, however, formed from the protoplasm, lie in and partly on it, and in adult man run in an essentially opposite direction to the protoplasmic processes. In great part these fibrils, as to the length of which nothing is known, have become quite free from the cell-body. Similarly there are cells which are in connection with only a few fibrils or with none. The fibrils are of very unequal thickness and perhaps without anastomoses. They are beautifully shown by Weigert's method.

Lenhossék with Golgi's method, and Weigert with his own staining, both reached accurate results; all that was wanting was a combination. This was effected by Kölliker, whom the author corroborates.

Lingual Glands of Vipers.†—Dr. C. Bisogni describes a superior lingual gland lying in the tongue-sheath of *Vipera Redii*, *V. chersea*, *V. Ammodytes*, *V. Aspis ocellata*, and *V. Aspis maculata*. It is probably of more general occurrence. Its function is to assist the inferior lingual gland common to all Ophidians.

The histological structure resembles that of ordinary salivary glands. Secretory tubes, lined by cylindrical glandular epithelium, are united by abundant connective tissue. The glandular cells have their nuclei at their base, and appear granular when in secretory activity, homogeneous when in repose.

In a second paper,‡ which is somewhat beyond the scope of this Journal, Bisogni calls attention to the exact anatomical correspondence in non-venomous snakes between the group of sub-lingual glands and the jugular plates which form the cutaneous covering of the lower jaw.

Nuclear Degeneration and Renewal.§—L. Cuénot directs attention to the degeneration of the macronucleus in the Gregarine *Diplocystis*. It remains intact during the enormous increase of the cell, from 8 to 1300 μ, when for about four months reserves are accumulated. Thereafter, presumably as the result of its share in metabolism, it is as it were used up and incapable of division. Degeneration follows, and the micronucleus enters upon its distinctly reproductive rôle. Similar phenomena are known in Infusorians, in *Thalassicola*, and in Coccidia. Cuénot compares them with processes which occur or, as he says, ought to occur

* Arch. f. Mikr. Anat., l. (1897) pp. 1–14 (1 pl.).
† Anat. Anzeig., xiii. (1897) pp. 490–94 (3 figs.).
‡ Tom. cit., pp. 495–8 (3 figs.).
§ Comptes Rendus, cxxv. (1897) pp. 190–3.

in the eggs of Metazoa. Thus the egg of *Salamandra maculosa* accumulates reserves for four years, and grows from 28 to 3500 μ, and is, he says, in the same sort of state as the full-grown Gregarine. It may be that the rejection of used-up material is effected by the first polar body; but apart from this it is noted that Hæcker has described some possibly analogous process in *Æquorea*, and Wheeler in *Myzostoma*. The author ventures the suggestion that "l'épuration nucléaire" is of general occurrence.

c. General.

Comparative Anatomy of Vertebrates.*—Prof. W. N. Parker has edited a second English edition of this well-known text-book by Prof. R. Wiedersheim. It has been almost entirely re-written, so as to incorporate the new material of the third German edition without too great increase of size. Continually, however, as the history of this book shows, the "Grundriss" tends to grow into the "Lehrbuch." The excellencies of the book are well known; it is enough to say that, good as it was before, it is better now.

Anticipation of Modern Views on Evolution.†—Prof. E. B. Poulton calls attention to the importance of the evolutionary views of James Cowles Prichard, the anthropologist. In the second edition of his 'Researches into the Physical History of Mankind' (1826), he argued forcibly in favour of organic evolution; he recognised the operation of artificial and natural selection; and he not only drew a clear distinction between acquired and congenital characters, but sought to show that the former were not transmitted. He was not rigidly consistent, and in after years his convictions seemed to have weakened, but some of his sentences might have been written by Darwin and others by Weismann. We shall quote two:—"It appears to be a general fact, that all connate varieties of structure, or peculiarities which are congenital, or which form a part of the natural constitution impressed on an individual from his birth, or rather from the commencement of his organisation, whether they happen to descend to him from a long inheritance, or to spring up for the first time in his own person—for this is perhaps altogether indifferent—are apt to reappear in his offspring." . . . "On the other hand, changes produced by external causes in the appearance or constitution of the individual are temporary, and, in general, acquired characters are transient; they terminate with the individual, and have no influence on the progeny." We may note that Prichard's position on this question is referred to very explicitly by Lucas in his great work on Heredity (1847–50).

So-called Accessory Parts of the Skeleton.‡—Dr. G. Thilenius begins an interesting discussion by criticising Emery's classification of "accessory" skeletal parts, i.e. novel additions to the primitive skeletal system. Emery's first division includes parts which are only found in

* 'Elements of the Comparative Anatomy of Vertebrates,' adapted from the German of Dr. Robert Wiedersheim by W. N. Parker. 2nd edition, founded on the third German edition. London and New York, 8vo, 1897, xvi. and 488 pp., 333 figs.
† Science Progress, i. (1897) pp. 278–96.
‡ Anat. Anzeig., xiii. (1897) pp. 483–90.

particular genera or families, to which Thilenius objects that this presupposes a complete knowledge of comparative anatomy. Thus, a few years ago the radiale externum would have been ranked in this division, but no one would now admit this. Emery's second division includes parts which are typical for Mammals, but have been secondarily added, for instance to the original chiridium, as is shown by their absence in other Vertebrates. He gives the metacarpo-phalangeal sesamoids as an example; but Thilenius notes that he has suggested the presence of sesamoids in the anomodont *Keirognathus cordylus*, and that Nassonov has described hyaline cartilage preformations of metacarpo-phalangeal sesamoids in the ostrich. Emery's third category includes accessory parts falsely so-called; and to this Thilenius has no objection, except that he questions whether it does not include all the cases.

An appeal has been made in this connection to the supposed ontogenic recapitulation of phylogeny, but the author places little confidence in this. The phyletic time-succession is not observed; the Vertebrate central nervous system appears in the gastrula stage, the heart is present and functioning before there are capillaries, the wisdom-tooth is surely not phyletically younger than the others. In fact, the ontogenic succession is influenced by the physiological importance of the parts, unimportant parts being slowed, important parts being hastened. Therefore one cannot determine phyletic age by time of ontogenic appearance. At the same time, ontogeny is of much importance in showing the process by which the adult state is reached, by revealing parts which are absent or rudimentary in the full-grown form, and by exhibiting structural conditions of ancient date, as in the pentadactyl *Anlage* of the bird hand.

"Accessory," like other parts of the skeleton, may be represented in the embryo by preformations in connective tissue, e.g. the Wormian bones of the skull, or by preformations in hyaline cartilage, e.g. the metacarpo-phalangeal sesamoids. Neither here nor in histological distinctions can the conception of strictly novel accessory parts find at present any secure basis.

Venoms of Toad and Salamander.*—Dr. R. T. Hewlett gives an account of recent researches and of his own investigations into the cutaneous secretions of the toad and salamander. Both animals secrete, from special skin-glands, an intensely bitter venom, differing entirely from snake-poison in that it is alkaloidal, not proteid. The venom of both, if subcutaneously injected, is fatal to birds, dogs, and guinea-pigs; administered by the mouth, that of the toad produces only vomiting, that of the salamander is toxic only in large quantities. Phrynin, or bufidine, the active principle of toad-venom, has an action on respiration and circulation not unlike that of digitalis; salamandrine is predominantly convulsive in its action, and has no direct effect upon the heart. The venom is fatal to the animal which secretes it only when administered in comparatively large doses; but an ordinary dose of the venom of the toad or the newt kills the salamander, and an ordinary dose of salamandrine is fatal to the newt and the toad, though all the secretions have a general similarity in action.

* Science Progress, i. (1897) pp. 397–405.

Japanese Zoology.*—Prof. K. Mitsukuri, in introducing 'Annotationes Zoologicæ Japonenses,' which is referred to in detail in this number of the Journal, takes an interesting retrospect of the progress of zoology in Japan. In the eighth century Japan had its Imperial University; in the ninth century the Imperial Library contained 16,790 volumes, some with "very modern sounding titles"; early in the eighteenth century there was a treatise on Natural History, in 1000 parts; and the naturalist Ono Ranzan, at the beginning of this century, had nearly one thousand pupils. Over 300 Japanese works on Botany existed before 1868, and the Botanic Garden of the Imperial University was established in 1681. The treasury of Western civilisation was first opened by a Dutch key. The visits of Thunberg (1775) and Siebold (1821) had their due effect on natural history studies. A work on the use of the Microscope was published in 1801. With the restoration in 1868 a new period began, and the modern Japanese school of zoology dates from the appointment of Prof. E. S. Morse to the chair of Zoology in Tokyo in 1877. Prof. Whitman introduced modern technical methods. Since 1881 the development of zoology in Japan has been entirely in the hands of Japanese, and a vigorous school has sprung up, as all zoologists are now aware.

Natural History of the Sea.†—Mr. George Murray has written an interesting article with this title. It contains some account of pre-'Challenger' work, discusses some of the conclusions and suggestions of the final 'Challenger' volumes, and notices some post-'Challenger' researches, e.g. Fischer's study of Bacteria in the sea, Schütt's study of Peridineæ, and the evidence which Prof. McIntosh and Mr. George Murray have furnished, that, as "all flesh is grass," so all fish appears to be diatom. The article ends with a note on a simple method of converting a mail steamer into a Plankton expedition.

Life in the Primeval Ocean.‡—Mr. C. Morris draws a necessarily speculative picture of the primeval ocean. As its waters "slowly cooled, and inorganic chemism declined in activity, organic chemistry probably set in, aided by the solar rays, then perhaps first freely reaching the waters. The material for this new phase of action had been prepared before, and existed abundantly in the water and air. . . . Certainly organic forms appeared in the waters of that period, and conditions favouring their formation must have existed. . . . Seed-forms of organic substance may have first appeared—simple carbon compounds. These would serve as the basis of more complex molecules, and there may have been a long-continued process of de-oxidation and formation of higher carbon and nitrogen compounds, till true organic matter appeared. . . . The conditions favouring the development of organic material were transitory, and no longer exist."

Tunicata.

Budding in Ecteinascidia.§—Dr. G. Lefevre comments upon the absence of parallelism between embryonic and bud-development, which

* 'Annotationes Zoologicæ Japonenses, Auspiciis Societatis Zoologicæ Tokyonensis, seriatim editæ,' i. (1897) Tokyo, pp. i–xi.

† Science Progress, i. (1897) pp. 379–96.

‡ Proc. Acad. Nat. Sci. Philad., 1897, pp. 12–17.

§ Anat. Anzeig., xiii. (1897) pp. 473–83 (6 figs.).

many recent researches have made prominent, and which his own study of *Ecteinascidia turbinata*, one of the Clavelinidæ, confirms. The bud-development of this form is very like that of *Perophora annectens*, though without the peculiar rotation or transverse shifting of the inner vesicle which occurs in the latter. The absence of an epicardium, with which the formation of the pericardium is closely connected, sharply contrasts these two genera with *Clavelina*. In *Ecteinascidia* and *Perophora annectens* the pericardium, dorsal tube, and ganglion (and in the former the gonads also), are all formed, in greater part at least, from cells which wander out from the wall of the inner vesicle into the rudiments. The primitive vesicle is the all-important part of the bud-rudiment, providing material for all the internal structures, for the ectoderm has no active rôle except as regards the test. Whether derived from an ectodermic or an endodermic larval structure, it gives rise to all the organs derived in embryonic development from the two primary germinal layers, and in some cases it also furnishes cells to the blood, as in the two forms last-mentioned. But although it is undifferentiated, like a blastula, it is mapped out into areas which form particular structures; and it is possible to make a series showing varying degrees of this differentiation. Thus, at the lowest end stands *Perophora viridis*; a step higher we find *Ecteinascidia* and *Perophora annectens*; a still higher grade is illustrated by *Botryllus* and many others.

Compound Larva of a Synascidian.*—M. Maurice Caullery has studied *Diplosomoïdes Lacazii* Giard, a Synascidian of the family Didemniæ, which, as Lahille has observed, begins to bud during the development of the oozoïd. According to Lahille, the hatched larva is already a colony of three individuals—the oozoïd and two blastozoïds. According to Caullery, the hatched larva includes (*a*) the oozoïd, typical, except that the terminal part of the digestive tube is atrophied; (*b*) a typical abdominal bud; and (*c*) two complementary thoracic half-buds. Perhaps it is most correct to say that there are two individuals—the oozoïd and diverse parts of a blastozoïd. It has a twofold interest, (1) in the precocity of the budding, and (2) in the separation of the two halves of the thoracic bud. The latter peculiarity may be explained by the presence of an abundant vitellus; it may be an illustration of the mechanical influence of the vitellus on the processes of morphogenesis.

Follicle-Cells in Salpa.†—Mr. M. M. Metcalf discusses these cells, which have been the subject of such discrepant interpretation. Salensky believed that the fertilised ovum merely served as food for its unfertilised sister-cells—the follicle-cells—which he regarded as truly formative. Brooks believed that the embryo was blocked out in follicle-cells, which were afterwards replaced by blastomeres. Heider and Korotneff have continued the inquiry. What Metcalf has shown may be very briefly stated. He finds that the disputed bodies within the blastomeres have a distinctly nuclear character, and he interprets them, with Brooks, but against Heider and Korotneff, as the ingested nuclei of the follicle-cells. Heider regarded the bodies as nucleated cells, Korotneff found no trace of a nucleus within them, Metcalf says they *are* nuclei in process of digestion.

* Comptes Rendus, cxxv. (1897) pp. 54–7.
† Zool. Anzeig., xx. (1897) pp. 210–17 (1 fig.).

INVERTEBRATA.

Microfauna of Samoa.*—Dr. A. Krämer gives a picturesque description of a wood-lake in Samoa, enclosed by a crater-wall and encircled by palms. It abounds in vegetable debris, but contained few animals. He collected two new species of *Cyclops*, and another Copepod; *Daphnella*, *Macrothrix*, *Alona*, and other Cladocera; a small Nematode, and some insect larvæ. The point of his note is rather to emphasise the importance of studying the freshwater Plankton in these regions, for it seems to be one of the last things that even the naturalist traveller thinks of doing.

Mollusca.

Skin-Glands of Molluscs.†—Dr. J. Thiele discusses the minute structure and homologies of the skin-glands in a large number of Molluscs. Thus he compares *Haliotis* and *Arca* as follows:—

Haliotis.	*Arca.*
Anterior foot-gland.	Anterior foot-gland.
Lip-gland.	Mucus gland in foot-groove.
Sole-gland.	Byssus-gland.
—	Posterior mucus-gland.
Peripheral goblet-cells.	Peripheral mucus-glands.
Sole.	Foot-groove and Byssus-cavity.

All the skin-glands have this character in common, that they are composed of glandular cells and supporting cells. The latter constitute a meshwork in which the former are wholly or partly imbedded. The author proposes to use this character as a means of distinguishing the skin-glands from those of the mesoderm and endoderm, and gives a number of examples corroborating the distinction.

Molluscan Fauna of Freshwater Lakes in Central Celebes.‡—Herren P. and F. Sarasin direct attention to the remarkable molluscs which live in the large and deep inland lakes of Celebes. The forms they were able to capture point to the existence of a fauna perhaps as interesting as that of the Lake of Baikal. The authors begin with a new Gasteropod—*Miratesta celebensis*, for the reception of which it seems necessary to establish not only a new genus, but a new family (Miratestidæ). The structure, which is briefly described, shows a combination of characters distinctive of various families. The animal is nearest the freshwater Pulmonates, especially the Limnæidæ, as is suggested by the *Planorbis*-like structure of the radula, the nervous system without chiastoneury, the hermaphroditism, and the absence of an operculum. But any very close affinity is impossible, as is shown by the large gills, the very peculiar pouched feelers, and the structure of the shell. Distant relations may perhaps be found in the so-called Thalassophilæ (*Amphibola* and *Siphonaria*). In any case, the family is phylogenetically old, near the base of the freshwater Pulmonates.

* Zool. Anzeig., xx. 1897, pp. 135–6.
† Zeitschr. f. wiss. Zool., lxii. (1897) pp. 632–70 (2 pls.).
‡ Zool. Anzeig., xx. (1897) pp. 241–5 (2 figs.).

α. Cephalopoda.

Indian Cephalopods.*—Mr. E. S. Goodrich reports on a collection of cuttlefishes received from the Calcutta Museum, and for the most part collected by the 'Investigator.' Eleven new species are described, belonging to the genera *Inioteuthis*, *Sepia*, *Loliolus*, *Sepioteuthis*, *Abralia*, *Cheiroteuthis*, *Histiopsis*, *Taonius*, and *Octopus*. No new genus has been founded, but four genera included are new to the Indian region.

γ. Gastropoda.

New Gastropod in an Antarctic Holothurian.†—Prof. H. Ludwig has found in two specimens of *Chiridota Pisanii*, a new Gastropod parasite, which, in its habit and mode of fixation, resembles a form which he previously discovered in *Myriotrochus Rinkii*, and which Voigt described under the title *Entocolax Ludwigii*. Whether the new form is really related to *Entocolax* or to the more familiar *Entoconcha* remains to be seen.

Nervous System of Molluscs.‡—Dr. J. Gilchrist has studied this by the methylen-blue method. He injected a nearly saturated solution into the living animal by the foot or by the blood system. The tentacles baffled the method until the device of first injecting cocain (5 per cent. in sea-water) was discovered. Good results were obtained with *Aplysia*, but not with *Doris*, *Patella*, or Lamellibranchs. Each case seems to require some special treatment.

The ganglia of *Aplysia* showed (1) typical motor-cells, each with a long axis-process leading away into the nerve, and other processes which break up into fine branches in the ganglia; and (2) cells, the smaller processes of which break up in one ganglion, while the main process passes over into another, probably breaking up there. Fibres passing into the ganglia were seen to break up into branches. An investigation of peripheral parts showed hints of a hypodermal nerve-plexus.

Various attempts have been made to discover the connection between the osphradial epithelium and the underlying ganglion; Gilchrist has demonstrated the existence of intra-epithelial structures—the peripheral endings of sensory cells, the nucleated bodies of which lie at a greater or less depth under the epithelium, and the lower offshoots of which penetrate the ganglion. The rhinophore shows an arrangement of ganglionic cells somewhat similar to that of the osphradium.

Phenomena of Fertilisation and Maturation in Gastropod Ova.§—Dr. F. M. MacFarland begins by describing the fertilisation phenomena in the Opisthobranch *Pleurophyllia californica* (Cooper) Bergh. The centrosomes which form the poles of the first segmentation spindle arise exclusively from the spermatozoon; they retain their independence throughout, though they are not continuously visible. There is no quadrille of the centres. The central spindle in the first cleavage arises by the approximation of two ray-systems, which are at first quite separate,

* Trans. Linn. Soc. Zool., vii. (1896) pp. 1–24 (5 pls.).
† Zool. Anzeig., xx. (1897) pp. 248–9.
‡ Journ. Linn. Soc. (Zool.), xxvi. (1897) pp. 179–86 (1 pl.).
§ Zool. Jahrb. (Abth. Anat.), x. (1897) pp. 227–64 (5 pls.).

and by the fusion of certain groups of their radii. Here the author's results entirely agree with Drüner's.

Secondly, MacFarland describes the behaviour of the centrosomes in the maturation of the eggs of another Opisthobranch, *Diaulula sandiegensis* (Cooper) Bergh. The second directive spindle with its centrosomes (but not including the mantle-fibres) arises by gradual growth and associated change of form from the inner centrosome of the first directive spindle. The daughter centrosomes arise from the division of the mother centrosome, but a residue is left which forms the central spindle. In short, as Heidenhain has said, "central spindle and centrosomes are in their origin one whole." The same is probably true in the case of the first polar body, but the difficulties of observation prohibit a certain conclusion.

Structure of Apera Burnupi.*—Mr. W. E. Collinge describes the alimentary canal, pedal gland, and reproductive organs of this Natal slug. That *Apera* has affinities with the Testacellidæ admits of little doubt, but there is a wide gap between it and either *Testacella* or *Daudebardia*. In the generalised character of its reproductive organs, it resembles in some ways the genus *Schizoglossa*, but here again there is a wide gap.

δ. Lamellibranchiata.

Hinge-Teeth in Lamellibranchs.†—M. Félix Bernard discusses the morphology of the hinge-teeth. The Mytilidæ furnish a starting point; they and the other Anisomyaria illustrate the state which Neumayr called dysodont. From the normal dysodont type a regressive and a progressive developmental series may be said to emerge. The former is illustrated by *Plicatula* and oysters; the latter begins in *Crenella* and Aviculidæ, becomes pronounced in Arcidæ and Carditaceæ, and is more and more accelerated in Lucinaceæ, Cyrenaceæ, and other families, which show the division of the primitive plate into cardinal and lateral teeth. Considered mechanically, the evolutionary process is roughly this:—at first, the provinculum was enough to secure the fixity of the hinge; dysodont teeth prevented dorso-ventral slipping; the hinge grew, the fine dentations became insufficient, the primitive plates curved and prevented both horizontal and vertical slipping; division of labour occurred between the different segments, becoming always more precise in its effect, and precocious in its ontogenetic appearance. The total disappearance of the provinculum in the majority of Heterodonts is the natural consequence of this acceleration.

Arthropoda.

α. Insecta.

Castes in Termites.‡—A translation (by W. F. H. Blandford) is published of the second portion of the valuable memoir by Prof. B. Grassi, in collaboration with Dr. A. Sandias, on the constitution and development of Termite societies. The paper embodies the result of a long series of observations on *Calotermes* and *Termes*. From his study of these and

* Ann. Nat. Hist., xx. (1897) pp. 221–5 (1 pl.).
† Comptes Rendus, cxxv. (1897) pp. 48–51.
‡ Quart. Journ. Micr. Sci., xl. (1897) pp. 1–75.

from the results of other workers, Prof. Grassi has been led to conclude that all the species of Termitidæ belong to two main types. These are :—(1) A colony presided over by a king and queen, which have possessed and shed fully developed wings. When orphaned, it is headed by a pair of royal substitutes or neoteinic forms. (2) A colony at the head of which are numerous neoteinic queens, the kings—also neoteinic —being present for short periods only. The colony is not founded by the royal forms which govern it; the neoteinic forms have been raised by a detached portion of a pre-existing colony, which thus founds a new and independent society.

Many fully winged insects emerge every year from the nest of *Calotermes flavicollis* and *Termes lucifugus*. A certain number of those belonging to the former species succeed in founding new colonies; but those of the latter are all irretrievably lost under natural conditions—at least in Sicily. The males and females swarm separately, and consanguineous pairing is thereby rendered difficult. The winged *Calotermes* settle on decayed trees, get rid of their wings, and begin to burrow. The sexes meet and pair, and each pair begins to found a fresh colony. Such pairs have the antennæ mutilated, and these organs are never found intact in a royal pair either of *Calotermes* or *Termes*. Termites communicate among themselves chiefly by a jerking convulsion of the whole body. The tibial organ, discovered by Fritz Müller, is tympanic, and probably auditory. Termites appear to hear the sounds produced by the convulsive movements. Members of the same nest recognise each other.

The food of Termitidæ consists of—(1) Triturated particles of dead or decayed wood. (2) The material disgorged by their fellows, wood-particles mixed with saliva. (3) The excrement of their fellows : this is their favourite food, and they solicit it by caressing the abdomen of another insect with their feet. It is not sufficient to maintain life unless wood is procurable. Thus a colony of soldiers which cannot gnaw wood soon dies of starvation ; but one large larva which is constantly burrowing can keep eight or ten soldiers alive. (4) Dead, moribund, or even healthy but superfluous individuals of the same species. (5) The salivary secretion of their fellows (a transparent alkaline liquid). Occasionally they imbibe water, but not habitually.

The colony can modify the development of a certain number of individuals, which would normally become perfect insects, by varying the quantity and proportion of their nutriment. It thus obtains workers, soldiers, and neoteinic forms. The neoteinic forms become sexually mature without fully acquiring the perfect instar, and thus preserve the facies of the larva or nymph ; they consist of substitute or complementary kings and queens. These transformations can take place without limitation as to age in the individuals selected. The larvæ and nymphs administer a large quantity of saliva to individuals destined to become neoteinic. This causes the disappearance of the parasitic Protozoa otherwise always found within the alimentary canal. The importance of this is not clearly understood ; but it is not sufficient in itself to produce neoteinia. Newly born larvæ receive nothing but saliva ; those in process of becoming workers or soldiers receive little or none. *Termes lucifugus* often migrates from one tree to another, carrying eggs and young; but as long as communication with the main colony is kept up, may not provide new queens; but as soon as this is lost, many substitutes are provided, and thus new colonies arise. In *Calotermes*, strangers of the same species are readily received into a nest; and even a royal pair may be received if they are orphaned. Jealousy is most conspicuous among royal forms, but is less marked than among bees. Several substitute pairs are provided to replace the true royal pair; but only one usually survives the conflict which takes place.

The paper also contains a historical survey of earlier works on the same subject, and appendices on the Protozoa parasitic in Termites, and on the Embiidæ.

Embiidæ.*—Prof. B. Grassi, in an appendix to his memoir on Termites, makes a contribution to the study of the Embiidæ. He gives a detailed account of the external features of the larva and the adult male and female of *Embia solieri*, which is widely distributed in Italy, but of which only the larval form has hitherto been known. There is no trace of wings in either sex at any stage. The insects live from November till May in ramifying silken galleries which they construct under stones. From May to July they make their galleries 10–15 cm. under ground, to avoid too great dryness. The spinning of a gallery takes from 12–15 hours, and is accomplished with the fore-legs either alternately or together, with intervals of rest. The silk is extruded as a liquid; and from its structure and the method in which the insect works, Prof. Grassi concludes that it is secreted in the anterior legs, which have well developed glands. The Embiæ become adult about the middle of June, pair at the end of that month, and probably die during summer. The species in question is degenerate in being wingless. This is probably due to the fact that the climate of Europe is not so hot as that of the countries where most species occur. The insects do not acquire wings before summer drought sets in, and there is a precocious maturation of the generative organs (neoteinia).

The authors give an account of the internal anatomy, which the translator supplements from his study of *Embia urichii*. The systematic position remains doubtful. They are very remote from Termitidæ, and have no more definite affinity with Perlidæ; nor is the much-mooted relationshop with Psocidæ more than problematical. Grassi thinks that they should be ranked among Orthoptera (s. lat.) as a special sub-order parallel with Orthoptera (s. str.). The translator is inclined to assign them a position intermediate between the Thysanura and the Orthoptera Cursoria.

Development of Lepisma.†—Dr. R. Heymons has studied the development of this primitive form (*L. saccharina* L.). The eggs are laid by means of a long and extremely narrow ovipositor; their form is a long oval; their colour changes from whitish to yellowish-brown; the shell consists of a delicate colourless exochorion, and a firm resistant endochorion; the content shows yolk-balls and fat-drops between them; the segmentation is peripheral.

* Quart. Journ. Micr. Sci., xl. (1897) pp. 55–75 (the date of the original paper is 1888–9).

† Zeitschr. f. wiss. Zool., lxii. (1897) pp. 583–631 (2 pls. and 3 figs.).

The relatively small germinal streak develops ventrally; the relatively extensive extra-embryonic area is covered by very large flat cells (= serosa-cells). In the middle of the embryonic disc a dark spot appears where the mesoderm cells wander into the interior. The very early incurving of the germinal streak into the yoke is noteworthy. It can hardly be doubted that this had to do with the development of the amnion. The amnion-cavity has a persistent amnion-pore, secondarily closed by a chitinous membrane produced by the serosa. As regards the segmentation of the body, the results confirm what has been established in Orthoptera and Odonata; indeed, the resemblances between the entire development of *Lepisma* and that of Orthoptera are very close. At the end of embryonic development, the head acquires a brownish chitinous egg-tooth, which serves to open the shell. The young larva is whitish; even the eyes are but slightly coloured. It seeks out a dark corner and subsists for some days on its yolk. On the seventh day the first moulting occurs. The differences between the larva and the adult, though relatively trivial, are quite distinct, and are duly enumerated.

The author proceeds to a description of the development of particular parts. We can only notice a few points. (1) The styles do not arise until some time after hatching; they develop from a part of the body which has directly arisen from rudiments of embryonic appendages. (2) The origin of the mesoderm and its derivatives, though in some respects peculiar, bears a strong resemblance to what is known in Orthoptera. (3) The ganglion-cells are formed, as in Orthoptera, from large neuroblasts which appear in the neural ridges on each side of the deep and narrow neural groove. There is at first but a slight development of the longitudinal commissures of the nerve-chain; even when the young form leaves the egg, the whole ventral cord is a continuous strand. (4) The tracheæ are late in developing. Besides the meso- and meta-thorax, the first nine abdominal segments have stigmata, and even the tenth segment has a hint of one. As the adult has only ten (Grassi), the ninth abdominal stigma is probably lost. The appearance of stigmata or stigma-rudiments beyond the eighth abdominal segment is a primitive character. (5) The genital cells make their appearance very early. There is no evidence of homology between gonapophyses and appendages. (6) The origin of the mid-gut is quite different from that in Orthoptera. It is formed from the yolk-cells.

In two concluding chapters, the author points out particularly (*a*) the resemblance between the development of *Lepisma* and that of Orthoptera, and (*b*) the bearing of his observations on some vexed questions in the comparative morphology of insects.

Development of Campodea.*—Dr. H. Uxel continues his preliminary account of the development of *Campodea staphylinus* Westw. The most important results are the following:—(1) On the intercalary (pre-maxillary) segment of the embryo there are appendages which form part of the oral apparatus in the adult, namely the intercalary lobes. (2) Each of the rudiments of appendages on the second to seventh abdominal segments gives origin to a ventral style and to an eversible vesicle. (3) The tergites of the maxillary segments take but little part

* Zool. Anzeig., xx. (1897) pp. 125–8, 232–7.

in the dorsal covering of the head, but they form most of the cheeks. (4) The "sutures" on the head of the adult only partially correspond to the original regions in the embryo; in fact they appear also in places where in embryonic life there are no boundaries. (5) The "dorsal organ" appears internally in the posterior region of the head. (6) What have been hitherto called labial palps are the lobi externi; Meinert's "verrucæ oblongæ" are the labial palps. (7) What is called the ligula is formed from the sternite of the first maxillary segment; the two parts called paraglossæ arise from the sternite of the mandibular segment; and the three parts together should really be regarded as hypopharynx.

Gonads and External Genital Appendages of Plecoptera.*—Herr Fr. Klapálek was led to study these organs because of their value in classification. This is particularly true of the Plecoptera or Perlidæ. He describes a dozen species as regards the structure of the parts in question, and then discusses some related morphological questions. He comes to the general conclusion that both the internal organs and the external parts are more primitive in Perlidæ than in any other insects, including the Apterygota.

Viviparity of an Ephemerid.†—Sig. A. Coggi returns to a discussion of the discovery of viviparity in *Cloëon dipterum* L. We need not enter into the details, though they have doubtless their interest; the point is that the viviparity of this mayfly, vaguely announced by Siebold, was discovered and studied by Luigi Calori in 1848, and, after having been for long ignored by many, has been recently confirmed.

Tetrameric Regeneration of the Tarsus in Phasmidæ.‡—M. Edmond Bordage has shown that, after autotomy or amputation of a limb in larvæ or nymphs of Phasmidæ, a regeneration occurs in which the tarsus has only four instead of the usual five joints. He gives particular details in regard to *Monandroptera inuncans*. Bateson and Brindley have cited such cases in Blattidæ as examples of discontinuous variation ("variation brusque"), but Bordage thinks it "much more logical" to regard the occurrence as an atavism, as a return to an ancestral condition similar to that which may still be seen among the Locustidæ.

Natural History of Ants.§—M. Charles Janet publishes an admirable lecture on the habits and life-history of ants. Taking as his type the common little red ant, *Myrmica rubra*, he first describes the successive stages in the life of the individual, noting, as an instance of abrupt change in animal habit, that while many larvæ spin a perfect cocoon, others of the same species spin none at all. He then discusses polymorphism, comparing the functions and status of the queens and workers of an ant-colony with those of bees and wasps, and tracing the fate of males and young queens after the nuptial flight. The males are allowed to die or are pitilessly killed, while such of the females as can be found are brought back to the nest to add to the number of its queens, and the rest creep away into holes to lay their eggs and laboriously found a new

* SB. Akad. Wiss. Wien, cv. (1896) pp. 683–738 (5 pls.).
† Anat. Anzeig., xiii. (1897) pp. 498–9.
‡ Comptes Rendus, cxxiv. (1897) pp. 1536–8.
§ Paris, 8vo (au siège de la Soc. Zool. de France), 1896, p. 36.

colony. Various types of nest are described, and cases are cited where two colonies apparently nest together. Such cases may be (1) mere accidental juxtaposition, when two or more colonies seek to take advantage of a specially favoured spot, but have no true association; (2) there may be double nests, as where *Solenopsis fugax* makes its tiny galleries within the more massive walls of the nest of *Formica fusca*, and from that position of vantage steals and devours its neighbours' nymphs. Or they may be (3) genuine mixed colonies, where two different species live in harmony in one nest. After giving full instructions for the making of an artificial nest which will allow of constant observation of the inmates, the author gives a very graphic account of the daily life of an ant-colony, and the relatively enormous amount of labour required to make and maintain the nest, feed the entire community, and attend to the young. No small portion of this labour consists in daily moving all the eggs and young from chamber to chamber, according to the changes of temperature. The eggs, which are adhesive, are removed in packets, the smaller larvæ in bundles attached together by the hooked hairs (*poils d'accrochage*) borne among the ordinary defensive hairs, but the larger larvæ and the pupæ have to be carried one by one.

Descriptions are given of the alimentary canal, the changes it undergoes in the larval and pupal stages, and its final adaptation to the collecting of food and carrying it for distribution; of the structure of the antennæ and their rôle as sensitive organs, of the organ of stridulation, the mandibles, and the sting; of the secretion of the poison-gland, and of the alkaline gland beside it, which may, the author thinks, neutralise the acidity of any venom left in the sting after it has been used. Animals which are parasitic on ants in varying degrees, the relations of colonies among themselves, the development of the instinct of slave-making, and the keeping of pets are all treated of; and the paper concludes with an account of some remarkable exotic species, e.g. the honey-ants (*Myrmecocystus*) of Mexico and Colorado, and the leaf-cutting ants (*Atta fervens* and *A. discigera*) of Texas and Brazil.

Notes on Ants.*—Herr E. Wasmann makes some remarks on a small collection of ants from Madagascar. There were several new species, which will be described by Forel. In the nests of *Cremastogaster Ranavalonæ* For. var. *Paulinæ-Ranavalonæ* there were numerous myrmecophilous insects of different orders. The beetles seemed to be all new forms, and will be described.

Of much interest were some cases of "myrmecoidie" or mimetic resemblance to ants. A form belonging to the Phanapterid Orthoptera, and related to *Myrmecophana fallax* Brunn, resembles a small worker of a black *Camponotus*. Another form belonging to the Hemiptera, suggesting *Alydus calcaratus* L., is mimetic of a *Polyrhachis*. A third form, a spider of the family Attidæ, related to *Salticus formicarius*, resembles a red-headed *Odontomachus*.

In a second short paper,† Wasmann describes from the same collection an ergatoid (worker-like) female of *Champomyrmex Coquereli* Rog., and gives a list of the species in which ergatoid or ergatomorph forms are known. They are the rule in *Tomognathus sublævis* Nyl.,

* Zool. Anzeig., xx. (1897) pp. 249–50. † Tom. cit., pp. 251–3.

frequent in *Polyergus rufescens* Latr., very rare in *Myrmica sulcinodis*, and so on. The author proceeds to a brief discussion of pseudogynous forms, and notes, in regard to their frequency, that in 315 *Sanguinea*-colonies in the neighbourhood of Exaeten, 30 contained these interesting transition-forms.

Relations of Antennophorus and Lasius.*—M. Charles Janet gives the results of his observations on the relations of *Antennophorus Uhlmanni* Haller and *Lasius mixtus* Nyl. The former is an Acarid which is epizoic upon the ant. It fixes itself on the lower surface of the head, or on the sides of the abdomen by means of the caruneulæ in which its feet terminate, and which are furnished with an adhesive substance. These mites are blind; but the first pair of feet is transformed into long antenniform appendages provided with very sensitive olfactory organs. A working ant usually carries only one parasite, but may carry several without being hindered from taking part in the work of the colony. The mite attaches itself to the naked nymphs, but never to a nymph enveloped in a cocoon. Its shows a marked preference for newly hatched nymphs, probably because these are the recipients of much care from the older workers. The presence of the mite is tolerated by the ants, which apparently give it food willingly, and the mite subsists solely on the fluid disgorged by its bearers; so that it is a case of very advanced myrmecophily.

Palps of Butterflies.†—Herr E. Reuter has studied the palps of 670 species of butterfly, belonging to 302 genera, paying special attention to the external form, the hairy or scaly covering, and the basal spot—a bare space on the inner side of the basal joint—which is striated, pitted, and set with numerous conical hair-scales. The importance of this patient task is of course taxonomic, and the author applies his results to the elaboration of a genealogical tree. The Hesperiidæ are regarded as a distinct suborder, and are separated from the Rhopalocera under the name of Grypocera.

A Californian Book-Worm.‡—Mr. H. G. Hanks describes and figures a larval insect which he found burrowing in his books, and apparently feeding upon the skins and glue used in the binding. It was 5–8 mm. in length, with 13 or 14 silvery-white segments with sparse hairs. The head was amber-coloured, with two antennæ which could be retracted into a sheath. Mandibles, three pairs of clawed legs, and five pairs of sucker-like appendages, were present. The author does not pretend that his description is a scientific one.

Tendons and Muscles of Hymenoptera.§—M. Charles Janet describes the articular membranes, the tendons, and the muscles, of ants, bees, and wasps. Each muscle consists of a group of fibres, almost always divergent; one of the insertions is usually expanded, and the other condensed. At the expanded insertion each fibre is fixed by its whole diameter to the chitinous skeleton; at the condensed insertion each fibre is

* Comptes Rendus, cxxiv. (1897) pp. 583–5. Ann. Nat. Hist., 1897, pp. 620–3.
† Acta Soc. Fenn., xxii. (1896) 6 pls. Ann. Nat. Hist., xx. (1897) pp. 114–5.
‡ Read at a meeting of the San Francisco Micr. Soc., June 16, 1897 (4 pp., 1 pl.).
§ 'Études sur les Fourmis, les Guêpes et les Abeilles,' 12me note, Limoges, 8vo, 1895, 25 pp. and 11 figs.

received into a little capsule which may be sessile, but is more frequently continued into a long chitinous stalk. These fine stalks fuse to form a tendon, which is covered by hypodermis, and has an axial cavity more or less reduced, two details which suggest its origin as an integumentary invagination.

Each fibre may be considered as a multinucleated cell, the sarcolemma representing the cell-membrane. The semi-fluid homogeneous hyaline doubly refractive substance which fills the sarcolemma-tube, has a nutritive function in relation to the longitudinal and radiating filaments which are imbedded in it. The longitudinal filaments run parallel to the long axis, and are of course the essential contractile elements; the radiating filaments follow the surfaces of van Gehuchten's *réseau transversal*, and are attached to the sarcolemma, acting as antagonists to the pressure of the internal substance, and supporting the longitudinal filaments. The author believes that they also transmit the nervous stimulus to the longitudinal filaments, and restore these to their position after contraction.

Association of Mites and Ants.* — M. Charles Janet discusses the association of *Discopoma comata* Berlese and *Lasius mixtus* Nylander. Too little, he says, is known in regard to these interesting associations; the most connected observations are those of Michael, who showed that *Lælaps cuneifer*, found in the nests of *Camponotus herculeanus*, ate the corpses of the ants and other insects. The Uropod which Janet observed occurs sparsely in the galleries, and in great numbers on the larvæ of males and queens, and especially on the abdomen of adult workers. An ant may bear from one to six mites.

When Janet placed a mite in the nest, the ants attacked it with fury, though they seem to resign themselves to those they carry about. The attack may end fatally; but very frequently the ant's mandibles slip on the resistant and flexible carapace of the mite, which is then projected to a distance of 3–4 cm.

The mites do not eat either the living larvæ or the corpses of the ants; they use their cheliceræ to make minute punctures in the articular membranes of their host, and are true external parasites, absorbing the blood.

Prothoracic Gland of Dicranura Vinula.†—Mr. O. H. Latter gives an account of investigations into the function, structure, and homologies of prothoracic glands. Experiments with *Dicranura vinula* have led him to conclude that in that species there exists a special relation between the undischarged silk and the formic acid secreted by the larva, and that the formic acid is utilised not only for defensive purposes during larval life, but also for rendering the cocoon extremely tenacious, hard, and waterproof. Similar experiments with the silk-glands of other species gave quite different results, and it is probable that the chemical composition of the silk in various species is far from constant. After a *resumé* of the work of other investigators, from De Geer, who in 1745–6 accurately described the main features of the organ in question, the author gives a detailed description of the structure of the

* Comptes Rendus, cxxiv. (1897) pp. 102–5 (4 figs.).
† Trans. Entom. Soc. London, 1897, pt. ii. pp. 113–23 (1 pl.).

prothoracic gland of *D. vinula*; and, after a discussion of the homologies of prothoracic glands, he concludes that there exists a fairly complete series which commences with projecting setiparous warts or tubercles surrounding a glandular opening, and leads up to invaginated spiny (setiparous) tubes placed laterally to the opening of the median gland. This evidence appears to him sufficient to justify the supposition that these lateral structures are directly derived from setiparous projections of a Chætopod ancestor, and he maintains that the spines now present in the lateral tubes of *D. vinula* and other species are the actual representatives of original setæ. The glands under discussion, he concludes, are the homologues of the coxal glands, and of the acicular gland sacs of Chætopods, while the lateral appendages (spiny projections or tubes) represent groups of parapodial setæ.

Sympathetic System of Orthoptera.*—L. Bordas has studied the sympathetic nervous system of 25 species belonging to the Phasmidæ, Blattidæ, Mantidæ, Acridiidæ, Locustidæ, and Gryllidæ. There is great uniformity throughout. The system begins at the anterior end of the pharynx in a large dorsal ganglion, the *frontal* or *buccal*. This is connected by two large cords with the œsophageal connectives just below the brain, and it gives off from its posterior surface the unpaired recurrent or medio-anterior nerve, running to the *œsophageal* or *hypocerebral* ganglion, which varies greatly in degree of development. There is also a *lateral* ganglionic system in the œsophageal region, with two pairs of ganglia with which the unpaired ganglion is connected. The anterior pair are connected with the lower surface of the brain, and with the posterior pair; they give off numerous branches to the lateral walls of the œsophagus and to the salivary glands. There is indeed an œsophageal plexus. The hypocerebral ganglion gives off posteriorly a posterior recurrent nerve or pair of nerves, with which the paired or unpaired *abdominal* ganglia are connected.

Function-Change in Moulting Hairs of Insects.†—Dr. K. Escherich describes two cases where the cuticular processes or hairs which are of use in loosening the old cuticle take on a new function. (1) In the expanded end of the invaginated ductus ejaculatorius, which Verhoeff calls the præputium, there are fine spines, hooks, and the like, which help to secure the hold in copulation. These correspond to moulting hairs. (2) On the pleural and intersegmental membranes of some Meloidæ (*Meloë variegatus*, &c.), where there is considerable strain, due to the large number of eggs, there is a variable arrangement of ridges running parallel to the folds of the skin, i.e. at right angles to the folding force. These ridges are, without doubt, strengthening structures, which do not interfere with the necessary elasticity; and the author compares their effect to that of a string wound round an india-rubber tube. They also protect the regions left uncovered by the short and delicate elytra. Now it is interesting to find that these ridges sometimes consist of small lamellæ, and are doubtless, in all cases, derived from moulting hairs.

* Comptes Rendus, cxxv. (1897) pp. 321–3.
† Biol. Centralbl., xvii. (1897) pp. 542–4 (1 fig.).

The Pear-Borer.*—M. Matsumara describes the adult and the life-history of *Nephopteryx rubrizonella* Rag., the larger pear-borer of Japan, which destroys 30–50 per cent. of the fruit every year. It was identified by Mr. W. J. Holland of Pittsburg, and belongs to the Microlepidoptera, group Pyradina, family Phycidæ. The remedies are, pruning off the branches which bear eggs, the use of kerosene emulsion, and, as a last resource, pouring carbon bisulphide into the hole made in the fruit.

β. Myriopoda.

A Mysterious Myriopod.†—M. H. W. Brölemann refers under this title to *Scolopendra* (*Scolopendropsis*) *bahiensis* Brandt, 1841, the only Scolopendra with 23 segments and possessed of ocelli. No one seems to have observed it since Brandt received it from Bahia in 1840, until Brölemann recently found a specimen in a collection made by M. Gounelle in 1889, in the environs of Bahia. He gives a description of the external characters, and refers, as Pocock has done, to the extraordinary resemblance between it and *Pithoptus calcaratus* Pocock. One slight difference is that the armature of the tarsi in *P. calcaratus* is absent in *Scolopendropsis bahiensis*; but Pocock's *P. inermis*, also without armature, seems to show that the difference referred to is unimportant. There remains the fact that Brandt's species has 23 segments, while Pocock's has 21, but it may be that the individuals with 23 segments simply express dimorphism or some peculiarity of development.

Oviparity of Scolopendra.‡—Sig. Filippo Silvestri has observed the female of *Scolopendra cingulata* Latr., guarding its *eggs*, which it does most assiduously, and has thus disproved the statement of Gervais and Lucas, not to speak of many text-books, that these Myriopods are viviparous. The eggs had a pale-yellow colour and an elliptical form. It is possible that the mistake arose as an erroneous inference from the way in which the mother animal guards its young ones.

Morphology and Classification of Diplopoda.§—Dr. C. Verhoeff concludes his prolonged series of studies on Diplopoda. This part deals with (*a*) Chordeumidæ (including descriptions of two new genera, *Heterobraueria* and *Bielzia*, and several new species), and (*b*) Iulidæ (including the new genus *Stenophyllum*, and several new species).

δ. Arachnida.

Development of Phrynidæ.‖—Mdlle. S. Pereyaslawzewa has studied the first stages in the development of *Tarantula palmata* Herbst, *Phrynus medius* Herbst, and *Phryniscus bacillifer* Gerstaecker.

(1) In the first form the spherical ova showed a white spot covering about a third of the surface. Sections demonstrated this to be a blastoderm, with the three embryonic layers, and with the rudiments of thoracic limbs and nervous system.

(2) In the second form the blastoderm surrounded the whole egg;

* Annot. Zool. Japon., i. (1897) pp. 1–3 (1 pl.).
† Bull. Soc. Zool. France, xxii. (1897) pp. 142–6.
‡ Atti R. Accad. Lincei (Rend.), vi. (1897) pp. 56–7.
§ Zool. Anzeig., xx. (1897) pp. 97–125 (14 figs.).
‖ Comptes Rendus, cxxv. (1897) pp. 319–21.

the thoracic limbs and the two lateral organs above the third pair were already large, and the embryo was folded in two halves. A very thick cuticle covered the embryo, and bore papillæ into which the ectodermic cells protruded; the mesoderm was thickest in the dorsal median line where the heart appears; the nervous system consisted of two distinct bands of nerve-cells; the segmentation of the abdomen was very faint; the endoderm was not yet a continuous layer; a deep invagination above each chelicera formed the ganglion of the median eye.

(3) In the third form the appendages were much longer; the lateral organs still existed; the cephalothorax was defined from the abdomen; the ganglia were established; the segmentation of the abdomen was marked only by lateral mesodermic buds; the mesoderm cells of the appendages were beginning to form muscle groups, and the somatic layer was distinguishable from the splanchnic; the œsophagus and rectum had not yet united with the slowly developing endoderm.

Galeodidæ.*—Mr. H. M. Bernard gives a very interesting account of the Galeodidæ or "wind-scorpions." The popular name is translated from the Arabic, and refers to their swiftness of movement. One observer compares them to "a piece of thistle-down driven before the wind." They do not make webs like spiders, but "run down" various insects, even hard beetles. Some feed on scorpions, others are reported to hunt bed-bugs. Some are nocturnal, others "run about the streets in broad daylight."

The jaws consist of a pair of stout pincers, projecting straight out in front, with sharp curved points, inner teeth, and external bristles. Size apart, they are the most horrible jaws in the whole animal kingdom. They are worked alternately in a sort of sawing motion, cutting deeper and deeper into the victim.

The next pair of limbs, remarkable for their length, wave in the air as if to "interrogate space," and bear in an invagination at their tips a remarkable protrusible "smelling" organ, which some have mistaken for a sucker. The mouth is a very minute aperture at the end of a rigid beak, which has at its tip a lattice-like sieve of fringing bristles. Lichtenstein has suggested that the "mice" and the "emerods" by which the Philistines were punished on a memorable occasion were respectively wind-scorpions and the sores caused by their bites. The fact seems to be that they only bite men accidentally, but if they bite, they bite badly. The German name for *Galeodes* is "Gift-Kanker," but no poison-glands are known. Perhaps the violent inflammation set up by the bite is due to exudation of (excretory) matter through the setal pores. It seems likely that the very varied bristles and hairs on the body, especially on the legs, are protective.

The legs have long curved claws with movable tips. In some species there are stridulating ridges, different in character from the apparatus in spiders. The last pair of legs bear stalked fan-shaped sensory "raquet" organs, five on each. Like the pectines of the scorpion, they are probably associated with reproductive processes. Mr. Bernard confirms Johannes Müller's discredited observation that there are six eyes; the lateral pairs are degenerate, and difficult to find.

The female is said to attack and devour the male as soon as she has

* Science Progress, i. (1897) pp. 317–43.

received the spermatophores, but she takes good care of the eggs and young.

After this introduction the author proceeds to consider the anatomy of the Galeodidæ in its relation to that of other Arachnids, in order to show how near we may thus come to "a reconstruction of an ancestral form capable of producing all the known Arachnids." He discusses the segmentation, the waist or diaphragm, the degeneration of the abdominal limbs, the tracheæ, the number of stigmata, the endo-skeleton, and the possible connection between bristle-formation and gland-formation. We must content ourselves, however, with citing the author's "reconstruction."

"We must picture to ourselves a loosely segmented hairy creature, showing a slight waist-like constriction between the sixth and seventh segments. The first three segments are fused together, and distorted in such a way as to range two pairs of limbs round an anterior mouth which is at the tip of a kind of beak. These limbs are specialised for seizing prey and crushing it in front of the mouth. The four following pairs of limbs are used for locomotion, while those of the segments behind the waist, which are often swelled up by liquid food, are more or less useless and degenerating. This, in brief, would represent the form from which, by modification and specialisation in various directions, all the existing Arachnida could be derived."

Notes on Hydrachnidæ.*—Mr. C. D. Soar has collected in one season 32 species, representing 15 genera, within a radius of 20 miles round London. He makes brief notes on (1) the eggs and the variable period (12–38 days) required for hatching in different genera; (2) the hexapod larvæ and their diverse habits; (3) the free-swimming nymphs with eight legs; and (4) the adults with their well-known brilliant colouring.

ε. Crustacea.

Segmentation of Nebalia Ovum.†—Dr. P. Butschinsky describes the segmentation and the formation of the blastoderm in the eggs of this Crustacean. There is a large quantity of yolk, the main mass of which forms a granular clump in the centre, enclosing the nucleus. A thin protoplasmic layer lies peripherally around the egg. The mode of cleavage is of an intermediate character between the discoidal and the peripheral types.

New Subterranean Isopods.‡—M. Adrien Dollfus first describes *Sphæromides Raymondi* g. et sp. n., found by P. Raymond in a Cevennes grotto. The body is oval and elongated (16 mm.); the first pair of antennæ are shorter and more delicate than the second pair; the mesepistoma is narrow and elongated; the eyes are absent; the pereion has the coxal parts well developed on segments 2–7; the posterior pereiopods are delicate, and those of the first three pairs are prehensile; the pleon has five free segments, the sixth having fused with the telson; the uropods are subequal.

The author then describes *Stenasellus Virei* g. et sp. n., a vermiform

* Journ. Quekett Micr. Club, vi. (1897) pp. 318–21.
† Zool. Anzeig., xx. (1897) pp. 219–20 (1 fig.).
‡ Comptes Rendus, cxxv. (1897) pp. 130–31.

Asellid, found by A. Viré in a Cevennes well. The body is very narrow; the head is closely united to the first pereial segment; the first pair of antennæ are shorter than the second; there are olfactory hairs, but no eyes; on the segments 2–7 of the pereion, the coxal parts are very small; the first pair of pereiopods have elongated protopodites; the succeeding limbs are delicate; the pleon has the first three segments free and much developed; the pleotelson is oblong and elongated; the uropods are greatly developed.

It is premature to say that these are archaic forms, relics of a Tertiary marine fauna; but there is no doubt as to their interest.

Sense-Organs of Subterranean Crustaceans.*—M. Armand Viré has previously noticed in regard to cave-animals that, as the eye disappears, other sense-organs become hypertrophied and acquire a new delicacy. He confirms this in reference to the two Isopods described by Dollfus.

In *Sphæromides Raymondi* there are remarkable tactile hairs; some are straight, rigid, and unbranched; others, especially on the antennæ and limbs, are slightly jointed at the base, and, about half-way up, swell and give off minute secondary hairs of great mobility and delicacy. The author does not give any histological or other proof that the hairs are tactile; but one must remember the preciousness of the specimen. The olfactory organs were crushed.

In *Stenasellus Virei* the tactile hairs resemble those above mentioned. The olfactory organs consist of flattened lamellæ supported on a stalk which is articulated to the end of each segment of the antennule. A very interesting series is noted. In *Asellus aquaticus*, from the brooks round Paris, the organ is hardly half the length of one of the segments of the antenna; in the same species living in darkness in the subterranean water-conduits of the city it is almost as long as a segment; in those from the catacombs of Paris it exceeds the length of a segment; in *Stenasellus* it is more than one-and-a-half times the length of a segment. The reverse is true of the eye: it is black and well-developed in the *Asellus* of the brooks; it is paler in those from the conduits; it is represented only by red points in those from the catacombs; in *Stenasellus* it is quite absent. The series confirms "Geoffroy Saint-Hilaire's law of the balance of organs, and Darwin's theories of the influence of environment."

Eye of Corycæus.†—Dr. A. Steuer makes a preliminary communication as to the structure and function of the eye in *Corycæus anglicus* Lubbock, a Copepod related to *Copilia* which Exner investigated. The frontal margin shows the usual large lens, connected by a conical tube (eye-sheath), with the internal pigment-rod, which bears a *Secretkugel* (*Secretlinse*) at its cup-shaped anterior end. As in other Corycæidæ, the frontal lens consists of two parts, and on the inner side there is a non-cellular part hitherto overlooked. The eye-sheath is a complete, finely fibrous tube, containing only blood. At the end of the pigment-rod are seen the optic cells and the cylindrical optic rods. At the upper part of the pigment-rod and to the ventral side, lies the so-

* Comptes Rendus, cxxv. (1897) pp. 131–2.
† Zool. Anzeig., xx. (1897) pp. 229–32.

called accessory lens, probably comparable to the pigmented "clear sphere" in *Copilia*, and apparently innervated by the optic nerve. The pigment not only surrounds the optic rods, but forms partitions and tubes in the interior. There are three optic rods, of unequal thickness, and twisted like a screw round 360°. The pigment-rod itself is notched in the middle, and thereabouts the optic nerve enters.

Gegenbaur compared this remarkable eye to a telescope, and supposed that rhythmic *longitudinal* movements of the pigment-rod secured accommodation by bringing the crystalline sphere (*Secretkugel*) nearer the cornea.

Exner fixed his attention on supposed *lateral* movements of the pigment-rods, which he suggested might enable the terminal nervous apparatus to sample the image which is formed by the frontal lens, but is too large to be appreciated as a whole. But Steuer was unable to detect anything but the rhythmic movements of the gut which have an influence on the eyes. He cannot accept either Gegenbaur's or Exner's theory, but refrains from suggesting as yet what his own view is.

The Genus Sympagurus.*—MM. A. Milne-Edwards and E. L. Bouvier discuss this genus, which closely resembles *Parapagurus*, except that the branchial lamellæ have become biserial, and the false genital appendages have a tendency to disappear. Eight species are known, and of these a diagnostic table is given. A new species, *Sympagurus Grimaldii*, is described.

Systematic Notes on Copepods.† — Dr. W. Giesbrecht makes a number of corrections and additions. Boeck's insufficiently described *Pseudocalanus elongatus* is not the same form as that which Brady described by that name; the latter must be referred to a new genus *Bradyidius*, related to *Aëtidius*. Scott's *Amallophora*, proposed as a subgenus of *Scolecithrix* Brady, belongs to the genus *Xanthocalanus* Giesbr.; Scott's *Pleuromma princeps* belongs to *Metridia*; in both these cases the specific name must be changed; and Giesbrecht proposes *Scotti*. The hitherto unknown female of *Arietellus setosus* Giesbr. is described. The form which Scott describes as *Labidocera Darwinii* Lubbock is a distinct species, *L. Scotti*. As to Scott's *Paracartia spinicaudata* and *P. dubia*, they are respectively the female and male of a species of *Acartia* (*A. dubia*), nearly related to I. C. Thompson's *A. verrucosa*.

New Edriophthalma from Irish Seas.‡—Mr. A. O. Walker describes *Leuconopsis* g. n., resembling *Leucon* in many ways, but distinguished as follows. The female has a distinct two-jointed appendage to the fourth pair of feet, not furnished with natatory setæ; the lower antennæ are short, with the third joint conical, with three minute one-jointed rudimentary flagella; the rami of the uropods are subequal; the male has a pair of curved blade-like processes on the second joint of the third pair of feet. One species is known, *L. ensifer*.

* Bull. Soc. Zool. France, xxii. (1897) pp. 131–6.
† Zool. Anzeig., xx. (1897) pp. 253–5.
‡ Journ. Linn. Soc. (Zool.), xxvi. (1897) pp. 226–32 (2 pls.).

He also describes *Apseudes hibernicus* sp. n., *Stenothoë crassicornis* A. O. Walker, and *Parapleustes megacheir* sp. n., a form which may be at once distinguished from all other species of the genus by the shape and large relative size of the second gnathopods.

Phosphorescence of Cypridina Hilgendorfii.* — Mr. H. Watanabe finds that the phosphorescent organ of this Ostracod, "the sea firefly," is a group of elongated unicellular epidermal glands opening to the exterior symmetrically on either side of the median line, on the outer edge of the upper lip (Claus's *Oberlippendrüse*, 1873). They secrete transparent colourless "secretive vacuoles" and yellow homogeneous granules, which are stored in the necks of the glands. Physical and chemical stimuli cause contraction of the muscles of the upper lip, and the secretion of the glands is thereby squeezed out.

The phosphorescence is a chemical phenomenon accompanying the contact of the pigment of the granules with the sea-water. Free oxygen in any considerable quantity is not essential, but the presence of water, unless it be strongly acid, is a necessary condition. "As the phosphorescent organs of the Metazoa seem to be generally derived from a glandular transformation of the ectoderm, so physiologically they are attributable to a pigment-producing change in the glands; the phosphorescence being simply a collateral phenomenon due to contact of a yellowish pigment, capable of changing into red or green, with water. It is, generally speaking, a means of frightening other animals, possessed by certain aquatic organisms, or those living in a moist medium."

New Ostracods.†—Prof. G. S. Brady describes some Ostracods—residues of the 'Challenger' collection and from other sources—belonging to the section Myodocopa. In the family Cypridinidæ, the new genus *Cyclasterope* is established beside *Asterope*, with two new species. The following are also new:—*Cypridina castanea, C.* (?) *armata, C.* (?) *squamosa, Philomedes corrugata.*

Annulata.

Nephridia of Polychæta.‡ — Mr. E. S. Goodrich describes the nephridia of *Hesione sicula* Dch., *Tyrrhena Claparedii* Quatref., and *Nephthys scolopendroides* Dch. He begins with the ciliated organ of *Hesione*. It is crescent-shaped, with two free horns, and lies at the point where the dorso-lateral blood-vessel first touches the hinder edge of the oblique muscles. The surface which faces backwards and away from the muscle is deeply grooved and densely ciliated; the anterior surface towards the muscle is lined with flat cœlomic epithelium. There is no trace of glandular structure. A pair of ciliated organs occurs in the anterior region of every segment after the third parapodium.

The nephridium opens into the cœlom by a simple funnel with long stiff curved cilia; a narrow neck leads to a wide and somewhat twisted tube; this becomes narrower and more convoluted, forming a mass

* Annot. Zool. Japon., i. (1897) pp. 69–70.
† Trans. Zool. Soc. London, xiv. (1897) pp. 85–100 (3 pls.).
‡ Quart. Journ. Micr. Sci., xl. (1897) pp. 185–95 (4 pls.).

flattened dorso-ventrally, stretching backwards on the floor of the segment. Finally it widens slightly, and opens below the base of the parapodium. Nephridia occur in all the segments which have ciliated organs, and the lip of the nephrostome is directly continuous with the ventral prolongation of the ciliated organ. In *Tyrrhena* the condition of ciliated organs and nephridia is very much the same as in *Hesione*.

In *Nephthys* the ciliated organ is somewhat like the shell of *Pecten*, smaller and more rounded than in *Hesione*, with no communication with the lumen of the nephridium. In both sexes there is a pair of ciliated organs in every segment except about the first ten.

The nephridium of *Nephthys* is remarkable. It has no internal opening, but ends in a bunch of short blind branches, composed of unique "tube-bearing" cells with flagella. There is an internal current towards the external pore, and it seems likely that excretion takes place through the walls. Possibly the thin-walled tubes in which the flagella work act as osmotic filters, while solid excretory products may be conveyed to the lumen of the canal by the cells themselves. The morphological interest of the facts will be discussed in a subsequent paper.

Phagocytic Organs in Marine Annelids.*—Dr. J. Cantacuzène has made observations on *Nephthys margaritacea*, *Glycera convoluta*, *Arenicola piscatorum*, and *Spirographis Spallanzanii*, as regards their phagocytosis. His method was to inject carmine (in suspension in sea-water) into the body-cavity, and to investigate the points where the colour was temporarily localised. It may be noted at the outset that the carmine was never found *free* after 48 hours.

The phagocyte apparatus is represented by (1) the amœbocytes; (2) the endothelial cells of the cœlome and their fixed derivatives, the lymphoid glands or masses; and (3) the nephridial cells. The endothelial cells which act as phagocytes lose their flat shape, and project singly or in groups into the general cavity, especially in the parapodia. The lymphoid masses result from the proliferation of endothelial cells, and occur both irregularly and quite symmetrically. In the nephridial cells the carmine was always localised between the nucleus and the free margin of the cell. In all cases the solid particles are enclosed in a vacuole or lacuna, the contents of which become rose-coloured as the carmine passes into liquid form.

Structure and Development of Spirorbis borealis.†—Mary A. Schwely has studied this Chætopod. There are 14–20 segments; the prostomium bears eight branchiæ (including the operculum; prostomium and peristomium coalesce in a buccal somite; thoracic and abdominal regions are distinguishable; the parapodia are very slightly developed; the alimentary system consists of a short fore-gut, a short hind-gut, and a long mid-gut; the gut is surrounded by a blood-sinus; the shell-gland lies in the anterior thoracic region, in the median ventral line. The body undergoes considerable modification during development, being greatly influenced by the shell. The animal is hermaphrodite, and has

* Comptes Rendus, cxxv. (1897) pp. 326–8.
† Proc. Acad. Sci. Philad, 1897, pp. 153–60 (2 pls.).

two breeding periods in summer; the gonads lie on each side of the gut on the walls of the body-cavity; the eggs pass into the operculum, where they are fertilised; the operculum does not, however, serve as a brood-pouch, as in *Sp. spirillum*; the encapsuled eggs lie in a long membranous sac along the mid-dorsal furrow. The eggs are telolecithal, with considerable nutritive yolk. The blastula has a small blastocœle; a gastrula is formed by invagination. Nine larval stages are described, which follow one another in rapid and direct succession in the three days between the first segmentation and the emergence of the free-swimming ciliated form.

Septal Valves of Owenia.*—Prof. G. Gilson continues his study of *Owenia*. (1) The perivisceral compartments are less numerous than the metameres; details of the relation are given. (2) The septa are not complete; some show gaps at their attachment to the body-wall, others have perforations, others have holes surrounded by a muscular sphincter. Several septa have both marginal gaps and sphinctered apertures. (3) The cœlomic cavity of certain metameres is in communication with the exterior. The sixth shows in the female a ciliated funnel applied to the third septum, and provided with a short canal which perforates the wall and enters an epithelial sinuous tube lodged in the epidermis. In the male there are two pairs. In both cases they are genital. At the level of septa v. and vii. there are two epidermic invaginations in the thickness of the septa; each ends at the sphincter, and perhaps opens into the body-cavity. Less developed structures occur in most of the septa. (4) The genital funnels are probably modified nephridia. The epithelial tubes may have the same significance. Perhaps the septal canals and the sphincters may be vestiges of nephrostomes. The secretory function of the true nephridia has totally disappeared.

New Species of Perichæta.†—Dr. W. B. Benham describes and gives diagnoses of five new species—*Perichæta novæ britannicæ*, *P. Sedgwickii*, *P. Arturi*, *P. Floweri*, and *P. Madelinæ*. The first three are from New Britain, the other two from Singapore and Borneo respectively. He also describes *P. malamaniensis*, which he named in 1891. At the end of his paper, Benham offers some remarks on Michaelsen's criticism of the value of certain specific characters of the genus.

New Species of Earthworm.‡—Dr. W. Michaelsen describes three new species obtained from the Hamburg Botanic Garden, but really belonging to the West Indies and South America, viz. *Tykonus peregrinus*, *T. wiengreeni*, *Criodrilus breymanni*.

Chætognatha of Misaki.§—Mr. T. Aida gives a list, with descriptive notes, of twelve species of Chætognatha which he collected in Misaki harbour. He follows the classification of Langerhans, and describes four of the forms he found as new, viz. *Sagitta neglecta*, a very small form

* La Cellule, xii. (1897) pp. 377–416 (3 pls.).
† Journ. Linn. Soc. (Zool.), xxvi. (1897) pp. 198–225 (2 pls. and 4 figs.).
‡ Zool. Jahrb. (Abth. Anat.), x. (1897) pp. 359–88 (1 pl.).
§ Annot. Zool. Japon., i. (1897) pp. 13–21 (1 pl. and 1 fig.).

(7 mm. in length); *S. regularis*, in which the tactile prominences are exceedingly regular, and the epidermis is especially thick anteriorly, so that the head is not constricted from the body as in other species; *Krohnia foliacea*, with a single pair of lateral fins of remarkable size, extending from before the abdominal ganglion to the middle of the caudal segment; and *K. pacifica*, which is easily distinguished by its faintly yellowish-green epidermis, and ovaries of the same colour.

Rotatoria.

Rotifer Commensal with Caddis-Worm.*—Mr. Hy. Scherren records having found *Callidina parasitica* inside the case of the larva of *Phryganea grandis*. This *Callidina* is usually found attached to the gill-plates of *Gammarus pulex* and *Asellus aquaticus*, where it takes advantage of the current of water over the gills.

Mastigocerca hamata sp. n.†—Dr. O. Zacharias figures and describes this new species found in a gathering of plankton from a small lake in Upper Silesia. Its principal characteristic is a long curved frontal hook; the toe is nearly as long as the body.

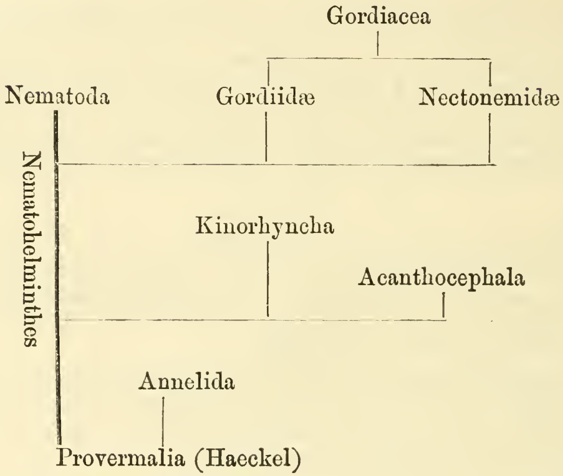
Nematohelminthes.

Epidermic Nuclei of Anguillulidæ.‡—M. Joannes Chatin discusses the structure of the epidermis or hypodermis of Nematodes, concerning which there has been prolonged dispute. The integument of a Nematode in the adult state, or in some types at certain stages of development, shows beneath the cuticle a granular layer of a plasmodial appearance, with scattered nuclei. This epidermis is interpreted by some as a case of free nuclei without protoplasmic territories. Others regard it as only secondarily syncytial, produced by a coalescence of cellular elements. The second view was maintained by Chatin in 1888 and 1891; but, as he has been recently cited as an upholder of the first interpretation, he has restated his position. Moreover, he has found clear corroboration in studying *Tylenchus*, *Heterodera*, and various Anguillulidæ. There the epidermis or hypodermis is at first distinctly cellular, but as it becomes older the boundaries disappear and the territories fuse.

New Classification of Gordiidæ.§—Prof. L. Camerano divides Gordiidæ into four genera, the diagnoses of which take especial account of the posterior ends of male and female, and of the external structure of the cuticle. These genera are:—*Chordodes* (Creplin) Möbius, with 27 species, *Parachordodes* g. n., with 15 species, *Paragordius* g. n., with 4 species, and *Gordius* Linn., with 13 species. There remain 30 species inquirendæ.

The author thinks the family should be made into an order Gordiacea, with, as H. B. Ward suggests, two families:—Nectonemidæ and Gordiidæ. His views as to general relationships are indicated in this *Stammbaum*:—

* Nature, lvi. (1897) p. 224.
† Forschungsberichte Biol. Station Plön, v. (1897) p. 8.
‡ Comptes Rendus, cxxv. (1897) pp. 57–9.
§ Zool. Anzeig., xx. (1897) pp. 225–9.



Excretory Organs of Ascarids.* — Prof. J. W. Spengel has some notes on a recent paper by N. Nassonow, which described four peculiar stellate organs in the body-cavity of *Ascaris megalocephala* and *A. lumbricoides.* Spengel and his assistant, Dr. K. Camillo Schneider, also observed these organs, and on looking up the literature, found them described in Anton Schneider's Monograph on Nematodes. Thus, Nassonow is hardly their discoverer, especially as Schneider refers to a description of them by Bojanus in 1818 and 1821, and by Lieberkühn in 1855. They were afterwards noted by Leuckart, Hamann, and Linstow. The moral is a painfully obvious one, that discovery must be preceded by an adequate study of the literature, to which this Journal is a readily available aid. Prof. Spengel says in conclusion, that he will add only one item of fact to the previous studies of the remarkable structures in question, namely, that they are not always lateral, between the gut and the lateral lines, but are sometimes also median, on or under the gut.

Nematode Parasite from Mantis.† — Mr. O. Collett describes an aproctous Nematode of the family Mermithidæ, 1/30 in. in diameter, 2 ft. $3\frac{1}{2}$ in. in length, found in the stomach of a specimen of *Mantis religiosa* which measured $2\frac{3}{4}$ in. in length.

Platyhelminthes.

Diploposthe lævis.‡—Dr. A. Jacobi describes this remarkable tapeworm which occurs as a parasite in wild ducks. It is noteworthy because in each proglottis the genital ducts (vas deferens and vagina) are double, while the essential reproductive organs are single. The author describes the skin and musculature, the excretory system and nerves, and the gonads in particular. In spite of the *partial* duplication of the repro-

* Zool. Anzeig., xx. (1897) pp. 245–8.
† Journ. R. Asiatic Soc., xiv. (1896) 2 pp. (1 pl.).
‡ Zool. Jahrb., x. (1897) pp. 287–306 (2 pls.).

ductive apparatus, and several less obvious peculiarities, the structure of *Diploposthe lævis* Dies. is essentially simple, and recalls the Microtæniæ of mammals, e.g. *Tænia diminuta* Rud. and *T. relicta* Zsch.

Gonads of Amabilia.*—Dr. V. Diamare describes the gonads of the remarkable tapeworm *Amabilia lamelligera* (= *Tænia lamelligera* Owen, and probably = *T. macrorhyncha* Rudolphi). Owen noted the remarkable lamellar structures on the sides of the proglottides, and the presence of a penis on each side; but the peculiarities do not end here. The author sums up in the following diagnosis:—There are two penes, the end-organs of a single vas deferens, which runs in a zigzag from one end of the joint to the other; the testes are in the form of fine clusters like grape-bunches, and occupy the upper surface of the joint; the single almost straight vagina lies across the vas deferens ventrally, and is in close connection with it; it opens on the middle line both dorsally and ventrally; the ovary is single and median, and the oviduct is also single; the yolk-gland has many lobes and a long yolk-duct; the uterus is like a flattened cage enclosing the ovaries: the eggs are enclosed in spindle-shaped capsules.

In the course of some systematic notes, the author expresses his conviction that the genus *Diploposthe*, recently proposed by Jacobi, is an unnecessary synonym for *Amabilia*, and that *T. lævis* St. is either *A. lamelligera* or a related species.

Cysticercus venusta.†—Mr. T. B. Rosseter found this new *Cysticercus* in *Cypris cinerea*, along with *Cysticercus gracilis* and *C. coronula*. After repeated failures he succeeded in rearing the tapeworm in the domestic duck. After comparing it in detail with the other (six) tapeworms of birds whose rostellum bears eight hooks, he finds himself justified in establishing a new species—*Tænia venusta*.

Cysticercus of Tænia liophallus.‡—Mr. T. B. Rosseter has succeeded in finding the hitherto unknown Cysticercus stage of *Tænia liophallus*, a parasite of the swan and probably also of the duck. The bladder-worm was found in *Cypris cinerea* in an old pond near Canterbury.

Studies on Tetrarhyncha.§—Dr. Th. Pintner describes a Tetrarhynch larval form found in the muscle of a fish which was in process of digestion in the stomach of species of *Heptanchus*. His study is especially noteworthy, because of the discovery of a new organ. On each side of the body-margin, sometimes just above the excretory vessels, sometimes between these and the more lateral nerve-strand, there is a canal with delicate walls and variable diameter. At the anterior end it bends round in an arch, like the excretory vessels and nervous system. On the margin of the bladder posteriorly it becomes more irregular, and gives off small branches which, by uniting again with the main canal, enclose little islands. In the region of the excretory vesicle it seems to break up into a sort of plexus. Sections show that the whole canal is

* Centralbl. f. Bakt. u. Par., xxi. (1897) pp. 862–72 (8 figs.).
† Journ. Quekett Micr. Club, vi. (1897) pp. 305–13 (2 pls.).
‡ Tom. cit., pp. 314–7.
§ SB. K. Akad. Wiss. Wien, cv. (1896) pp. 652–82 (4 pls.).

formed from a strand of cells united in a kind of syncytium, and traversing the lumen with a complex series of bridges and strands. At the boundary between scolex and bladder the canal in question is doubled, but it could not be followed up into the scolex, where perhaps the riddle of its nature may be solved. That it is not part of the excretory system seems the only certainty. The paper ends with a discussion of the excretory system in other Cestodes.

Musculature and Sensory Cells of Trematodes.*—Dr. H. Bettendorf has investigated *Distomum hepaticum* L., *D. cylindraceum* Zed., *D. crystallinum* Rud., *D. clavigerum* Rud., *Diplodiscus subclavatus* Goeze, and *Polystomum integerrimum* Fröl., and various young stages of Trematodes, with particular reference to the musculature and sensory cells. He used Golgi's chrome-silver method and Ehrlich's methylen-blue method. His main results are the following:—

(1) The muscles of Trematodes retain very markedly their cellular character, the contractile elements remaining in connection with the large nucleated formative elements or myoblasts. The latter are either in direct contact with the fibres, or are united to them by plasmic processes. Thus transitions from the Nematoid to the Annulate type are in evidence. The innervation of the muscles is partly through the myoblasts, partly by direct connection with the fibres.

(2) The whole body of the Trematode is surrounded by a richly ramified nervous plexus, which lies directly beneath the peripheral muscles. The nerve-fibres which arise from this plexus, as also from the longitudinal nerves and the annular commissures connecting them, pass either to the musculature (motor fibres) or to specific sense-cells (sensory fibres). These sense-cells, which have terminal vesicles in the cuticula, are distributed over the whole body, but are most numerous in the suckers.

Epithelium of Triclads.†—Dr. R. Jander has studied the peculiar state of the epithelium in *Dendrocœlum lacteum* Örst., *D. punctatum* Pallas, *Planaria polychroa* O. Schm., *Polycelis nigra* O. F. Müll., *Gunda ulvæ* Örst., &c. He describes the structure of the pharyngeal lining and its connection with the other tissues of the pharynx, the modification of the simple epithelial cells of the completed embryonic pharynx into the peculiar lining found in the adult, and the new formation of the pharyngeal lining after injuries.

His most important result is that the pharynx in Triclads (and Polyclads as well) is lined by a genuine epithelium of ciliated cells, which have by no means lost their cellular character, though they are much modified. The cells which line the completed pharynx in the embryo persist in the adult, but they are divided into (*a*) a part which serves mainly to protect the pharynx, viz. the ciliated plate, and (*b*) a part which sustains the cell-life, viz. the deep-growing nucleated process. Many analogous differentiations are known in epithelial cells, and the author suggests the application of his results to other Platyhelminthes.

* Zool. Jahrb. (Abth. Anat.), x. (1897) pp. 307–58 (5 pls., 1 fig.).

† Tom. cit., pp. 157–204 (3 pls.).

Echinoderma.

Brood Care in Holothurians.*—Prof. H. Ludwig has discovered some new cases of this interesting habit. In *Chiridota contorta*, in which the sexes are separate, the genital tubes function as brood-chambers in which the whole development occurs. Thus this species is practically viviparous.

The author also finds † that *Psolus antarcticus* carries its young on the ventral surface which is flattened for creeping purposes. On the best specimen there were 22 young ones fastened by their tube-feet to the naked area of the sole. By this discovery the number of Holothurians exhibiting prolonged attachment between the young ones and the mother is raised to nine. Five of these are antarctic and one is arctic. The relatively large number of antarctic forms is remarkable; but even more interesting is the fact that each of the five has its young attached in a different way. In *Psolus ephippifer* the young develop among the dorsal plates; in *Cucumaria crocea* on the modified dorsal ambulacra; in *Cucumaria lævigata* in ventral pouches; in *Chirodota contorta* in the genital tubes; and in the present case on the ventral sole.

Changes in Calcareous Deposits of Stichopus.‡—Prof. K. Mitsukuri has observed interesting changes which occur with advancing age in the calcareous bodies in *Stichopus japonicus* Selenka, of which, it may be noted in passing, Theel's variety *typicus* is only a growth-stage, and Selenka's *Holothuria armata* a northern variety. The form of the calcareous bodies (apart from the terminal discs and supporting rods of the tube-feet, which are not discussed) changes with age. The youngest individuals have most perfectly formed large-sized tables, and nothing but these. As the animal grows, perfectly formed tables decrease in number and size, and occur mixed with various stages of arrested development. In fully grown individuals there are only small perforated plates, representing merely a small central part of the basal disc and without any trace of the spire. In comparison with the thickly crowded or even overlapping tables of the young forms, those of the adult are sparsely scattered. As Mitsukuri notices, it is unlikely that these changes occur only in *Stichopus japonicus*; if they are general the fact will have an important bearing on the classification of Holothurians.

New Zealand Echinoderms.§—Mr. T. W. Kirk describes a collection of these, including *Evechinus chloroticus* Valenciennes, of which Prof. Jeffrey Bell's *E. rarituberculatus* is said to be the young form; *Ophiopeza Danbyi* sp. n., distinguishable from all other species of the genus by the small number of arm-spines (4) and their large size; *Amphiura pusilla* sp. n., very nearly allied to *A. constricta* Lyman; *Asteropsis imperialis* sp. n.; and some others.

New Species of Asthenosoma.‖—S. Yoshiwara describes two new species of these Echinoids—*Asthenosoma longispinum*, from 313–376

* Zool. Anzeig., xx. (1897) pp. 217–9. † Tom. cit., pp. 237–9.
‡ Annot. Zool. Japon., i. (1897) pp. 31–42 (3 figs.).
§ Journ. Linn. Soc. (Zool.), xxvi. (1897) pp. 186–98 (2 pls.).
‖ Annot. Zool. Japon., i. (1897) pp. 5–11 (1 pl.).

fathoms in the Sagami Sea, distinguishable by the presence of very long spines on the abactinal, and of hoof-capped spines on the actinal side; and *A. Ijimai*, distinguished by the peculiar arrangement of the primary tubercles.

Cœlentera.

Structure of Hydractinia.*—Miss M. C. Collcutt has studied the structure and relative positions of the cœnosarc and chitinous parts in *Hydractinia echinata*. The chitinous skeleton is for the most part a continuous irregular crust attached to some foreign body, and overlaid by a cœnosarc consisting of two layers of ectoderm, enclosing between them a number of branching and anastomosing endodermic tubes. These tubes are connected at intervals with the endodermic canals of the polyps, the upper layer of ectoderm being continuous with the ectoderm of the polyps.

As is well known, the colonies are common on whelk-shells inhabited by hermit-crabs. A large colony may cover the whole shell except the roundish patch which rubs along the ground; a small colony is usually situated near the edge of the shell; a Polychæte worm, *Nereis bilineata*, was always found along with the hermit crab.

A colony consists of—(1) gasterozooids or nutritive polyps, (2) blastostyles or reproductive polyps, (3) dactylozooids or spiral polyps, and (4) tentacular polyps. The gasterozooids are naturally most numerous, but in early spring and in summer the blastostyles increase greatly in numbers, and at these times give rise to the genital products. The colonies are either male or female. The dactylozooids are situated around the shell mouth; they are capable of coiling themselves spirally, and may function as defensive polyps. Miss Collcutt has succeeded in demonstrating the presence of a mouth, which Allman and Strethill-Wright failed to notice. She also gives evidence of the migration of ova between ectoderm and endoderm in the blastostyle. The histology of the two layers is described in detail.

Stinging Cells.†—Prof. R. von Lendenfeld furnishes an up-to-date account of the stinging-cells of Cnidaria. He gives a list of the literature since 1887, and then sums up the facts in regard to the structure, development, and function of the elements in question.

Among the steps of progress the following may be noted. The stinging cells are either modified gland-cells (Lendenfeld and Schneider), or modified epithelial cells (Iwanzoff). There is an essential difference between nematocysts and spirocysts (Bedot). The muscular nature of the stalk (Chun) has not been confirmed; it is doubtful whether even the mantle is muscular. All later authors agree that the wall of the capsule is two-layered. According to the majority, the thread is a continuation of the inner layer; Iwanzoff represents the opinion that it is a continuation of the outer, or of both. The spirocyst thread is always smooth; the nematocyst-thread has normally three spiral ridges of spines, usually larger at the base. They probably increase the thread's power of penetrating and boring. As to the explosion, the hygroscopic nature of the capsule contents explains the increased tension when water

* Quart. Journ. Micr. Sci., xl. (1897) pp. 77-99 (1 pl. and 3 figs.).
† Biol. Centralbl., xvii. (1897) pp. 465-85, 513-30.

enters through the wall of the thread and of the capsule, but there is some other cause of the actual shooting out of the thread. The author adheres to his theory that the sub-epithelial nerve-plexus inhibits the expulsion, which he regards as reflex. He concludes less optimistically than he did in his summary of ten years ago, when he spoke of our knowledge of the functioning of the stinging cells as satisfactorily complete.

Aliciidæ.*—Mr. J. E. Duerden recalls his study of *Alicia costæ* Panc. and *Cystiactis tuberculosa* Quoy and Gaim., which showed the necessity of separating them from the Bunodidæ, and the erection of a new family Aliciidæ. He has since been fortunate in obtaining an authentic specimen of *A. mirabilis* (the type of the genus) from Mr. J. Y. Johnson, who founded the genus in 1861. He also describes a new species of *Bunodeopsis*, *B. antilliensis*, and compares it with the type *B. strumosa*. To *Alicia*, *Cystiactis*, and *Bunodeopsis*, the genus *Thaumactis* Fowler has also to be added. The family diagnosis is as follows:—Hexactineæ, with a large flat contractile base. Tentacles simple, subulate, and entacmæous. Column with simple or compound hollow outgrowths or vesicles over more or less of its surface, arranged mostly in vertical rows. No cinclides. Sphincter muscles endodermal and diffuse, variable in amount of development. Perfect mesenteries few or numerous. No acontia.

Porifera.

Position of Sponges in the Animal Kingdom.†—Mr. E. A. Minchin has a learned article on this difficult problem. He states the case for Sponges, as (1) Protozoa, (2) Metazoa, and (3) neither. The majority are in favour of sponges being Metazoa; but then the alternatives crop up—are they Cœlentera, or do they represent a distinct phylum?

The four points of primary importance in the discussion of the affinities of Sponges are:—(*a*) The unfailing possession of collar-cells, and their great resemblance to Choanoflagellata; (*b*) the reproduction by ova and spermatozoa; (*c*) the formation of two germ-layers by processes not specially characteristic of sponges, and the possession of a larva very similar to the cœlenterate planula; and (*d*) the reversion of the germ-layers at metamorphosis—a fact which is quite subversive of the cœlenterate theory.

We have but two theories, the author says, to choose between:—either to regard sponges, with Bütschli, Sollas, and Delage, as descended from choanoflagellate ancestors independently of the Metazoa; or to regard them, with Maas and, apparently, Balfour, as true Metazoa, whose two primary germ-layers have become reversed in position in the adults. The author inclines to the second alternative, but says we should be cautious in pinning our faith to either. Perhaps there is yet another.

Hexactinellids with Discoctasters.‡—Prof. J. Ijima gives a general description of the structure of the Hexactinellida which have those strongly modified discohexasters which F. E. Schulze called discoctasters. This peculiar kind of spicule has hitherto been known to occur

* Ann. Nat. Hist., xx. (1897) pp. 1–15 (1 pl.).
† Science Progress, i. (1897) pp. 426–60.
‡ Annot. Zool. Japon., i. (1897) pp. 43–59.

in four species of Rossellidæ, viz. *Acanthascus cactus* F. E. S., *Rhabdocalyptus mollis* F. E. S., *Rh. Roeperi* F. E. S., and *Rh. Dowlingi* L. M. Lambe. To this list Prof. Ijima adds two new species of the last-named genus, viz. *Rh. capillatus* sp. n., *Rh. victor* sp. n., and three others belonging to a new genus *Staurocalyptus*. In this he includes Schulze's *Rh. Roeperi*, Lambe's *Rh. Dowlingi*, and his own new forms which he names *St. heteractinus*, *St. glaber*, and *St. pleorhaphides*. The diagnosis of the new genus reads—"Discoctasterophorous Rossellids with pentactin hypodermalia, the paratangential rays of which never possess hook-like prongs, but are either smooth or minutely and uniformly rough."

Protozoa.

Influence of Various Solutions upon Infusoria.*—Mr. A. Yasuda has experimented as to the effects of placing Infusorians (*Colpidium*, *Chilomonas*, *Euglena*, *Paramœcium*, &c.) in solutions of milk-sugar, cane-sugar, grape-sugar, glycerin, and common salt. The action depends more upon the chemical nature of the substance than upon its concentration; for isotonic solutions of the five substances mentioned above do not produce corresponding effects. In solutions of higher concentration a contraction of the Infusorians takes place, which disappears after some hours, when the organisms begin to accommodate themselves to the new media. Higher concentration of the medium retards first the multiplication, and then the movement of the organisms. In sugar-solutions of higher concentration, some Infusoria seem to increase in size only till a certain limit is reached. The vacuoles or the corpuscles in the cells increase in diameter as the concentration of the medium becomes stronger. The more the concentration of the medium increases, the more rounded become the organisms.

Biflagellata.†—Dr. W. H. Dallinger replies indirectly to R. Francé's criticism of the well-known studies which he and the late Dr. Drysdale made on biflagellate organisms. The point seems clear that the investigators refrained from nomenclature or classification, but observed (first independently and then jointly) seven definite living micro-organisms passing through a continuous series of cyclic changes. Whether the "biflagellate" of Dallinger and Drysdale is identical with the *Polytoma* of Francé's paper remains uncertain, and therefore cannot form a basis of criticism. Dr. Dallinger adheres to the conclusions reached with great care and patience many years ago, and questions the competence and suitability of Francé's methods as modes of criticism of the joint work of Dr. Drysdale and himself.

Parasitic Flagellata of Termites.‡—Prof. B. Grassi and Dr. A. Sandias described in 1890 the parasitic Protozoa in Termites. An edited translation is now available. Of Lophomonadidæ, there are three —*Joenia annectens* g. et sp. Grassi (in *Calotermes lucifugus*), *Trichonympha agilis* Leidy (in *Termes lucifugus*), and *Microjoenia hexamitoides* g. et sp. Grassi = Leidy's immature *Trichonympha* (in *T. lucifugus*); of Cercomonadidæ, there are two—*Monocercomonas termitis* Grassi (in

* Annot. Zool. Japon., i. (1897) pp. 23–9. See Bot. Mag. Tokyo, xi. (1897).
† Biol. Centralbl., xvii. (1897) pp. 305–11 (4 figs.).
‡ Quart. Journ. Micr. Sci., xl. (1897) pp. 43–54 (1 pl. in vol. xxxix.).

T. flavicollis and *T. lucifugus*), and *Dinenympha gracilis* Leidy (emend.); probably = *Pyrsonympha vertens* Leidy (*pro parte*), in *T. lucifugus*; of Pyrsonymphidæ, there are two—*Pyrsonympha flagellata* Grassi (in *T. lucifugus*), and *Holomastigotes elongatum* g. et sp. Grassi in the same. It is remarkable that none of these were seen encysted or clearly in process of reproduction. They all ingest solid particles of wood, except the last named; and it is the only one without the rods and rodlets which probably serve as an endoskeleton for the support of the cell and protection of the nucleus. These parasites may aid in digestion; they die or disappear in individuals fed with saliva; and it is only when they disappear that the gonads of the Termite mature.

Regeneration of the Micronucleus in Ciliata.*— M. Félix Le Dantec has experimented with portions of ciliated Infusorians which contained the macronucleus or a fragment thereof, but no trace of micronucleus. He does not regard his results as quite conclusive; but, in some cases at least, it seems as if a new micronucleus could be formed within artificially produced pigments (merozoites) which contained no trace of the original micronucleus.

Experimental Study of Coccidia.†—M. Louis Léger has made some experiments in order to test his theory that the primitive Coccidian sporozoite has not a dimorphic development resulting on the one hand in *Eimeria* and on the other hand in *Coccidium*; but that it exhibits a continuous cycle leading to the formation of Cystozoites (sporozoite of *Eimeria* according to other authors), and continuing into sporocysts (or cysts with lasting spores).

Starting from the fact that the adults of *Scolopendra cingulata* usually contain a polysporous Coccidian (*Adelea dimidiata* Schneider) and numerous groups of Eimerian sporozoites, while the young are but rarely infested, Léger took two young forms which seemed to be free from parasites, and made them swallow cysts of *Adelea* in a state of perfect maturity. After 25 days one was sacrificed, and showed a mid-gut crowded with Eimerian sporozoites free or in groups; the second specimen, killed twenty days afterwards, showed young forms of *Adelea* already furnished with a protective sheath.

The experiments show the specific unity of *Eimeria* and *Adelea*. They also confirm the view that the primitive sporozoite, issuing from a cyst of *Adelea*, gives rise first to Eimerian cysts whose sporozoites afterwards become the cysts of *Adelea* or sporocysts. The results also explain why *Eimeria* should be abundant in Myriopods in spring, and *Adelea* in autumn; they are stages, not different forms.

The sporozoite of Coccidia probably corresponds to the Gregarine sporoblast, and the coccidian sporocyst to the octozoic spore of Gregarines. Perhaps the difference in the cycles is due to the absence of sufficient nutritive material in the Eimerian cyst of Coccidia, whereas in Gregarines the cyst is abundantly furnished with reserves which are amply sufficient for the further development of the sporoblasts.

New Type of Sporozoa.‡—MM. F. Mesnil and E. Marchoux describe *Cœlosporidium chydoricola* g. et sp. n., which they regard as intermediate

* Comptes Rendus, cxxv. (1897) pp. 51–2. † Tom. cit., pp. 329–30.
‡ Tom. cit., pp. 323–6 (6 figs.).

between the Sarcosporidia and *Amœbidium* Cienkowsky. It is an internal parasite of *Chydorus sphæricus* O. F. Müller—a Crustacean belonging to the family Lynceidæ and order Cladocera—which occurs in the ponds in the woods of Bellevue, near Paris. One part of the life-history takes place in the cavity of the body, where rounded young forms increase in size, become ovoid and almost crescent-shaped, show great nuclear multiplication, and acquire a thick and resistant envelope. The division of the protoplasm is effected slowly, but the result is a cyst with numerous ovoid or spindle-shaped corpuscles, which doubtless correspond to the reniform bodies of the Sarcosporidia. They probably infect other individuals after the death of their host. Within the tissue, however, on the dorsal surface of the gut, another phase of the history has its seat. Elongated cylindrical forms occur, with fewer and larger nuclei than the free forms, and without their refractive and fatty globules. They probably increase the infection within the individual host.

As this new type shows a close resemblance to *Amœbidium*, an ecto-parasite of freshwater Crustacea, the authors propose to include the latter along with *Cœlosporidium* in a new sub-order of Sarcosporidia. They suggest that *Amœbidium* is an exceedingly primitive form, and they point out the interest of the double developmental cycle in their new type. Dimorphism seems to be very general in Sporozoa.

Two biological facts are of much interest. (*a*) All the infected Crustaceans were non-reproductive; there seemed to be parasitic castration; (*b*) the parasite is confined to this particular species.

Gregarines of the Cricket.*—L. Cuénot has found two new species of *Diplocystis* (*D. minor* and *D. major*) and a new *Clepsidrina* (*C. gryllorum*) in *Gryllus domesticus*. He showed experimentally that crickets are infected by eating other crickets with ripe spores; the sporozoites take up their position in the epithelium of the mid-gut, and the cycle recommences. The author notices the "positive cytotropism" expressed in the association of the Gregarines in pairs, and what seems like a micronucleus. When two individuals unite before sporulation, the membranes persist on to an advanced stage, so that there cannot be any karyogamic fertilisation. The nuclear phenomena of sporulation include (1) degeneration of the macronucleus, which loses its membrane and nuclear sap, while the central karyosome slowly dissolves in the cytoplasm; and (2) the division of the micronucleus (in a manner midway between the mitotic and the amitotic fashion) to form the archispores.

Double Use of the Name Diplocystis.†—L. Cuénot notes that in Schaudinn's Heliozoa in the new 'Thierreich,' a genus is recorded as *Diplocystis* Penard (1890). The name was, however, applied in 1887 by Künstler to a Gregarine found in the body-cavity of *Periplaneta americana*. Only one species, *D. Schneideri*, was noted; and as it was not re-observed, the validity of the genus has been doubted. But Cuénot has recently found two cœlomic parasites in *Gryllus domesticus* which evidently belong to Künstler's genus. Therefore *Diplocystis* Penard must be changed.

* Comptes Rendus, cxxv. (1897) pp. 52–4.
† Zool. Anzeig., xx. (1897) pp. 209–10.

Life-History of Coccidia.*—Dr. P. L. Simond has studied *Coccidium oviforme*, *Coccidium* (*Karyophagus*) *Salamandræ*, and *C. proprium*. The facts seem at first to point to a polymorphism rather than a dimorphism; but all the forms of the asporulate state are simply phases of one process, polymorphic in relation to particular conditions, and contrasted, not with one another, but only with the sporulating state. The latter, especially in its final resistant stage, exhibits a fixity of characters which makes it the essential and typical mode of reproduction. The two modes are morphologically and physiologically distinct, like fission and the formation of endospores in Bacteria; the one is a rapid temporary multiplication in a suitable environment; the other, which probably requires an antecedent sexual process, secures the rejuvenescence and perpetuity of the race. Those forms which seem to have but one mode of multiplication require further investigation. All the asporulate forms may be considered as one individual or generation which undergoes repeated fragmentation; the true specific reproduction is confined to the sporulate condition.

The new facts shed light upon the life-history of the parasite of paludism discovered by Laveran, and corroborate Metschnikoff's indication of the affinities between this Hæmatozoon and Coccidia. The motile stage of *Coccidium* explains the flagellate bodies of the paludism parasite and of *Polymitus* in birds. In short, the life-histories of Coccidia and Hæmatozoa should be carefully correlated.

New Myxosporidium.†—M. L. Léger describes a Myxosporidium which affects the larvæ of *Simulium ornatum* Meig. It inhabits the general body-cavity, the intestinal tract being quite free. It occurs in masses, which often have the appearance of thin-walled cysts. Microscopic examination of these masses shows them to be composed of a prodigious number of spores which are ovoid and refracting, and have a large vacuole at the expanded end. Under the influence of iodine, a filament, twenty times as long as the spore itself, shoots out from the pointed end, a fact which indicates that these parasites belong to the family *Glugeidæ*. The spores are of two kinds, small (4–5 μ) and large (8 μ). Some sacs contain only microspores, and then usually in little groups of eight, while others have only macrospores.

* Ann. Inst. Pasteur, xi. (1897) pp. 545–81 (2 pls.).
† Comptes Rendus, cxxv. (1897) pp. 260–2.

BOTANY.

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

α. Anatomy.

(1) Cell-structure and Protoplasm.

Spermatogenesis in Lilium Martagon.*—Miss E. Sargant supplements her previous observations on this subject by a detailed account of the processes which take place in the nuclear divisions of the pollen-grain. They are strictly parallel to the corresponding stages in oogenesis. The first division of the pollen-mother-cell nucleus is similar in every detail to that of the primary embryo-sac nucleus, and may be termed heterotype; the three later divisions are homotype.

When the pollen-mother-cell is differentiated, its nucleus is built up of 24 chromosomes. The whole interval between the complete differentiation of the pollen-mother-cell and the formation of the young pollen-grains within it may conveniently be divided into four periods, viz.:—(1) The nucleus of the pollen-mother-cell grows larger and alters in structure, finally assuming the well-known spirem-condition; (2) Twelve chromosomes are formed from the spirem-ribbon, and lie loose in the nuclear cavity; (3) The first karyokinesis of the pollen-mother-cell nucleus separates the two halves of each chromosome; cell-division follows this nuclear division; (4) The second karyokinesis divides the nucleus of each daughter-cell into two, and is followed by a corresponding cell-division. The various stages of these processes are described in great detail.

The four nuclear divisions included in the spermatogenetic series of *Lilium Martagon* present one important characteristic in common with each other, with the three oogenetic divisions, and with ordinary vegetative division. In each of these cases the effect of the whole process of karyokinesis is to divide each parent chromosome into a pair of daughter-chromosomes by longitudinal fission, and to build up duplicate daughter-nuclei from the duplicate sets of daughter-chromosomes thus formed.†

Honeycomb Structure of Vegetable Substances.‡—Herr K. Puriewitsch brings forward evidence in opposition to Bütschli's theory of the honeycomb structure of protoplasm. In a large number of cases examined by him—starch-grains of arrowroot, potato, and wheat, cotton-fibres, bast-fibres of *Nerium Oleander*, stone-cells of *Podocarpus salicifolia*, &c.—he found the structure to agree more with Nägeli's micellar theory than with Bütschli's. An argument against Bütschli's theory is that if vegetable structures consisted of a meshwork containing fluid, they would present different optical properties when dry to what they do when moist, which does not appear to be the case.

* Ann. Bot., xi. (1897) pp. 187–224 (2 pls.). Cf. this Journal, *ante*, p. 213.

† The processes of fixing, imbedding, and staining employed by Miss Sargant will be found at p. 445.

‡ Ber. Deutsch Bot. Gesell., xv. (1897) pp. 239–47.

Streaming of Protoplasm in Pollen-Grains.* — According to Miss H. B. Potter, many pollen-grains—those of the foxglove are a good example—are convenient illustrations of the streaming of protoplasm. The granules of protoplasm move in opposite streams side by side, turning at the lower end of the tube and inside the grain. The rate of motion may be calculated at 1 mm. in $1\frac{1}{2}$–2 minutes. The pollen-tube itself was observed to grow at an average rate of 0·1 mm. per hour.

Cell-Membrane.†—Prof. J. Reynolds Green reviews the present state of our knowledge of the constitution and chemical properties of the cell-wall. It may be stated as certain that the cell-wall is originally far from homogeneous; and that, while cellulose enters very prominently into its composition, there are present in it a number of other substances which have hitherto been somewhat loosely described under the names of pectose, pectine, and compounds of pectic acid. The modifications of cell-wall which give rise to gums and mucilages, all of which are probably very complex, may well be derived from these, and not from the cellulose constituents. These compounds may be arranged in two series, neutral and feebly acid. Of the former the most important are pectose and pectine; of the latter, pectic and metapectic acids. There is a marked difference between cellulose and pectic substances in their behaviour towards staining reagents. Cellulose acts as a feeble base, and takes up acid stains, especially those which contain nitrogen. Pectic compounds, on the other hand, act as acids, and require basic stains. Hæmatoxylin, methylene-blue, vesuvian-brown, and quinolin-blue, stain the pectic constituents of the wall, not the cellulose.

Inclusions in the Living Cell-Wall.‡—Herr C. Müller finds, in the walls of certain cells in the root of *Spiræa Filipendula*, crystal-like masses, which give none of the reactions of calcium oxalate or calcium carbonate, but, on the contrary, those of cellulose. He concludes that these crystalline masses are cellulose, and believes their occurrence to be very general.

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

Red Pigment of Flowering-Plants.§—Mr. F. W. Keeble gives a *resumé* of the observations and theories of various writers on the red pigments of the floral organs known under the general term anthocyan, and of their functions. He dismisses, as unsupported by sufficient evidence, the theory that the red pigment acts as a screen to the chlorophyll, preventing its destruction by the action of the sun. On the other hand, he strongly supports Stahl's view, that its main function is the absorption of heat. Hence its very frequent presence in the perianth, anthers, or styles of anemophilous trees and shrubs, as in the poplar, hazel, *Rumex*, and *Poterium*. In the case of the red stigmas of the hazel, it may materially accelerate the growth of the pollen-tube towards the ovary.

Structure of Starch-Grains.‖—Herr W. Rothert criticises in several points Meyer's views as to the structure of starch-grains, and the nature

* Nature, lvi. (1897) p. 248. † Science Progress, i. (1897) pp. 344–64.
‡ Ber. Deutsch. Pharm. Gesell., 1897, p. 11. See Bot. Gazette, xxiii. (1897) p. 388.
§ Science Progress, i. (1897) pp. 406–23. Cf. this Journal, 1896, p. 543.
‖ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 231–9. Cf. this Journal, 1896, p. 80.

of the phenomena connected with their swelling. He regards as unnecessary the use of the terms α-amylose and β-amylose, as proposed by Meyer, the former being practically identical with the farinose, the latter with the granulose of earlier writers. The term amylose might then be retained for the substance resulting from the conversion of granulose into paste. He dissents further from Meyer's theory as to the mode in which water penetrates into the substance of the starch-grain. The author does not agree with Meyer as to the difference between ordinary swelling and conversion into paste; both consist in an absorption of water into the substance of the starch; but while, when starch dissolves in cold water, the unchanged granulose absorbs but little water, and preserves its solid consistence and its crystalline structure; when converted into paste it passes over into a different substance which absorbs much more water, and forms, in the swollen condition, dimorphic mucilaginous drops. Swelling is simply a special case of solution, in which a fluid substance is dissolved in a solid substance. Bodies capable of swelling are those which are able to dissolve certain fluids. The author does not consider that Meyer brings forward satisfactory evidence of his statements that every starch-grain is completely and constantly surrounded by the substance of its chromatophore, and that the chromatophore-envelope is also the sole seat of the formation of diastase. In all probability it is formed in the cytoplasm.

Soluble Starch.*—M. P. Guérin finds a substance possessed of the chemical properties of starch dissolved in the cell-sap in *Cola acuminata* and *C. Ballayi*, belonging to the Sterculiaceæ. The cells in which this substance occurs are almost exclusively epidermal; but it has been found also in the mucilage canals. In the lower epiderm of the leaves, starch-grains of the ordinary kind are present in the same cells as the soluble starch.

Aromatic Principles in Leaves.†—M. G. Jacquemin finds that with plants which bear fragrant or sapid fruits—as the apple, pear, raspberry—if the leaves are placed in a saccharine fluid with *Saccharomyces* or some other enzyme, the fluid will acquire the flavour and odour of the fruit, and the alcohol obtained by distillation from this liquid will possess the corresponding bouquet.

Active Principles of the Aroideæ.‡—Mdlle. J. Chauliaguet and MM. A. Hébert and F. Heim have investigated the nature of the poisonous principles in several species of Aroideæ, chiefly *Arum maculatum*, *A. italicum*, and *Arisarum vulgare*. They find the constant presence of a glucoside, with the characters of a saponin, in the underground organs and the leaves. The alkaloid was extracted, and was found to correspond in all its properties with the conicin of the hemlock, though somewhat less active. A similar volatile alkaloid exists in the tubercles of *Caladium bulbosum* and *Amorphophallus Rivieri*. The author was unable to confirm the occurrence of hydrocyanic acid, affirmed by previous writers.

Latex and its Function.§—From the fact that some of the chief constituents of latex are starch, proteids, and sugar, and that the pro-

* Bull. Soc. Bot. France, xliv. (1897) pp. 91–5.
† Comptes Rendus, cxxv. (1897) pp. 114–6. ‡ Op. cit., cxxiv. pp. 1368–70.
§ Ann. of Bot., xi. (1897) pp. 334–9.

teids are typical circulatory forms, and that the quantity of sugar varies with the plant's assimilation, Mr. R. H. Biffen argues that one function of latex must be to transport reserve-materials in the plant. The blind endings of the laticiferous system are generally connected with the palisade-cells. The result is given of determinations of the amount of sugar present at different periods of the day in several species of *Euphorbia*.

Caroubinase, a new Hydrolytic Enzyme.*—M. J. Effront finds, in the seeds of the carob, *Ceratonia siliqua*, a hitherto undescribed diastase formed during germination, to which he gives the name *caroubinase*. It is produced especially after the seedling has developed a considerable amount of chlorophyll, and possesses strong liquefying and saccharifying properties.

Doubling of the Fundamental Band of Chlorophyll.† — According to M. A. Étard, the number of the bands of chlorophyll and the wavelength of their mean axis may be accurately counted by the method of successive dilutions, and may serve to characterise the exact kind of chlorophyll. The diversity of the chlorophylls is shown by the wavelength of the axis of their bands either already existing or incited by the action of reagents. The fundamental band of the chlorophylls is not always uniformly dark; it may be double or triple. The special characteristics are described in detail of "loliophyll," the chlorophyll derived from *Lolium perenne* and other grasses.

(3) Structure of Tissues.

Stem of Compositæ.‡—Herr F. E. Ahlfvengren has examined the anatomical structure of the stem of 230 species belonging to 125 genera of Compositæ. He finds no single character belonging to the entire group. The following are some of the more interesting points. The sieve-plates are horizontal, or only slightly oblique; there are none on the side-walls. There is always an intraxylary cambiform. The Cichoriaceæ have invariably septated latex-tubes; most of the Tubifloræ have oil-canals. In the Cynareæ oil-canals occur in those genera and species which have no latex-idioblasts in the vascular bundles. The quantities of starch and inulin are in inverse proportion to one another in the stem of Compositæ; the younger parts are richer in starch, the older parts in inulin. Starch appears to be transformed into inulin during its migration.

Stem of Cuscuta.§—M. M. Cornu finds several peculiarities in the stem of a species of *Cuscuta* from Turkestan, *C. Lehmanniana*, parasitic on *Robinia pseud-acacia*. These are as follows:—The formation of secondary elements in the fibro-vascular bundles, and in the interfascicular zones. The nature of these elements, especially of the tracheids, which vary in their origin according to their position. The deposition of a special substance, of the nature of cellulose, in the cells which border the primary or secondary vascular elements and the

* Comptes Rendus, cxxv. (1897) pp. 116–8.
† Op. cit., cxxiv. (1897) pp. 1351–4. Cf. this Journal, *ante*, p. 48.
‡ (Swedish) Lund, 1896, 86 pp. and 28 figs. See Bot. Centralbl., lxx. (1897) p. 208.
§ Bull. Soc. Bot. France, xliii. (1897) pp. 699–720 (2 pls. and 2 figs.).

internal lacuna. The increase, either in diameter or in thickness, of certain elements near the haustoria, and a considerable increase in the size of the nuclei. The large size and the nature of the sieve-tubes, which vary in form, and which recall the general type in woody plants. The large size and the number of the laticiferous tubes, which are very distinct from the pericyclic fibres.

Structure of Piperaceæ.* — M. A. de Candolle calls attention to several interesting points connected with the structure of the stem of climbing plants belonging to the Piperaceæ, especially to the large size of the vessels compared to those of allied species which are not climbers.

Polystely in Primula.†—Mr. D. T. Gwynne-Vaughan finds remarkable variations in structure as to polystely within the same species in the genus *Primula*, even in different regions of one and the same plant. In *P. japonica*, *obtusifolia*, *denticulata*, and *involucrata*, the normal stem-structure of 2–4 anastomosing steles is by no means universal; all the steles are very often defective or imperfect. In *P. japonica* and *denticulata* certain structures were invariably found in the petiole which are similar in all essential respects to normal and perfect steles.

Lenticels of Monocotyledons.‡—Herr A. Weisse describes the occurrence of true lenticels in a variety of plants belonging to different orders of Monocotyledons:—in the aerial roots of Aroideæ (*Monstera deliciosa*, *Philodendron*, *Anthurium*); in arborescent Liliaceæ (*Aloë*, *Dracæna*, *Cordyline*); and in the rhizome of *Iris germanica*. In the Pandanaceæ and Palmæ, on the other hand, no true lenticels could be detected, either in the stem or in the root. Neither is any true periderm found in these plants. In the aerophilous roots of the Pandanaceæ, the peculiar pneumathodes assume the function of lenticels.

Resinocysts.§—Herr M. Schoennett describes under this name bodies of a very peculiar nature found in the stem, leaf-stalk, and lamina of a species of *Begonia*. They are usually hemispherical structures, in close apposition to the cell-wall, always in pairs, one on each side of the wall. They have a characteristic stellate appearance. They are always found in the fundamental parenchyme, in immediate proximity to the primary vascular-bundle system. They vary in breadth between 8 and 12 μ, and in length between 12 and 20 μ. They are attached to the cell-wall by a very short stalk. With regard to their chemical constitution, they are undoubtedly of a resin-acid nature. They are completely soluble in alcohol, and take up stains very readily. Other chemical reactions are given in detail. The stalk consists of pure cellulose. As regards their function, they must be regarded as in the main products of excretion, though the author is of opinion that they may in certain cases take part in the formation of food-materials for the plant. They have not, at present, been detected elsewhere in the vegetable kingdom.

* Ann. Sci. Phys. et Nat., iii. (1897) pp. 514–5.
† Ann. of Bot., xi. (1897) pp. 307–26 (1 pl.).
‡ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 303–20 (1 pl.).
§ Kosmos, xviii. pp. 382–98 (2 figs.) (Polish). See Bot. Centralbl., lxx. (1897) p. 50.

Abnormal Formation of Resin-Ducts.* — Dr. A. P. Anderson describes the conditions under which resin-ducts are formed abnormally in Conifers. This may be due either to the effects of frost, or to the attacks of *Æcidium elatinum*, the fungus which produces "witch-broom," or to infection by other fungi, such as *Agaricus melleus*, *Phoma abietina*, and *Pestalozzia Hartigii*. He regards the resin as in all cases an excretory product, having no further use in the metabolism of the plant. Whenever resin-reservoirs are found in the wood of *Abies pectinata*, they are a sure indication of some pathological condition existing in the plant.

Anatomy of the Œnothereæ and Halorageæ.† — A study of the anatomical structure of the stem and leaves leads M. P. Parmentier to divide the order Onagraceæ into the two families Œnotheraceæ and Haloragaceæ—the former being again subdivided into the Ludwigieæ and the Œnothereæ; the latter into the Halorageæ and the Gunnereæ. Details are given of the histology of each genus. *Gayophytum* and *Clarkia* are sunk in *Œnothera*, and *Jussiæa* in *Ludwigia*; while *Schizocarya* is separated generically from *Gaura*. There are distinct modes of crystallisation of the calcium oxalate characteristic of the two families Œnotheraceæ and Haloragaceæ. *Ludwigia* possesses both kinds. Another difference between the two families is in the nature of the hairs. The root of *Gunnera* presents a remarkable peculiarity in having secondary vessels enclosed in its pith. Stomates occur on both surfaces of the leaf, even in the aquatic species.

(4) Structure of Organs.

Relationship between the Structure and Function of Organs.‡— Herr Rosen gives a brief *resumé* of the facts respecting the degeneration or other modification of the floral and vegetative organs of plants, and their consequent adaptation to special functions.

Position of Dorsiventral Organs.§—From an examination of the forces which determine the position of leaves in a number of plants, Mr. R. N. Day derives the following conclusions:—The prevalence of an epinastic or hyponastic condition in any organ is due entirely to independent causes, and may be said to be spontaneous. In many plants leaves are epinastic in an earlier and hyponastic in a later period of growth, or *vice versâ*. It is entirely independent of light; there is no such thing as photo-epinasty. All dorsiventral leaves are diaheliotropic. They may be either diageotropic or apogeotropic. The position of the organ is determined by the relative intensity of the geotropic and the trophic forces acting upon it.

Development of the Flower.‖—Prof. L. J. Celakovsky traces the phylogenetic development of the flower of Phanerogams from the sporophyll of the Lycopodiaceæ and Equisetaceæ. The lowest stage is seen in the flower of the Gymnosperms,—naked in the Cycadeæ and Coniferæ,

* Forst.-naturw. Zeitschr., 1896, 38 pp. and 7 figs. See Bot. Gazette, xxiii. (1897) p. 292.
† Ann. Sci. Nat. (Bot.), iii. (1896) pp. 63–149 (6 pls.).
‡ J.B. Schles. Gesell. vaterl. Cultur (No. 71); Bot. Sect., pp. 33–42. See Bot. Centralbl., lxx. (1897) p. 125.
§ Minnesota Bot. Studies, 1897, pp. 743–52 (1 pl.).
‖ S.B. K. Böhm. Gesell. Wiss., 1896, 91 pp. and 4 figs.

but provided with a perianth in the Gnetaceæ. The absence of a perianth in the two first-named orders is not the result of degeneration. The "cones" of the Araucarieæ are not flowers, but spike-like inflorescences. The separation of the sexes is, on the other hand, a phenomenon of reduction, the oldest forms having hermaphrodite flowers. The Gnetaceæ exhibit also reduction of the gynæceum to a single carpel, and also in the number of the stamens. The Araucarieæ have always only a single integument; the outer integument of the Taxaceæ is homologous to the carpid of the Araucarieæ. Doubling of the stamens occurs for the first time in the male flowers of the Gnetaceæ. We get in the Gymnosperms the first manifestation of the spiral arrangement of the phyllomes, so common in Angiosperms.

In the Monocotyledones we have a further advance in the differentiation of the perianth into calyx and corolla; both whorls may be sepaloid, the outer sepaloid and the inner petaloid, or both petaloid. They cannot be regarded as metamorphosed stamens (except in *Halophila*). The oldest forms are unquestionably hermaphrodite. The typical flower of the Cyperaceæ has 6 perianth-bristles, 6 stamens, and a 2–3-merous whorl of carpids (*Lepidosperma*), the smaller number in other genera being the result of reduction. The Gramineæ also exhibit all stages of reduction in the gynæceum from numerous carpels (*Ochlandia*) to 3 (*Streptochæta*), and 1 with a single stigma (*Nardus*); a corresponding reduction taking place also in the number of the stamens.

Structure of Pollen-Grains.*—Herr J. Balázs describes the form and structure of the pollen-grains of a number of plants belonging to the Angiosperms. He classifies them under 4 types, viz.:—(1) reniform; (2) ellipsoidal; (3) spherical; (4) ellipsoidal, abruptly rounded at both ends.

Structure of the Fruit in Ranunculaceæ.†—Herr K. M. Wiegand classes the genera of Ranunculaceæ into 8 groups according to the structure of the fruit, a classification which he believes also to represent their genetic affinity. The form and size of the embryo, the nature of the endosperm, the histology of the two integuments of the seed, and the form and structure of the pericarp, are described in detail for each genus. The author believes that the achene represents a reduced capsule (follicle), resulting either from contraction of the upper part and reduction of the ovules to one, as in *Ranunculus*, or from expansion of the ovary below with almost complete closing of the upper part, as in *Clematis*, *Anemone*, and other genera with pendent seeds.

Micropyle of the Seed in Leguminosæ.‡—M. H. Coupin has studied the structure and development of the micropyle in a number of species of Leguminosæ. He classifies the various forms under 4 types, viz.:—(1) a cup (*Vicia Faba*); (2) a canal (*Cytisus*); (3) a closed cavity (*Lupinus*); (4) indistinct (*Arachis*). In all cases the micropyle undergoes considerable changes during the development of the ovule into a seed. Except in the case of *Abrus*, the epiderm of the micropylar canal has

* 'Ueb. d. Pollen,' Kolozsvár, 1896, 61 pp. See Bot. Centralbl., lxx. (1897) p. 156.

† Proc. Amer. Micr. Soc., 1894, pp. 69–100 (8 pls.). See Bot. Centralbl., lxx. (1897) p. 211.

‡ Rev. Gén. de Bot. (Bonnier), ix. (1897) pp. 175–80 (1 pl.).

entirely disappeared in the ripe seed, and the cavity is surrounded immediately by the parenchymatous cells, thus communicating directly with the intercellular spaces of the parenchyme. The canal is usually obliterated in its lower portion.

Crest of Seeds.*—Mr. C. Robertson suggests that the purpose of the crest of many seeds, where it is not sufficiently large to add to their attractiveness to frugivorous birds or other animals, is to furnish a handle by which they can be carried away by ants, and their dissemination thus secured.

Domatia.†—Mr. A. C. Hamilton gives an account of the occurrence of these structures in a number of Australian and other plants. Their most common form is that of a tuft of hairs in the axil of a vein on the under surface of the leaf, with which is connected an opening through the epiderm. The author classifies them under 5 heads, viz.:—(1) Circular lenticular cavities on the under side of the leaf, each with a small opening and a thickened rim; (2) pouches formed by a widening of the principal and lateral veins at the axils, the space being filled in with tissue so as to form a triangular pouch or pocket; (3) depressions or hollows formed by a thinning of the leaf-substance at the axils; (4) bunches of hairs in the axils of the principal and secondary veins; (5) denser bunches of hairs at the vein-axils of hairy leaves. The author gives the number of species in which domatia have been observed by himself or others as nearly 300, about one-half of these belonging to two natural orders, Rubiaceæ (107) and Tiliaceæ (40). The domatia are generally, but not always, inhabited by mites; but the author does not accept Lundström's view that their main object is connected with commensalism. He considers it more probable that their primary function is concerned with the absorption of gas, vapour, or water.

Morphology of Aquatic Plants.‡—The conclusion arrived at by Goebel that the narrow ligulate leaves of *Sagittaria sagittæfolia* are the results of a reversion of the mature sagittate leaves to an earlier and simpler type, is applied by Herr W. Wächter to other aquatic plants. In *S. natans* there are two forms of leaf; the earlier ones are ligulate, and (in contrast to those of *S. sagittæfolia*) are persistent, the mature leaves having an elliptical lamina. These merely represent different forms of the same leaf, the difference being apparently due to conditions of light. The results were not so decisive with *S. chinensis, Eichhornia azurea*, or *Hydrocleis nymphoides*.

A detailed description is given of the anomalous *Weddellina squamulosa*, belonging to the Podostemaceæ.

Leaves of Aquatic Gentianaceæ.§—M. E. Perrot describes a peculiarity in the structure of the leaves of certain species of *Villarsia* and *Limnanthemum*. In *L. nymphæoides* the under surface of the floating leaves exhibits a number of brown spots, formed of cells with straight somewhat thickened walls, containing a brown pigment of the nature of tannin, and numerous grains of chlorophyll. At these spots the epi-

* Bot. Gazette, xxiii. (1897) pp. 288–9.
† Proc. Linn. Soc. N. S. Wales, xxi. (1896) pp. 758–92 (1 pl.). Cf. this Journal, 1888, p. 87.
‡ Flora, lxxxiii. (1897) pp. 367–97 (21 figs.).
§ Journ. de Bot. (Morot), xi. (1897) pp. 195–201 (4 figs.).

dermal cells are much smaller than elsewhere, and the subjacent layers are rich in chlorophyll. The normal epidermal cells are thin-walled, and are charged with a violet pigment. The spots with the small thick-walled cells become "domatia" for epiphytic algæ and aquatic animals.

Metamorphosed Buds of Lilium bulbiferum.*—Herr H. Hesselman describes a very remarkable development of the buds of *Lilium bulbiferum*, in which the scales are transformed into floral leaves—perianth-leaves and stamens. In some cases the former completely assumed the form and colour of ordinary perianth-leaves, while the latter even produced pollen-grains capable of germination. The phyllotaxis of the metamorphosed bulbils was always spiral.

Pellucid Dots in Hypericum.†—Mr. T. Meehan calls attention to the occurrence of two kinds of dots on the leaves and other organs of many species of *Hypericum*, black and pellucid, the abundance of each kind being often in inverse proportion to that of the other. He regards the pellucid dots as "the initial steps taken by the plant in the formation of veinlets and veins."

Honey-Glands in Plants.‡—Mr. T. Meehan describes the nectar-glands in a Nepalese orchid, *Cymbidium aloëifolium*, in which the exudation of saccharine matter appears to be absolutely useless to the individual plant. In *Phlox paniculata* also (p. 179), the most abundant flow of nectar takes place long after pollination has been effected, the stigma appearing to be self-pollinated.

Glands of Tozzia and Lathræa.§—On the leaves and leaf-scales of *Tozzia alpina* and *Lathræa squamaria*, Prof. K. Goebel finds two kinds of gland, peltate and capitate. As is the case with other Rhinantheæ, these plants possess the property of exuding water from the leaves; and the glands—certainly the peltate, and probably also the capitate kind—appear to be the organs by which this exudation is effected.

Spines of the Aurantiaceæ.||—From observations made on the orange, Mr. T. Meehan concludes that the spines in this order of plants are not of axial, but of foliar origin, being in fact, strongly developed bud-scales.

Tubers of Orchideæ.¶—M. Leclerc du Sablon states that in the Orchideæ (*Ophrys aranifera*), during the period when the tubers are being formed, they contain an increasing quantity of starch; the sugars, which are at first abundant, disappearing almost entirely. When the tubers give up their reserve food-material, the amyloses are first transformed into saccharose, then into glucose. Like many other perennial plants, the period of greatest vital activity is the winter months, from September to May; the summer months from May to September being a period of comparative repose.

* Acta Horti Bergiani, iii. (1897) 19 pp. and 1 pl. See Bot. Centralbl., lxx. (1897) p. 292.
† Proc. Acad. Nat. Sci. Philadelphia, 1897, pp. 181–3.
‡ Tom. cit., pp. 183–5 (1 fig.).
§ Flora, lxxxiii. (1897) pp. 444–53 (7 figs.).
|| Proc. Acad. Nat. Sci. Philadelphia, 1897, pp. 174–5 (1 fig.).
¶ Comptes Rendus, cxxv. (1897) pp. 134–6.

Tubers of Aconitum.*—Dr. C. Hartwich describes several different kinds of abnormality in the tubers of species of *Aconitum*, natives of Switzerland, and derives from them conclusions as to the genetic relationship of the species. They comprise irregularities as to the disposition of the cambium and of the elements of the vascular bundles, and in the occurrence of a layer of cells in the cortex distinguished from the rest of this tissue by a difference in their refractive power.

Replacement of the Primary Root by a Secondary Root.†—According to M. Boirivaut, it very frequently happens when the primary root of a Dicotyledon is destroyed, that a secondary root takes its place, and this secondary root then assumes very much the structure of the primary root. This is especially manifested in an increase in the number of vascular bundles.

Spinous Roots.‡—Dr. D. H. Scott records two instances of this unusual structure,—in *Dioscorea prehensilis*, and in *Moræa* sp. belonging to the Irideæ. In the former case these spinous roots are produced entirely underground; in the latter they spring from the swollen base of the stem. In both cases they resemble true roots in their anatomical structure.

Structure of Bromeliaceæ.§—The late Dr. F. Müller records his observations on several species of this order, natives of Brazil. The honey-glands of *Vriesia* are described, situated on the septa of the ovary. In many species of Tillandsieæ the author finds bracteoles (*Vorblätter*), the existence of which has not been detected by previous observers.

Morphology of Thelygonum Cynocrambe.‖—Of this remarkable plant of the Mediterranean flora, of uncertain affinities, placed by Lindley among the Chenopodiaceæ, Dr. G. Balicka-Iwanowska has made a detailed examination, of which the following are the more important results. The stem is monopodial. The male flowers have no rudiments of bracts or supporting leaves, while the female flowers have both. The ovules, which are at first horizontal and anatropous, assume later a horseshoe shape. A large amount of mucilage is present in the colleters and in a circular swelling of the leaf-stalk.

β. Physiology.

(1) Reproduction and Embryology.

Moebius on Reproduction.¶—Prof. M. Moebius has brought together in one volume all his previous observations on the various modes of reproduction in the vegetable kingdom, and has added some new observations and theories.

Instead of the primary classification of modes of reproduction into sexual and non-sexual, he proposes one into reproduction by buds and by germs; the distinction lying in the rejuvenescence of the cell or cells in the case of germs, while no such rejuvenescence takes place in the

* Bot. Centralbl., lxx. (1897) pp. 114–20, 146–52, 178–84 (2 pls.).
† Comptes Rendus, cxxv. (1897) pp. 136–8.
‡ Ann. of Bot., xi. (1897) pp. 327–32 (2 pls.).
§ Flora, lxxxiii. (1897) pp. 454–86 (2 pls.).
‖ Tom. cit., pp. 357–66 (10 figs.).
¶ 'Beitr. z. Lehre v. d. Fortpflanzung d. Gewächse,' Jena, 1897, vi. and 212 pp. and 36 figs.

case of buds, but only growth by ordinary cell-division. An individual is a body which cannot be divided in such a way that the division gives rise immediately to two or more entirely new bodies. He combats the prevalent idea that continuous vegetative multiplication necessarily results in degeneration. The banana, date-palm, &c., are never reproduced sexually in cultivation. Cultivated plants which are reproduced by seeds (cereal crops, &c.) are as liable to injury from parasitic fungi as those which are propagated from buds or cuttings.

In most cases vegetative propagation has been the result of unfavourable conditions for the production of sexual organs or for the ripening of the seed. The advantages presented by sexual reproduction are: (1) the type of the species is more readily preserved by unispecific crossing; (2) by bispecific crossing the production of new species is (not made possible, but) rendered more easy; (3) it is a means for the development of more highly organised forms. There is no relationship between the complexity of the vegetative structure and that of the sexual organs.

Embryogeny of Sagittaria.*—Mr. J. H. Schaffner finds the development of the pollen-grain, embryo-sac, and embryo of *Sagittaria variabilis* to agree in general terms with that in *Alisma Plantago*. The generative nucleus divides into the two male nuclei long before the dehiscence of the anther, making a trinucleated pollen-grain. The two polar nuclei usually fuse completely before impregnation, the centrospheres and nucleoles appearing also to fuse. The three antipodal cells are usually surrounded by cell-walls before impregnation. The embryo-sac becomes divided, after impregnation, into two parts, the growth and curving of the embryo-sac taking place practically entirely above the division-wall. The pollen-tube expands, as it enters the embryo-sac, and passes down on one side past one of the synergids, which disappears at this time. The two male nuclei both enter the embryo-sac with the pollen-tube, but only one of them leaves the tube and takes part in fertilising the oosphere. Two very distinct centrospheres precede the male nucleus as it passes through the end of the tube. The apex of the tube appears to be ruptured by the passage of the nucleus. As the male nucleus approaches the oosphere, the latter developes a large bulge on the side facing the pollen-tube, two centrospheres sometimes appearing on the bulge. Centrospheres appear in resting nuclei and in division-stages; and, just before the contact and during the fusion of the male and female nuclei, two pairs of centrospheres appear, which seem to fuse simultaneously with the male and female nuclei.

Cleistogamy in Umbelliferæ.†—Mr. T. Meehan describes a peculiar kind of cleistogamy in *Cryptotænia canadensis*. It has two kinds of flower, male and hermaphrodite. In the latter the stamens, with short filaments and polliniferous anthers, are all enveloped in an extremely fugacious corolla, beneath which pollination is effected before the flowers open.

Double Pollination.‡—From experiments made on the hybridisation of several species of *Marica*, natives of Brazil, the late Dr. F. Müller contests the assertion of Gaertner that the mixed pollination of a stigma

* Bot. Gazette, xxiii. (1897) pp. 252–72 (7 pls.). Cf. this Journal, 1896, p. 436.
† Proc. Acad. Nat. Sci. Philadelphia, 1897, pp. 177–8.
‡ Flora, lxxxiii. (1897) pp. 474–86.

by different kinds of pollen produces no mixed types, but that each kind of pollen, on the contrary, exercises its own effects entirely independently of the others. He confirms, on the other hand, Kölreuter's statement that, when different kinds of pollen act at the same time, on the same stigma, forms result which present intermediate characteristics; half-bastards or "tinctures" when a small quantity of a plant's own pollen and a large quantity of a foreign pollen are used.

Pollination of Cyclamen.*—Herr F. Hildebrand describes a peculiar contrivance for aiding cross-pollination in the spring-flowering species of *Cyclamen* (*C. persicum*, *coum*, *ibericum*, &c. When the pollen first escapes from the terminal orifice of the anther, the pollen-grains adhere together in lumps by an oily secretion, which prevents their falling on to the stigma in the same flower. The first portion of the pollen leaves the anther in this condition, and is abundantly carried away by the numerous visiting insects. The oily secretion, however, rapidly dries up; and when the later portion of the pollen falls from the anther—at which time insects are no longer visiting the flowers—the grains are dry, and are readily carried by the wind to other flowers. The autumn-flowering species of *Cyclamen* (*C. græcum*, *neapolitanum*, *africanum*) appear not to be visited by insects. In most species of *Cyclamen* (e.g. *C. persicum*) the stigma ends abruptly in a flat surface, which is not papillose or hairy, but has a deep depression in which the pollen collects. In *C. ibericum* and *coum*, on the other hand, the stigma is provided with a tuft of papillæ, from which the stigmatic fluid secretes that detains the pollen-grains.

Cross-Pollination and Self-Pollination.—Mr. C. Robertson's † latest contribution to this subject treats of the adaptations for pollination and the insect-visitors of a number of species belonging to different natural orders growing in Illinois.

Dr. P. Knuth ‡ has investigated the pollination phenomena of the flora of Heligoland. Out of 174 species of flowering plants, 50, or about 30 per cent., are anemophilous; *Zostera marina* is hydrophilous; *Lemna trisulca* does not flower. The pollinating insects are chiefly flies; there are a few Lepidoptera, but no honey-bees or humble-bees.

The same writer § describes the mode of pollination in *Matthiola incana* and *Lunaria biennis*. In both species the two shorter stamens seem designed for cross-pollination by insects, the four longer ones for self-pollination when cross-pollination fails. Both species are visited by butterflies:—the former by *Vanessa Urticæ*; the latter both by the small tortoise-shell and by *Pieris Brassicæ*, also by a bee, *Anthophora pilipes*. In this case also, a bee, *Andrena Gwynana*, and a hover-fly, *Syritta pipiens*, are efficient in self-pollination. In both species the male and female organs mature synchronously.

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

Laws of Growth.‖—From observations made on a variety of plants, Sig. L. Montemartini concludes that the activity of the growing point

* Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 292–8 (4 figs.).
† Trans. Acad. Sci. St. Louis, vii. (1896) pp. 151–79.
‡ Bot. Jaarb. Gent, 1896, 47 pp. and 1 pl. See Bot. Centralbl., lxx. (1897) p. 274.
§ Bot. Centralbl., lxx. (1897) pp. 337–40 (6 figs.).
‖ Atti Ist. Bot. r. Univ. Pavia, v. (1896). See Bot. Centralbl., lxx. (1897) p. 276.

exhibits a great period, dependent on internal causes. There is a connection between the apical and the secondary growth, the two curves coinciding; the maximum of apical activity corresponds to the greater length of the zone of growth; both processes are influenced by external agencies. Similar laws apply to the growing point of the root. In the case of annual woody plants, growth in thickness (growth of the secondary meristem) exhibits a periodicity dependent on internal causes, corresponding to the periodicity of the primary meristem, but independent of it. The formation of an annual ring is the immediate consequence of spontaneous and periodic changes in the activity of the cambium; the periodicity in the activity of the cambium is independent of that of the primary meristem, although both are influenced by external conditions.

Rhythmic Growth in Plants.*—Mr. T. Meehan adduces a number of examples of the effect of "rhythmic growth" in producing apparent irregularities in the growth of plants. To this he attributes the occasional irregularity and the dimorphism in the flowers of *Phlox* and other genera of Polemoniaceæ. The so-called "polarity" of the leaves of *Silphium laciniatum* and other "compass-plants" is due to the same law. In many cases (e.g. *Gleditschia*), glands are the result of the arrested development of a branch—another illustration of the action of this law. The author points out also the small amount of evidence of the occurrence of hybrids in nature, even when the conditions appear to be specially favourable to the crossing of different species. The forms often regarded as hybrids he believes to be varieties dependent on the operation of the law of rhythmic growth.

Growth of Allium ursinum.†—Herr A. Rimpach notes a periodicity in the development of this plant. In the autumn, slender roots which are not contractile spring from the primary axis; also slender lateral roots from those formed in the previous spring. At the same time the bulb, consisting of a bud and a single leaf, begins to grow; the foliage-leaves developing in the course of the winter. In the spring the leaves appear above ground, and quickly unfold, the old bulb-leaf disappearing. Contractile roots are now formed, which drag the plant downwards into the soil. The foliage-leaves, the innermost of which is transformed into a receptacle for food-material, continue their function till August, when they wither.

Growth of Colchicum autumnale.‡—In this plant Herr A. Rimpach finds that the gradual sinking of the corm in the soil is not effected by the agency of contractile roots, or not to any appreciable extent. This depression takes place year after year, until the corm has sunk to a depth of about 15 cm., which may require about 20 years. After that it remains nearly stationary. Growth begins in the late summer or autumn, by the production of numerous slender roots at the time when the flowers expand. The assimilating period of the leaves lasts from April till July. Fleshy roots make their appearance in April or May, which have a strong resemblance to the contractile roots of other underground stems, but

* Proc. Acad. Nat. Sci. Philadelphia, 1897, pp. 178–81, 191–3, 194–6, 196–9.
† Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 248–52 (1 pl.).
‡ Tom. cit., pp. 298–302 (1 pl.).

which appear to have no contractile property. The growing point and the whole corm are constantly forced downwards by the growth of the new buds which are formed on its upper surface.

Germination of Cryptocoryne.* — Prof. K. Goebel describes the structure of *Cryptocoryne spiralis* and *ciliata*, marsh plants, species of Aroideæ, in which the embryo germinates while still attached to the plant. The small spadix is completely hidden within the spathe; an outgrowth from the spathe above the spadix prevents the access of larger animals, while small insects enter freely, and effect the carriage of the pollen to the stigma. The ovules are characterised by the very strong development of the outer integument. When the embryo begins to germinate, the cotyledon serves as an absorptive organ, and after the endosperm has been consumed, the embryo derives the greater part of its nutriment from the outer integument of the ovule.

Phenomena of Symbiosis.†—Mr. A. Schneider classifies the phenomena of symbiosis under the following heads:—

- I. Incipient Symbiosis (Indifferent Symbiosis).
  - 1. Accidental Symbiosis.
  - 2. Contingent Symbiosis.
- II. Antagonistic Symbiosis.
  - 1. Mutual Antagonistic Symbiosis (Mutual Parasitism).
  - 2. Antagonistic Symbiosis (Parasitism).
    - *a.* Obligative Antagonistic Symbiosis.
    - *b.* Facultative Antagonistic Symbiosis.
  - 3. Saprophytism.
    - *a.* Facultative Saprophytism.
    - *b.* Obligative Saprophytism.
- III. Mutualistic Symbiosis.
  - 1. Nutricism (Semi-mutualistic Symbiosis).
  - 2. Mutualism.
  - 3. Individualism.
    - *a.* Semi-individualism.
    - *b.* Complete Individualism.
- IV. Compound Symbiosis.

Accidental symbiosis represents the least specialised form, and is of wider occurrence than all the others combined. Contingent symbiosis (*Raumparasitismus*) involves a preference displayed by one organism for living in contact with another. Nutricism is illustrated in mycorhiza, such as that of the roots of Cupuliferæ; mutualism in the root-tubercles of the Leguminosæ. The two forms of individualism occur in the lower and the higher forms of lichens. Compound symbiosis is found especially in the animal kingdom.

Effect of Mineral Salts on Development.‡—M. C. Dassonville has experimented on the effect of solutions of mineral salts (chiefly Knop's solution) on the growth of different grasses (wheat, rye, oat, maize, &c.) as compared with that of pure water. He finds the general result to

* Flora, lxxxiii. (1897) pp. 426–35 (12 figs.).
† Minnesota Bot. Studies, 1897, pp. 923–48.
‡ Comptes Rendus, cxxiv. (1897) pp. 1467–70.

be that, with distilled water, the tissues are less fully developed, while, on the other hand, they are more strongly lignified. Thus, in a saline solution, both the roots and the stem become larger; the size, both of the vessels and of the air-cavities, is increased; while the walls of the former are less strongly lignified.

Effect of Electricity on Vegetation.*—Mr. Asa S. Kinney records the results of a series of observations on the effect on germination of a continuous electric current. With a small alternating current of moderate frequency and high voltage, there was in all cases an increase in the rapidity of germination and elongation of the radicle and hypocotyl. There was a distinct optimum above and below which the treatment was less effective, though never injurious.

(3) Irritability.

Movements of Swarm-Spores, Antherozoids, and Plasmodes.†—Dr. R. Kolkwitz gives a *resumé* of the literature published during the years 1885–1896 under the following heads:—Mechanics of the movements of Diatoms, Swarm-spores, Bacteria, Antherozoids, Oscillatoriaceæ, Desmidiaceæ, Gregarineæ, Plasmodes, Amœbæ, Flos-aquæ, Phycochromaceæ and Radiolarieæ; the influence on the movements of Light, of Chemical substances, of Heat, of Moisture, of Gravitation, and of Electricity.

Gamotropic and Carpotropic Movements.‡—Prof. A. Hansgirg gives a further very extended list of plants in which the parts of the flower, or the flower-stalk or fruit-stalk, exhibit movements of curvature for the protection of the reproductive organs, or to assist in pollination, or to place the fruit in a more favourable position for the ripening of the seeds. The gamotropic movements are arranged under the following classes:—(1) plants in which the flowers or inflorescences open or close periodically; (2) plants with ephemeral or pseudo-ephemeral flowers which open only by day or only by night; (3) plants with non-gamotropic flowers which open only once, and remain open until they wither; (4) plants with pseudo-cleistogamic and hemi-pseudo-cleistogamic flowers.

Of carpotropic movements the following 8 types are recognised:—(1) the *Avena*-type; (2) the *Oxalis*-type; (3) the *Primula*-type; (4) the *Coronilla*-type; (5) the *Veronica*-type; (6) the *Aloë*-type; (7) the *Fragaria*-type; (8) the *Aquilegia*-type. Special attention is paid to the carpotropic curvatures of sepals and bracts.

Further observations are also described on nyctitropic and paraheliotropic movements, on the irritable movements of stamens and stigmas, and on irritability in general.

Ombrophoby of Flowers.§—By this term Prof. A. Hansgirg designates the phenomena of curvature by which many flowers protect

* Bull. Hatch Exp. Station (Amherst, Mass.), No. 43, 32 pp. See Bot. Gazette, xxiii. (1897) p. 302.

† Bot. Centralbl., lxx. (1897) pp. 184–92.

‡ S.B. K. Böhm. Gesell. Wiss., 1896, 111 pp. and 1 pl. Cf. this Journal, *ante*, p. 144.

§ Tom. cit., 67 pp. and 2 pls. Cf. this Journal, 1890, p. 484.

themselves against injury from long-continued rain or other exposure to moisture. Such plants belong mostly to the xerophilous vegetation of temperate climates. They may be arranged under four types, viz.:—(1) Plants whose flowers close their perianth in rainy weather in such a way that drops of rain cannot enter (or only with difficulty) the flowers which are open in fine weather; the position of the flowers or inflorescence not being altered. (2) Plants in which, after the flower opens, the flower-stalk curves in rainy weather, in such a way that the opening of the flower, previously directed upwards, changes its position so as to protect the pollen or nectar against the rain. (3) Plants in which a similar movement takes place in the stalk of the inflorescence. (4) Plants in which the movements characteristic of the second and third type are accompanied by a closing of the perianth. In addition, the author gives a list of flowers in which the protection of the pollen against rain does not depend upon a photo-dynamic principle.

Curvature of Roots.*—Prof. D. T. Macdougal has carried out a series of observations on the localisation of the curvature of roots, and the causes which give rise to it. Curvatures in general he regards as due to changes in the cell-wall rather than in the osmotic activity of the cell-contents. But the curvatures of stems are not identical with those of most tendrils or of many roots. The curvature of roots is due to the excessive active elongation of the internal layers of the cortex of the side becoming convex, made feasible by the increased stretching capacity of the longitudinal membranes. In consequence of the stretching, the membranes of the convex side become thinner; and, as a later effect, the membranes of the concave side become thicker. The organs of the irritable mechanism of roots exhibit a physiological rather than a morphological differentiation. The part of the root affected may be divided into a sensory zone and a motor zone. The movement of a root is caused by changes in the region in which the energy of the periblem is turned from cell-division to cell-enlargement. The sensory zone consists of a cup-shaped mass of periblem extending 1–2 mm. axially, from which the bottom, representing the growing point, is wanting. The sensory zone extends approximately to the forward edge of the motor zone. The motor zone includes a length of 2–3 mm. The curvatures of roots apical and basal to the motor zone are mechanical accompaniments of the action of the motor zone.

Rheotropism and Thermotropism in a Plasmode.†—Mr. J. B. Clifford has studied these phenomena in the sclerote of a Myxomycete, probably *Fuligo varians*, which could be induced to assume the active plasmode condition by supplying it with abundant moisture. Up to a certain point the plasmode was found to be positively rheotropic, but a very slight increase in the strength of the current of water caused it to become negatively rheotropic; any considerable increase in the strength of the current induced it to move entirely away from the water. As to thermotropism, the plasmode will live in an atmosphere ranging from $-2°$ to $52°–53°$ C.; it remains positively thermotropic up to $33°–34°$ C., becoming negatively thermotropic above that point.

* Bot. Gazette, xxiii. (1897) pp. 307–66 (1 pl. and 7 figs.).
† Ann. of Bot., xi. (1897) pp. 179–86 (3 figs.).

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

Action of Diastase on Reserve-Cellulose in Germination.*—Dr. J. Grüss describes this process in further detail, the species specially studied being the date-palm. During germination the diastatic enzyme passes from the cell-cavity into the thickened cell-wall, especially in the neighbourhood of the scutellum. This is followed by a partial hydrolytic solution, by which the galactan is removed from the cell-wall. In this manner the hyaline marginal zone is formed. The mannan which remains in this zone undergoes allöolysis; the mass which is permeated by the enzyme passes over into the various mannin stages, and finally into mannose. According to the reactions a leuco-mannin and a cyanomannin can be distinguished.

Alcoholic Fermentation without Yeast-Cells.†—Herr E. Buchner finds that the aqueous extract loses its fermentative properties when kept for two days at 0°, or for one day at the ordinary temperature. This deterioration, which is accompanied by a loss in coagulable albumen, is attributed to the presence of peptonic enzymes. The extract retains its activity much longer in the presence of strong solutions of cane-sugar. When the extract is mixed with its own volume of a 50 per cent. solution of cane-sugar, fermentation continues for 7 days at moderate temperature, and for 14 days at 0°. That the activity is not due to the presence of plasma particles in the extract, is proved by the fact that the activity of the solution is not destroyed by antiseptics, such as chloroform, benzene, sodium arsenite, &c. The extract may also be evaporated to dryness at 30°–35° under reduced pressure; and an aqueous solution of the residue is also capable of fermenting cane-sugar. The dried extract may be kept for at least 20 days without losing its active properties. Only on one occasion was it found possible to precipitate the active substance, zymase, by the aid of alcohol. Well warmed yeast was dried at 37°; one portion was mixed with water and heated to 100°; plate cultures proved that all the cells had been destroyed, and yet the solution was capable of fermenting a sterilised cane-sugar solution.

The second portion was heated to 140°–145° for one hour; it was found to be incapable of bringing about fermentation, owing to the destruction of the zymase.

Reduction of Nitrates.‡—M. P. P. Dehérain made a number of experiments in which solutions of potassium nitrate were inoculated with straw, fresh manure, horse-dung, and peat manure. Nitrate-reducing organisms were found in straw and fresh manure, but not in peat manure. Horse-dung contained sufficient to reduce nitrates at 30°, but there was very slight reduction at the ordinary temperature. The denitrifying organisms develop rapidly in solutions containing starch and potassium nitrate, but not at all in pure nitrate solutions. The organisms will live in starch alone; but in absence of nitrate the starch is only very slowly destroyed. Solutions exhibiting the most rapid reduction contain starch (0·25), potassium nitrate (0·2), and potassium phosphate (0·01

* Bot. Centralbl., lxx. (1897) pp. 242–61 (2 pls.). Cf. this Journal, 1895, p. 200.

† Ber. Deutsch. Chem. Gesell., xxx. (1897) pp. 1110–3. See Journ. Chem. Soc., lxxi. and lxxii. (1897) pp. 380–1. Cf. this Journal, *ante*, p. 222.

‡ Ann. Agronom., xxiii. (1897) pp. 49–79. See Journ. Chem. Soc., lxxi. and lxxii. (1897) pp. 381–2.

per cent.). Experiments with soil showed the presence of denitrifying organisms, and that by adding starch a considerable amount of the nitrates present in the soil could be destroyed, while the addition of straw had very little effect.

The amount of nitrogen utilised by the reducing organisms is very slight, nearly the whole of the nitric nitrogen being liberated as gas, chiefly free nitrogen. Reduction takes place more readily in closed vessels than in the open air, and is retarded by passing air through solutions containing starch and potassium nitrate. There is no danger of loss of nitrogen by the application of the usual amounts of manure. Reduction of nitrates would only take place when the manure amounted to 400,000–800,000 kilos. per hectare. Hence it is quite unnecessary to treat stable manure with sulphuric acid before using it.

Nitrates in Seedlings.*—Herr E. Schulze finds potassium nitrate in very small quantities in etiolated seedlings of gourd and lupin grown in soil which does not contain nitrates. This may be the result of the oxidation in the soil of nitrogenous substances excreted by the root, the resulting nitrates being then again absorbed; or it may be the result of the air of the laboratory containing small quantities of nitrates resulting from the oxidation of atmospheric impurities.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Anatomy of Lycopodium.†—According to MM. E. David and L. Weber, the ultimate ramifications of the vascular bundle consist (in *Lycopodium clavatum*) of a xylem-bundle and two halves of a bast-bundle. The central cylinder is surrounded by a pericambium composed of three or four layers. The outer and inner layers of the cortical tissue have sclerotised cell-walls. The phloem completely surrounds the xylem in each bundle. The sporange consists of a cup, from the hypodermal layer of which are developed the spore-mother-cells. The outer wall is composed at first of a single layer, which subsequently splits into three; the innermost of these three is the nutrient layer of the spores.

Oophyte of Botrychium.‡—Mr. E. C. Jeffrey has studied the structure and development of the gametophyte (oophyte) generation of *Botrychium virginianum*. The middle of the upper surface of the prothallium is occupied by a well-defined ridge, upon which the antherids are situated. The archegones are found on the declivities which slope away from the antheridial ridge. The cells of the tissue which composes the lower surface of the prothallium are filled with a yellow oil, and contain an endophytic fungus. The antherids project but little above the ridge; the antherozoids are large, and resemble those of typical ferns; only the neck of the archegone projects above the surface. The first division of the oospore (oosperm) is at right angles to the long

* Zeitschr. f. Phys. Chemie, xxii. (1896) pp. 83–9. See Bot. Centralbl., lxxii. (1897) p. 361.

† Bull. No. 15 Soc. syn. d. Pharmaciens de la Côte d'Or, 1897. See Bot. Centralbl., lxx. (1897) p. 359.

‡ Proc. Canadian Inst., i. (1897) pp. 8–10. Ann. Bot., xi. (1897) pp. 481–6.

axis of the archegone; the second is at right angles to the first. The prothallium is very long-lived, apparently living as much as six years.

Formation of the Karyokinetic Spindle in Equisetum.* — Herr W. J. V. Osterhout gives the following as the main results of observations in the first nuclear division in the spore-mother-cells of *Equisetum limosum*. At the time when the chromosomes separate, there is formed in the cytoplasm, close to the nuclear wall, a layer composed of fibres which at first run irregularly, but at length place themselves at right angles to the wall. Tufts of filaments are produced by the union of the polar ends. After the wall of the nucleus has disappeared, these filaments reach the nuclear cavity and combine with the fibres of the linin-framework. New groups are formed by fusion of the original groups, and then separate into two opposite divisions. Each division consists of several such groups, which finally fuse together and form a bipolar spindle. There appears to be a complete absence of centrosomes in this mode of formation of the spindle.

Characeæ.

Division of the Nucleus in Chara.†—Herr B. Debski has investigated the mode of nuclear division in the vegetative cells and antheridial filaments of *Chara fragilis*. His conclusions differ materially from those of Johow, who was, he believes, led into error by mistaking the substance of the nucleoles for chromatin. The main results are as follows:—

No distinct centrosomes could be detected in the process of division of the nucleus. Nucleole-like bodies are formed in the protoplasm, probably composed of nucleolar substance, and which show remarkable relationships to the spindle-fibres and the formation of the cell-plate. No reduction in the number of chromosomes takes place in the antherids. The process of karyokinesis exhibits much greater resemblance to that in the higher plants than to that in Algæ. In *Chara*, as in the Archegoniata, the nuclear membrane is absorbed; while in most Algæ karyokinesis takes place within the nuclear membrane, which is absorbed only at a later period. In *Chara* the formation of the cell-plate takes place centrifugally.

Shoot-Nodes of Characeæ.‡—Dr. K. Giesenhagen describes in detail the structure and mode of formation of the nodes in the aerial stems of the Characeæ, especially in *Nitella gracilis* and *N. syncarpa*. While the earlier stages in their formation show a remarkable uniformity throughout the family, a variety of differences are exhibited in the later stages, according to the species.

Muscineæ.

Levierella, a new Genus of Musci.—Dr. C. Müller § defines as follows a new genus of Fabroniaceæ from the Himalayas:—Cespites latos depressos entodontoideos sistens; caulis vage ramosus tenuis, ramis brevibus secundifoliis robustioribus, anguste subcomplanatis, et junioribus multo tenerioribus sparsifoliosis, valde divisus; folia e basi

* Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) pp. 159–68 (2 pls.). (For method see p. 445.)

† Tom. cit., pp. 227–48. Cf. this Journal, 1882, p. 79. (For method see p. 445.)

‡ Flora, lxxxiii. (1897) pp. 160–202 (1 pl. and 17 figs.). Cf. this Journal, *ante*, p. 147.

§ Bull. Soc. Bot. Ital., 1897, pp. 73–4.

brevi subspathulata, cellulis alaribus quadratis subpellucidis ornata, in laminam ovato-acuminatam tenuiter serrulatam carinatam attenuata, nervo angustissimo evanido exarata, e cellulis fabroniaceis reticulata; theca parva longius pedunculata entodontoideo-cylindrica rostrata operculata; calyptra minuta dimidiata; annulus latus persistens grandecellulosus; peristomium duplex; dentes externi 16, angustissimi lineares articulati pallide flavocornei, in dentes 4 coaliti latere parum cristati, interni membranam adglutinatam obsolete dentatam sistentes; inflorescentia monoica. It is named *Levierella.*

Gemmæ of Aulacomnium.*—Herr C. Müller has studied in detail the formation of the gemmæ or bulbils in *Aulacomnium androgynum.* It in all cases depends on the production of a two-edged (wedge-shaped) apical cell at the end of a leafless pseudopode or gemmophore, but the number of segments which are produced from this cell varies. Usually this apical cell divides into a large number of segments by walls alternately inclined in different directions. But not unfrequently the terminal cell first of all divides transversely into two at about half its length, and the apical cell then results from the further segmentation of the upper of these two cells. The basal cell also always undergoes further division.

Algæ.

Encrusting and Perforating Algæ.†—Prof. R. Chodat enumerates the Algæ (and Protophyta) which form calcareous deposits on objects immersed in water. The Cyanophyceæ coming under this head belong chiefly to the genera *Calothrix* and *Schizothrix;* species of the latter genus may penetrate calcareous rocks to a depth of 1–2·5 mm. To them is commonly due the caries of pebbles. They also frequently attack bivalve shells. Species of *Hyella* living in consortism with a *Gongrosira*, a *Gomontia*, or a fungus known as *Ostracoblabe*, attack the shells of marine molluscs. Perforating properties to a very high degree are possessed by an alga apparently belonging to the genus *Gongrosira*, which invades the shells of *Anodon* in the Lake of Geneva.

Iodine in Algæ.‡—According to Herr Eschle, the iodine in Algæ (*Fucus vesiculosus, Laminaria digitata*) is almost entirely in the form of an organic compound.

Melobesiaceæ.§—Herr M. Foslie criticises, on several points, Heydrich's monograph of the Melobesiaceæ. He maintains that there are no good generic characters by which *Lithophyllum* can be separated from *Lithothamnion. Sporolithon ptychoides* must also be referred to the same genus. The alleged "layers of tetrasporanges" overgrown by new thallus-layers, are, according to the author, abnormal structures caused by the attacks of a Rhizopod, which either preys upon existing conceptacles, or bores for itself chambers having a close resemblance to conceptacles. Several also of Heydrich's species are sunk by Foslie in previously described species.

* Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 279–91 (1 pl.).
† Arch. Sci. Phys. et Nat., iii. (1897) pp. 512–4.
‡ Zeitschr. Phys. Chem., xxiii. (1897) pp. 30–7. See Journ. Chem. Soc., 1897, Abstr., p. 339.
§ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 252–60. Cf. this Journal, *ante*, p. 225.

Conjugation of Swarm-spores.—Herr F. Oltmanns* contests the accuracy of the well-known observations of Berthold on the conjugation of the swarm-spores (gametes) from the plurilocular sporanges of *Ectocarpus siliculosus.* From observations, made chiefly on *E. criniger*, he is able to state that, especially in cultivation, it is exceedingly common for the swarm-spores of this and of other algæ to be attacked and devoured by Flagellata, and he believes this phenomenon to have been mistaken by Berthold for a conjugation of swarm-spores. Especially he calls attention to the rarity of observations of the germination of the assumed zygotes by Berthold or others.

In reply, Dr. G. Berthold † entirely denies the accuracy of Oltmanns' interpretation of the observed phenomena, and gives further details, not hitherto published, of his own observations. He states that the swarm-spores exercise an influence on one another even before the female comes to rest.

Fungi.

Action of Alcohol on the Germination of the Spores of Fungi.‡—According to M. P. Lesage, alcoholic solutions up to a concentration of 6–8 per cent. do not prevent the germination of the spores of Fungi (*Penicillium glaucum*, *Sterigmatocystis nigra*). Above this limit alcoholic solutions impede germination, and finally kill the spores. A rise of temperature increases the toxic action.

Mucorini.§—M. M. Léger has studied the structure of the cell and the phenomena of conjugation in a large number of genera of Mucorini, and finds in all a great uniformity.

In the hyphæ the nuclei are very numerous, varying in diameter from 0·5 to 5 μ; they have a central deeply staining nucleole, surrounded by a peripheral layer which does not stain (with hæmatoxylin), the whole enclosed in a nuclear sac. The vegetative nuclei always divide directly; mitotic divisions occurring only in the spores at the period of germination.

The young zygosperm contains a very large number of nuclei derived from each gamete, which gradually disappear. As soon as the last have disappeared, two groups of bodies make their appearance, one at each end of the zygosperm, which the author terms "embryogenic bodies"; they are naked masses of protoplasm apparently derived from the nuclei; later, they fuse together in each group. These bodies, the "embryogenic spheres," surround themselves with a double wall, and constitute the "embryonic spheres" of the mature zygosperm. When the zygosperm is about to germinate, these spheres lose their walls and unite to form a single central mass with numerous nuclei. In the formation of the azygospores, exactly the same process takes place, except that there is only one group of embryogenic bodies, and one embryonic sphere. The author regards the union of the embryogenic bodies as a true sexual process; the azygospores are therefore as truly sexual bodies

* Flora, lxxxiii. (1897) pp. 398–414 (1 pl. and 4 figs.).
† Tom. cit., pp. 415–25. ‡ Ann. Sci. Nat. (Bot.), iii. (1896) pp. 151–9.
§ 'Rech. s. l. structure d. Mucorinées,' Poitiers, 1896, 151 pp. and 21 pls. See Bot. Gazette, xxiii. (1897) p. 389. Cf. this Journal, 1895, p. 461.

as the zygosperms. The phenomenon of conjugation is thus held to be a matter of secondary importance, and not sexually significant in the group.

Two new species of *Mucor* are described, *M. rigidus*, and *M. rubescens* with bright red sporanges.

Mucor agglomeratus sp. n.*—Herr. W. Schostakowitsch finds a new species of *Mucor* in putrid milk in Siberia. On bread it forms very dense greyish tufts, in which the much-branched sporangiophores are so densely crowded as to be indistinguishable by the naked eye. Each sporangiophore ends in a sporange, and the latter are also collected in nearly sessile clusters on lateral branches.

Entomogenous Fungi.†—Mr. J. G. O. Tepper enumerates the entomogenous fungi natives of Australia, all belonging to the genus *Cordiceps*. Thirteen species have been described, of which *C. Gunnii* is the most widely diffused. The species of larva which they attack are at present entirely unknown.

Geoglosseæ.‡—Mr. G. Massee gives a monograph of this family of the Discomycetes, consisting of the eight genera *Geoglossum*, *Spathularia*, *Vibrissea*, *Mitrula*, *Leotia*, *Spragueola*, *Hemiglossum*, and *Neolecta*. The family is thus defined:—Ascophore stipitate, erect, ascigerous portion terminal, clavate, spathulate, or pileate; asci elongated, narrowly clavate, eight-spored, dehiscing by an apical pore; spores coloured or hyaline, septate or continuous; paraphyses present. Of Massee's own genus *Spragueola*, the following diagnosis is given:—Ascophore sessile, subglobose, irregularly nodulose, glabrous, solid, hymenium covering the whole surface, attached to the substratum by radiating mycelium; asci narrowly cylindric-clavate, apex slightly truncate or obtuse, pore blue with iodine; spores eight, obliquely 1-seriate, continuous, hyaline, smooth, elliptical; paraphyses slender, septate.

The author considers the family as most nearly allied to the Bulgarieæ; but there is an affinity with the Pezizeæ through *Helotium*, and with the Helvelleæ through *Verpa*.

Development of the Tuberaceæ.§—Herr. F. Bucholtz traces in detail the development of *Tuber excavatum*, belonging to the subgenus *Aschion*. He finds that it has a gymnocarpous origin, the hymenium becoming enclosed only in the course of its development. This establishes the close relationship of the subgenus to the genera *Stephensia*, *Pachyphlœus*, and *Genea*, and renders highly probable the affinity of the Eutuberineæ to the gymnocarpous Helvellaceæ. Two isolated hyphal systems are present in the receptacle of *Tuber excavatum*, one of them ascogenous, the other resinigerous, indicating the great internal differentiation of the Tuberaceæ. Similar resin-hyphæ were found also in *Hymenogaster decorus*, confirming the view already put forward ‖ of the parallelism of the two families Tuberaceæ and Gasteromycetes.

* Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 226–8 (1 pl.).
† Bot. Centralbl., lxx. (1897) pp. 305–7.
‡ Ann. of Bot., xi. (1897) pp. 225–306 (2 pls.).
§ Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 211–26 (1 pl.).
‖ Cf. this Journal, *ante*, p. 153.

Sclerotinia.*—Herr R. Aderhold describes in detail the structure, development, and mode of propagation of the "Vermehrungspilz," so destructive especially of gardeners' cuttings. He regards it as a *Peziza* belonging to the form *Sclerotinia*, and nearly allied to *S. sclerotiorum.*

Sooty Mould of Citrus. — Mr. D. McAlpine † has determined the cause of the disease of various species of *Citrus* in Australia known as sooty mould to be a hitherto undescribed fungus which he names *Capnodium citricolum.* It is a polymorphic species, having Torula, Coniothecium, and Heterobotrys-stages. There are two different kinds of hyphæ—thin-walled, colourless or slightly coloured; and thick-walled, distinctly coloured. The colourless hyphæ produce conids, gemmæ, and glomerules; the coloured hyphæ produce conids and gemmæ, also spermogones, pycnids, and peritheces. The fungus is saprophytic, living on the sweet excretion from scale-insects, and its spread has been materially promoted by the destruction of honey-eating birds.

Mr. H. J. Webber,‡ on the other hand, attributes the "sooty mould" so destructive to the orange crop in Florida, to two species of Pyrenomycetes, *Meliola Penzigi* and *M. Camelliæ.* These fungi are also saprophytes, deriving their nourishment entirely from the honeydew secreted by certain insect pests, which the fungus invariably follows. The most destructive of these insect pests is the mealy-wing, or white fly, *Aleyrodes Citri*; and the author describes another fungus, *Aschersonia Aleyrodis*, which is parasitic on the larva and pupa of this insect. The principal reproductive bodies of the *Meliola* are conids, pycnids, stylospores, and peritheces.

Parasitic Fungi.—MM. E. Prillieux and Delacroix § find a disease of mulberry trees in European Turkey to be due to the attacks of *Sclerotinia Libertiana*, which forms sclerotes in the branches.

A parasitic fungus which attacks the stems of many cultivated orchids, is determined by M. M. Mangin ‖ to be *Glœosporium macropus.*

Under the name *Acremoniella verrucosa* sp. n., Sig. F. Tognini ¶ describes a parasitic fungus destructive of the haulms of wheat and oat.

Miss M. E. Olson ** has found a parasitic fungus on the leaves of *Selaginella rupestris*, belonging to the family Acrospermaceæ, which occupies an intermediate position between the Pyrenomycetes and the Discomycetes. It is named *Acrospermum urceolatum* sp. n.

Mr. H. T. Soppitt †† confirms his previous statement that *Puccinia Diagraphidis* developes its æcidioform only on *Convallaria majalis.*

Minks's Microgonids.‡‡—Dr. A. Minks makes a vigorous reply to Darbishire's criticisms on his theory of microgonids. He charges his critic with misrepresentation, with misinterpretation of observed phe-

* Gartenflora, xlvi. (1897) pp. 114–26 (1 pl.). See Bot. Centralbl., lxx. (1897) p. 166. † Proc. Linn. Soc. N.S. Wales, xxi. (1896) pp. 469–99 (12 pls.).

‡ Bull. No. 13 U.S. Department of Agriculture (Div. Veg. Phys. et Path.) 1897, 34 pp. and 5 pls.

§ Comptes Rendus, xxiv. (1897) pp. 1168–70. ‖ Tom. cit., pp. 1038–40.

¶ Rend. r. Ist. Lomb. sci. e lett., xxix. (1896) 4 pp. See Bot. Centralbl., lxx. (1897) p. 168. ** Bot. Gazette, xxiii. (1897) pp. 367–71 (1 pl.).

†† Zeitschr. f. Pflanzenkr., vii. (1897) pp. 8–10. See Bot. Centralbl., lxx. (1897) p. 200. ‡‡ Hedwigia, xxxvi. (1897) pp. 177–89. Cf. this Journal, 1895, p. 665.

nomena, and with the drawing of erroneous conclusions from insufficient experience.

Origin of Saccharomyces.*—Under the title What do we know about the origin of *Saccharomyces* ? MM. A. Klöcker and H. Schiönning again discuss the hotly debated question of whether there is a genetic connection between the Saccharomycetes and the Hyphomycetes, or whether typical Saccharomycetes are to be regarded as independent fungi. They made numerous experiments with *Aspergillus Oryzæ*, *A. glaucus*, *A. repens*, with *Dematium*, *Cladosporium*, with four species of *Penicillium*, &c., but in no case obtained *Saccharomyces*-cells. Similar results were obtained from observation made on mould fungi growing under natural conditions. The main conclusion arrived at is that the Saccharomycetes are not a developmental phase of some other fungus, but that, like Exoasceæ, they are independent organisms.

Pathogenic Blastomycete found in Carcinoma.†—Dr. D. B. Roncali publishes the results of a histological and bacteriological examination of an adenocarcinoma of the colon, with secondary deposits in the peritoneum. In the juice of the deposits were observed round and oval highly refracting bodies, branched hyphæ, and hyaline cells with double contour. Stained preparations of the juice gave evidence of Blastomycetes, and microscopical examination of a piece of tissue incubated for 56 hours showed that the Blastomycetes had increased in number. By treating masses of the highly refracting bodies with saturated solutions of caustic soda or potash, no effect was produced ; while in 4 per cent. hydrochloric or nitric acid they were dissolved without effervescence, and with 40 per cent. sulphuric acid needle-like crystals resembling those of gypsum were deposited.

Histological examination of the cancerous tissue revealed the parasites in astonishing numbers. By incubating some of the juice in a dilute acid solution of sugar, a Blastomycete was isolated in 47 out of 60 tubes. The parasite, which caused death in guinea-pigs in from 15–30 days, was recognised by the author as *Blastomyces vitrosimile degenerans*.

Herring-Brine Yeast.‡—The brine used for pickling herrings is, says Dr. C. Wehmer, unusually rich in living germs, the predominating organism in that used at Emden being a Blastomycete termed by the author *salt-yeast*. The organism was easily isolated and cultivated in gelatin containing 10 per cent. of salt, a quantity sufficient to prevent the growth of all fungi except *Penicillium glaucum*.

Morphologically the cells are spherical, oval, or elongated, invested in a delicate colourless membrane enclosing homogeneous or granular contents, wherein, according to age or other circumstances, may be observed a vacuole. The yeast was easily cultivated on solid or in liquid media without or with salt (3–15 per cent.). About eight millions of cells appear to be contained in each cubic millimetre of brine. Estimated by means of nitrate of silver, the Emden brine was found to contain 23–24 per cent. of salt. To a great extent cultural experiments confirmed the expectation that salt would, at least up to a certain per-

* Ann. de Micrographie, ix. (1897) pp. 233–50. Cf. this Journal, 1896, p. 339.
† Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 517–23.
‡ Op. cit., 2te Abt., 1897, pp. 209–22 (1 pl.).

centage, be favourable to the growth and multiplication of the yeast; for 10 and even 15 per cent. was found not to be deleterious. Besides this insensitiveness to the presence of salt, even in large quantity, this organism also possesses an unusual resistance to conditions extremely unfavourable to vegetation, such as exclusion of air, concentration of the medium, or the presence therein of alcohol or acetic acid. The exact source of the yeast is undetermined, though a marine origin is the most probable.

Morphology of Blastomycetes.*—In his researches on the morphology of Blastomycetes Dr. O. Casagrandi discusses at some length the membrane and the granules. The membrane is declared to be not a simple structure, but composed of two or more layers, both in the old and young ferments. Chemically the membrane is closely allied to pectin, and its principal characteristics are that it does not give the cellulose reaction with iodine; it is soluble in strong chromic and sulphuric acids; is insoluble in Schweizer's reagent, even if previously treated with hydrochloric acid, alcohol, or 2 per cent. acetic acid; and is only stained with difficulty by carminic or anilin dye solutions. The granules are represented as protoplasmic vesicles filled with a fatty substance which, according to the age of the cell, is liquid or solid. While these granules exhibit microchemical reactions proper to fatty substances, they also give some of the reactions indicative of proteid or nuclein. The latter are stated to be due to the investment, the former to the contents. With regard to the nucleus, the author expresses his certain belief in its existence.

Myxomycetes.

Pseudocommis Vitis.†—This Myxomycete, detected by M. Debray in the leaves of diseased potatoes, has now been observed by M. E. Roze in the hypodermal cells of the tubers, in the form both of plasmodes and of cysts. It attacks both the nucleus and the starch-grains. The author finds its occurrence very common in garden and greenhouse plants. The black and brown spots that indicate the malady known by gardeners as "burning" are due to the attacks of this parasite. It is often overlooked, owing to its very rudimentary structure, consisting of plasmode-like mucus, which becomes encysted in certain conditions. As long as this plasmode is in a living condition, it is able to escape, under favourable conditions, and infect other vegetable tissues.

The author further records the presence of this parasite in the leaves of *Elodea canadensis*, in the marine flowering plants *Zostera* and *Ruppia*, and in *Fucus serratus* and *vesiculosus*.

Protophyta.

a. Schizophyceæ.

Protophyta of the Norwegian Nordhavs Expedition, 1876-78.‡—Herr H. H. Gran's contribution to this publication includes the Diato-

* Il Naturalista Siciliano, ii. (1897) pp. 1-24.
† Comptes Rendus, cxxiv. (1897) pp. 704-5, 1109-11, 1470-2; cxxv. (1897), pp. 362-63, 410-11. Cf. this Journal, 1896, p. 215.
‡ Christiania, 1897, 36 pp. and 4 pls. (Danish and English).

maceæ, Silicoflagellata, and Cilioflagellata. After some general remarks, the species are described in detail. The Diatoms belong chiefly to the genera *Chætoceros* and *Coscinodiscus*. The modes of reproduction of *Chætoceros* are described in detail, and the species are arranged in two subgenera, Phæoceros, with thick, often spinous setæ, hollow, and filled with protoplasm and chromatophores; and Hyalochæte, with slender colourless setæ. There are a number of new species. The Silicoflagellatum found is *Distephanus speculum*; and the Cilioflagellata are *Ceratium tripos* and *C. fusus.*

Structure of Cyanophyceæ and Schizomycetes.*—After a detailed account of the researches and views of other observers on the structure of these organisms, Herr A. Fischer expounds his own views, which are in strong opposition on several points to those of Bütschli.

In the first place he contends that staining reactions are dependent on the physical rather than the chemical structure of the object; that, in particular, there is no true nuclear pigment; and that the staining properties offer no certain indication of the place of the object stained in any special group of proteid-substances, or of the morphological value of a cell-element.

The Cyanophyceæ possess a true parietal chromatophore, which is usually cylindrical; in it lies the so-called central body. This cannot be regarded as the phylogenetic ancestor of the nucleus of higher plants; it possesses no true chromatin; its granulations are simply collections of reserve-substances.

In the sulphur-bacterium *Chromatium* the pigment is not collected into a peripheral layer, but colours the cell-contents uniformly; there is no differentiation into a cortical and central portion. Neither in *Chromatium* nor in *Beggiatoa* is there any structure which can be regarded as a nucleus. The figment of a central nucleus is the result of plasmolysis. The bacterium-cell consists of a parietal layer of protoplasm, and an inner cell-sap-cavity which may be traversed by septa of protoplasm.

The author regards the Bacteria as more nearly allied to the Flagellata than to the Cyanophyceæ.

New Genera of Cyanophyceæ.—Under the name *Lœfgrenia anomala* g. et sp. n., M. M. Gomont † describes what he regards as probably the type of a new family of Nostocaceæ. The following is the diagnosis of the genus:—Planta myxophycea, filamentosa; trichomata evaginata, basi affixa, pilifera, in parte inferiori passim ramosa, ramificatione vera; heterocystæ nullæ; homogonia et sporæ usque adhuc ignota.

Among a large number of new species from tropical Africa, Messrs. W. and G. S. West ‡ find the following new genera:—

Camptothrix. Plantæ minutæ, filamentosæ et epiphyticæ; fila brevissima, haud ramosa, e serie singula cellularum irregularium formata, supra algas majores aquaticas repentia, irregulariter flexuosa et submoniliformia, vaginata; vagina delicata, arcta et hyalina; cellulæ sub-

* 'Unters üb. d. Bau d. Cyanophyceen u. Bakterien,' Jena, 1897, 136 pp. and 3 pls. See Bot. Centralbl., lxxi. (1897) p. 62. Cf. this Journal, *ante*, p. 235.

† Wittrock, Nordstedt, and Lagerheim; Algæ aquæ dulcis exsiccatæ, fasc. 26–9, Stockholm, 1896.

‡ Journ. of Bot., xxxv. (1897) pp. 264–72, 297–304 (1 pl. and 2 figs.).

globosæ, rotundo-quadratæ v. subrectangulares, apicem versus filorum minores, prope apicem filorum vaginis indistinctis v. destitutis; protoplasma pallide ærugineum et homogeneum.

The authors make this genus the type of a new family, CAMPTOTRICHEÆ:—Ordo novus Homogonearum Homocystearum. Fila brevia, vaginata, irregulariter flexuosa, extremitates versus attenuata, serie irregulari, singula cellularum intra vaginam unamquamque, cellulis haud uniformibus, vaginis delicatis et achrois.

Polychlamydum g. n. Vaginariarum. Plantæ aquaticæ; fila subbrevia (4–6 mm.), flexuosissima et sine ramis; vaginæ amplissimæ e serie tubarum concentricarum constitutæ, tubis interioribus firmissimis et coloratis, iis exterioribus hyalinis et plus minusve diffluentibus, apice aperto et leviter expanso; trichomata solitaria, nonnunquam 2 v. rarius 3 intra vaginam; apice trichomatis recto; cellulæ brevissimæ.

Proterendothrix g. n. Lyngbyearum. Plantæ minutæ, primum endophyticæ, tum epiphyticæ, fila solitaria v. 2–3 associata, brevia et simplicia; vaginæ achroæ, hyalinæ et amplæ, marginibus irregularibus; trichomata solitaria intra vaginam unamquamque.

β. Schizomycetes.

Sulphur Bacteria of the Hot Springs of Yumoto.*—Prof. M. Miyoshi found in the hot springs of Yumoto, in Japan, the following colourless sulphur bacteria:—*Thiothrix nivea*, and a new variety thereof, *Th. nivea* var. *verticillata*, the cells of which are from 2·5–3 μ long; also *Thiothrix tenuis* and *Beggiatoa alba*.

The following red sulphur bacteria are enumerated:—*Chromatium Weissii*, *Chr. minus*, *Chr. venosum*, *Chr. minutissimum*, and *Thioderma roseum* sp. n. The cells of the latter are spheroidal, 2·5 μ long and 1·5 μ broad, are of a pale red colour, and contain minute sulphur granules. It forms a thick red-purple scum, and is found on vegetable matter at 27° C.

It would appear that in quick-flowing streams the sulphur is deposited in amorphous granules or imperfect crystals, the tufts then being more white than yellow. When the current is slow the sulphur is deposited usually in longish rhombic octahedra, the tufts then being yellow. In the zooglœa-masses there are numberless sickle-shaped bacteria, associated with a greater or less number of other species; these have been already alluded to. Much attention was paid to the chemotactic sensitiveness of *Chr. Weissii*, which was found to be attracted by dilute solutions of H_2S, ammonium tartrate and phosphate, and potassium nitrate, while stronger solutions of these substances repelled these organisms. *Chr. Weissii* is somewhat sensitive to movement, and then often forms closely packed accumulations.

Iron Bacteria in Hot Springs at Ikao.†—Prof. M. Miyoshi has found that the muddy deposit in the chalybeate hot springs of Ikao consists of the remains or skeletons of iron bacteria, and chemically of iron oxide. Microscopically it is distinguished from ferruginous earth by the fact that the latter is of a dirty brown hue, is finely granular,

* Journ. Coll. Sci. Imp. Univ. Japan, x. (1897) pp. 143–73 (1 pl. and 26 figs.).
† Tom. cit., pp. 139–42.

easily suspended in water, and sediments with difficulty; the bacterial deposit being homogeneous, of a pale yellow colour, and of a fleecy-mucoid character. Microscopically the mud is seen to consist of bacterial cells, from 0·5–1 μ in diameter, straight or curved, of variable length, and of variable aggregation. The bacteria appear to have much in common with *Leptothrix ochracea*. The action of micro-chemical reagents (HCl and ferrocyanide of potassium) seems to indicate that the iron oxide is deposited not merely on the bacterial cells, but in their substance, and consequently that the muddy deposit is of purely bacterial origin.

Ginger-beer Plant.*—From fresh observations, Prof. H. Marshall Ward has now come to the conclusion that there are several distinct varieties of kephir and of other ginger-beer plants. In all cases the schizomycete *Bacterium vermiforme* appears to be concerned, but associated with different yeasts. An organism closely resembling kephir was found to be an aerobic bacterium capable of fermenting sugar to carbonic acid and some other organic acid. Very little yeast was present, and that apparently did not increase.

Bacterial Disease of Cotton.†—Mr. J. M. Stedman ascribes a disease which attacks the capsules of the cotton-plant to an undescribed microbe which he names *Bacillus gossypinus* sp. n. It consists of short straight rods abruptly rounded at the ends, 1·5 by 0·75 μ, usually solitary, sometimes in pairs, less often in chains of 3 or 4. The bacillus is motile, aerobic, forms spores, and does not liquefy gelatin. The disease does not make itself evident by external brown patches, as is the case with the anthracnose produced by *Colletotrichum Gossypii.*

Influence of the Röntgen Rays on Bacteria.‡—Prof. G. Sormani experimented with sixteen species of bacteria, most of which were pathogenic, for the purpose of ascertaining the effect of the X-rays. Broth cultures were exposed to the influence of the rays at a distance of 2–5 centimetres for periods varying from one to nine hours. After the procedure, the cultures were transplanted into new media, whereon they developed with quite normal characters. The pathogenic action of the exposed cultures was also found to be undiminished. The author concluded that the X-rays have no sensible effect on the cultural and pathogenic characters of the bacteria employed.

Resorption of Bacteria after Local Infection.§—Dr. J. Halban made experiments for the purpose of ascertaining how long bacteria take to reach the nearest lymphatic glands, and the circulating blood from the inoculation site, and also for ascertaining what histological changes arise in the lymphatic glands after the resorption of the bacteria. A general answer is returned to the first question. The time taken by the different species of bacteria to reach the nearest lymphatic glands varies with the bactericidal power of the alexins, being slower when the power is strong and quicker when it is weak. The time

* Ann. Bot., xi. (1897) pp. 341–4. Cf. this Journal, 1892, p. 524.

† Agric. Exp. Stat., Auburn, Alabama, Bull. No. 55, 12 pp. and 1 pl. See Bot. Centralbl., lxx. (1897) p. 35.

‡ Rendiconti Reale Ist. Lombardo, xxix. (1896) pp. 517–20.

§ S.B. K. Akad. Wiss. Wien, cv. (1896) pp. 349–452 (2 pls.).

bacteria take to reach the blood is also very variable, though it was fairly well ascertained that an infection of a bleeding wound may remain local for about 2½ hours (anthrax).

The chief histological changes were hæmorrhage, exudation of fibrin, hyperplasia, presence of leucocytes, pus-cells, and bacteria.

Excretion of Bacteria by the Animal Body.*—Dr. F. J. Cotton made a series of experiments on animals for the purpose of ascertaining under what conditions, at what time, and in what quantity, bacteria are excreted in the bile, and by the intestine after intravenous injection. The animals employed were rabbits, and the bacteria selected were *B. anthracis, subtilis, prodigiosus,* and *Pneumoniæ, Staphylococcus aureus,* and *Diplococcus pneumoniæ.*

Suspensions in bouillon of fresh agar cultures were injected into an ear vein, and the animals killed at various intervals. Cultivations were then made from the different secretions and viscera. From the results of his experiments the author concludes that certain bacteria, if present in large numbers in the blood, may be excreted by the bile without any perceptible changes having previously taken place in the liver or bile ducts, but the presence of large numbers of bacteria in the bile is almost necessarily associated with pathological changes. So too with regard to the intestine and the urine, the presence of bacteria in their case is evidence of pathological changes in the intestine or in the urinary tract.

Pathogenic Water Bacteria.†—The most prominent feature of Prof. H. M. Ward's report on the bacterial flora of the Thames is that many river bacteria are pathogenic or become so on culture, and that pathogenicity, like other characters, is variable. The author's work includes the consideration of some eighty forms, which for investigation purposes are aggregated into groups. Each of the groups contains a type, which is regarded by the author as probably a species of which the other forms included are varieties. The massing into groups was the outcome of finding that slight extrinsic and intrinsic changes, i.e. alterations in the cell or its environment, were immediately followed by distinct and often marked variations in the colonies and inferentially in the individual cells, and that characters derived from the behaviour of colonies are not sufficient for the determination of species. The report also points out that the effects of definite changes in the environment on the media and on the growing organism are important, and that this importance is not sufficiently recognised.

Micrococci of Malaria.‡—Dr. L. Facciolà describes appearances which he has observed in the blood of malarious persons, and depicts these appearances very copiously. The bodies observed vary considerably in size and shape, and from the illustrations have nothing in common with Micrococci except the name.

Plague Bacillus.§—From observations made during an epidemic of plague in Formosa, Prof. M. Ogata thus summarises his results. In the lymphatic glands of plague patients, and in the organs and blood of

* SB. K. Akad. Wiss. Wien, cv. (1896) pp. 453–512.
† Proc. Roy. Soc., lxi. (1897) pp. 415–23.
‡ Atti Soc. Toscana Sci. Nat., xv. (1897) pp. 220–9 (84 figs.).
§ Centralbl. Bakt. u. Par., 1[te] Abt., xxi. (1897) pp. 769–77.

plague corpses, there can be constantly found a bacillus which reproduces in animals a disease closely resembling plague. In the blood of plague-patients the presence of the plague bacillus is not constant. It may be often found in the urine and bile of plague corpses. Insects, such as the flea and mosquito, are capable of transporting it. It is constantly present in the blood and viscera of rats naturally or artificially infected with plague. Fleas found on plague rats often contain virulent plague bacilli. The blood, lymphatic glands, and other organs of plague patients and corpses, may contain various other bacteria as well as plague bacillus. The plague bacillus is but little resistant to antiseptics such as 5 per cent. carbolic acid, one per thousand sublimate, or even strong lime-water. Direct sunlight killed an agar-culture after an exposure of four hours. Inoculation experiments on animals seemed to show that the soil of plague-districts was not infected.

Spirillum Maasei.*—Dr. H. J. van't Hoff isolated from the Rotterdam Waterworks a choleroid organism which has the following characters:—It has two or more turns; it liquefies gelatin with extraordinary rapidity, and the colonies are round and transparent. Milk is not coagulated, nor bouillon acidified. On liquid medium a scum is formed sooner or later. There is no gas production. The indol reaction is quite like that of cholera. The spirilla are short and thick, 1–1·15 μ; these have one or two flagella, and are mobile. The spirillum is virulent to guinea-pigs.

Septicæmia of Calves.†—Prof. M. Thomassen describes a new septicæmia of calves which is associated with nephritis and urocystitis. The disease, which lasts about five or six days, is marked by considerable enlargement of the spleen, and by parenchymatous nephritis and cystitis. From the blood, the peritoneal fluid, and from various organs, a bacillus closely resembling in appearance the bacillus of typhoid or *B. col. com.* was isolated. From the latter it is distinguished by its great mobility, by its moist-looking growth on potato, by its slow growth on gelatin, by almost negative production of indol and carbonic acid, by its inability to ferment lactose and to coagulate milk, and by the absence of a disagreeable odour when cultivated in pepton-bouillon or on gelatin. From the bacillus of typhoid it is distinguished by the serum reaction; for although typhoid serum agglutinates the bacillus of calves' bacteriæmia, the agglutination effect is much less strongly marked, and is different in character.

Two Chromogenic Microbes from the Mouth.‡—Dr. Árpád R. v. Dobrzyniecki describes two micro-organisms found in the mouth:—(1) *Micrococcus latericeus* is about 1 μ in diameter, is devoid of movement, and has no special arrangement. It grows slowly in bouillon, the medium becoming cloudy, and after 2–3 days a granular brick-red sediment appears at the bottom of the culture-vessel. On gelatin plates rose-coloured colonies develop. The gelatin is not liquefied. On agar a similar growth develops. The micrococcus is easily stained, and is not pathogenic. (2) *Bacillus luteus* is found in carious teeth. It is a

* Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 797–8.
† Ann. Inst. Pasteur, xi. (1897) pp. 523–40.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 833–5.

rodlet about 1·5 μ long. In bouillon a yellow deposit is noticeable in 2–3 days. On gelatin which is not liquefied the growth is yellow. On agar, albumen, and potato the growth is also yellow. The bacillus is easily stained, and is not pathogenic to animals.

Micrococcus Ghadiallii.*—Dr. Ghadially has discovered a coccus which has the power of slowly destroying the enteric fever microbe in water and milk, and to some extent in bouillon. It also seems to have some power of destroying the *Bacillus coli communis* in water. The enteric fever microbe in water and milk died out within 24 hours after inoculation with *M. Ghadiallii.* Pains were taken in these experiments to acclimatise the enteric microbes before the micrococcus was added.

Agglutination of Bacillus typhosus by Chemical Substances.†—M. E. Malvoz records some interesting experiments made with certain chemical substances on cultures of the bacillus of typhoid.

Formalin, corrosive sublimate, oxygenated water, and alcohol, all produce well marked agglutination. With these substances concentration is an important feature, while with safranin and vesuvin the reaction obtains with very dilute solutions, one per thousand being sufficient to produce clumping of the bacteria. Salicylic acid and permanganate of potash were found to possess a slight agglutinating action. Caustic soda and ammonia mixed with a hard water have strongly agglutinating action, but not when mixed with distilled water.

As might be expected, the addition of a little safranin solution to a normal serum not possessing an agglutinating power readily imparts this property. The agglutinating property of these chemical substances was used by the author to distinguish the typhoid bacillus from *B. coli communis.* For this purpose formalin is especially effective; for with the typhoid cultures the bacilli are agglutinated into clumps, while the colon bacilli are immobilised and isolated. Safranin gives very similar results. From further experiments made after washing off the outer layers of the bacteria, it would seem that the ciliated envelope is responsible for the phenomenon of agglutination.

Bacteriology of Ambergris.‡—Ambergris, says M. H. Beauregard, is an intestinal concretion developed in the rectum of the Cachalot, and is composed of ambrein crystals, mixed with a greater or less quantity of black pigment. When fresh, the mass is rather soft, and has a highly stercoraceous odour which disappears with lapse of time. From one of the nuclei, of which these intestinal calculi are aggregations, cultivations on various media were made. Two tubes were fertile, one of gelose and one of bouillon. From these cultures was isolated a microbe, morphologically closely resembling the bacillus of cholera. This micro-organism, *Spirillum recti Physeteris,* has the following general characters.

The microbe is extremely polymorphic, presenting itself as straight rodlets or spirals according to the cultivation medium. It is extremely mobile. It varies in length from 1·4 to 4·2 μ, and in breadth from 0·5 to 0·8 μ. It is easily stained, but is decolorised by Gram's method.

* Brit. Med. Journ., 1897, ii. pp. 418–9.
† Ann. Inst. Pasteur, xi. (1897) pp. 582–90.
‡ Comptes Rendus, cxxv. (1897) pp. 254–6.

The optimum temperature is about 37°, and in bouillon it forms a pellicle on the surface of the medium.

The existence of this microbe affords some support to the notion that calculi may have a microbic origin.

Fate of the Tetanus Toxin.*—Dr. A. Marie, after pointing out that if tetanus toxin be injected into a vein it requires a dose 7 or 8 times greater to kill an animal than if injected under the skin, explains that this toxin is easily and effectively carried to the central nervous system along nerve-paths. If injected directly into the circulation, the poison is materially altered by the cells and plasma of the blood. Experiments made for the purpose of discovering what becomes of tetanus toxin, show that the toxin, when injected into animals, remains in their blood for a variable time, and when the time is past, inoculations from the organs and from secretions of glands do not excite tetanus. The author mentions that frogs were easily tetanised during winter when the water oscillated between 13° and 18° C., by injecting the toxin or cultures. With 0·5 milligram, the symptoms appear between the 18th and 25th day, and with 6 milligrams on the 9th to 15th day.

Staphylococcus hæmorrhagicus.†—Dr. E. Klein describes a coccus pathogenic to man and animals, isolated from a vesicular eruption, on the hands of persons who had been skinning sheep dead of "gargle" a few days after lambing. The coccus belongs to the group which comprises *Staph. pyogenes aureus*; it is 0·4–0·6 μ in diameter, and grows freely on all the ordinary media. It slowly liquefies gelatin, and coagulates milk in about a week. Alkaline broth rapidly becomes turbid, and its reaction acid in from 2 to 4 days. On agar and gelatin the growth is whitish, becoming somewhat yellow with age and increasing size. Cultures of this coccus were virulent to guinea-pigs and sheep, the chief morbid phenomena being a hæmorrhagic œdema of the subcutaneous and muscular tissues, and the presence of sanguinolent fluid in the peritoneal sac. Inoculations of the agar culture which proved fatal to sheep gave positive results on the author's hand.

Nitroso-Bacterium with new Growth-Form.‡—Dr. W. Rullmann describes a nitrite-forming bacterium which, cultivated on nitrite-agar, presents itself as thick, anisodiametric rodlets. It is devoid of movement and of flagella.

Nitroso-bacterium formæ novæ, when grown on gelatin, develops into filaments of greater or less length. The individual links are short rodlets with very marked polar staining, and much the same size as when grown on agar. If transferred to nitrite-agar or to liquid inorganic media, there appeared in the course of a few days forms exhibiting simple and branched processes. When retransferred to ordinary media the rodlet shapes reappeared. The processes, after an incubation period of four days at 37°, were observed to develop from one pole, the other pole becoming expanded or bulbous. At 22° the processes appeared on the sixth day. On the solid medium the processes were simple, in the liquid nutrient inorganic fluid only were they branched. That these

* Ann. Inst. Pasteur, xi. (1897) pp. 591–9.
† Brit. Med. Journ., 1897, ii. pp. 385–7.
‡ Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 228–31 (1 fig.).

processes are not flagella is obvious from their being easily stained; that the organisms are non-motile, from the branchings, and also from their being of the same thickness throughout. It is suggested that these outgrowths are to be regarded in the light of organs for taking up oxygen, which thus aid in the nitrification process.

Pseudo-Tuberculosis Hominis Streptotricha.*—Dr. S. Flexner gives a brief account of a bacteriological find in the lungs and peritoneum of a negro who died with symptoms of tuberculosis. The lungs were consolidated and breaking down; while on the peritoneum, in the liver and in the spleen were nodules resembling tubercles. Cover-glass preparations showed no microbes resembling the *Bacillus tuberculosis* in their morphology. Cultures from different sites were negative, both as regards *B. tuberculosis* and the fungus found in the lungs. This organism was a branching one, often occurring in clumps or in convoluted masses among which no ordinary bacillary forms were discovered. From the lesions in the lungs and peritoneum, and from the intimate relation of the masses of *Streptothrix* to the pathological process, and also from the symptoms resembling those of phthisis florida, the organism is designated *pseudo-tuberculosis hominis Streptotricha.*

Flavour-producing Micrococcus of Butter.†—Mr. S. C. Keith has isolated a micrococcus which produces a decided butter flavour and aroma when grown in milk or cream, and to this new species the name *M. butyri-aromafaciens* is given. The general characters of this coccus are that it occurs usually in pairs; it is 0·5–1 μ; is not motile; grows well at 37° and at 20°; is aerobic and liquefies gelatin slowly. On agar the growth is white and abundant. It does not coagulate milk, but imparts to it a slightly sourish pleasantly aromatic buttery flavour. The reaction of the milk is acid. It does not produce gas in Smith's medium; it does not grow well on potato; it renders bouillon turbid, forming at 37° a surface growth. It reduces nitrates to nitrites.

* Bull. Johns Hopkins Hosp., viii. (1897) pp. 128–9.
† Technology Quarterly, x. (1897) pp. 247–8 (2 figs.).

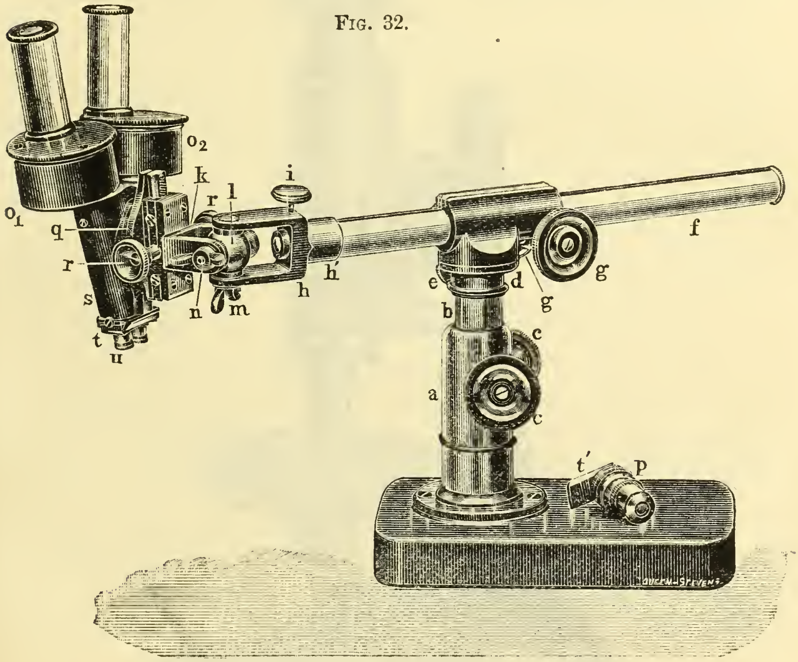
MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Preparation and Horizontal Binocular Microscope.† — Drs. L. Drüner and H. Braus describe an improved form of their binocular Microscope which has been especially useful for the dissection of nerves and muscles. The present improved stand (fig. 32), also made by Zeiss,

Fig. 32.



enables the optical portion of the instrument to be placed in any desired position, this being for the purpose of facilitating the dissection of large surfaces, and, when the Microscope is placed horizontally, for observing the movements of small organisms through the vertical sides of aquaria.

The optical portion may be moved with respect to the fork *k* by the rack and pinion *r*. The forks *k* and *h* are connected by a ball-joint *l* supplied with the necessary clamps; the whole of this rotates with the collar *h'* about the horizontal rod *f*. This rod has a longitudinal motion

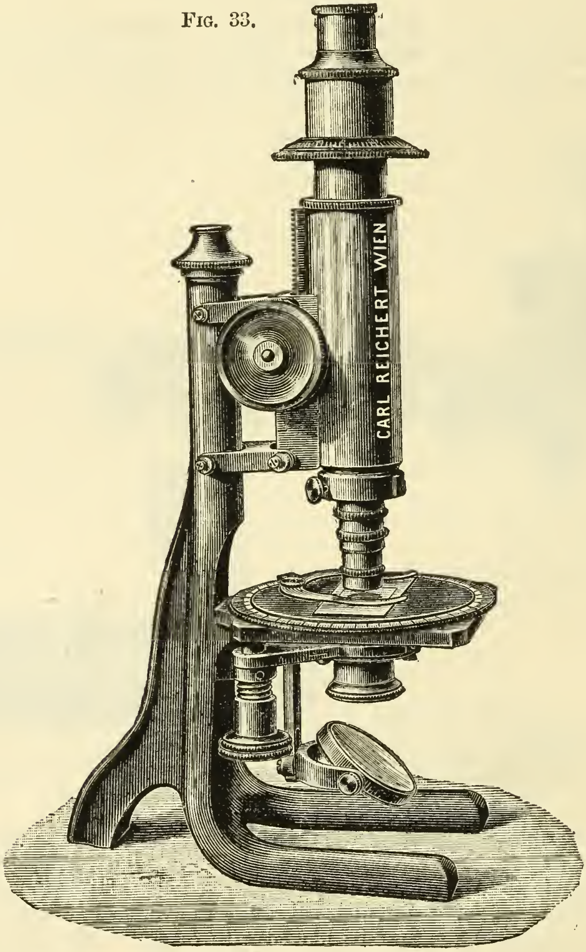
* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 5–10 (2 figs.). Cf. this Journal, 1895, p. 580.

by means of the rack and pinion *g*, a vertical motion by the rack and pinion *c*, and it can be rotated in a horizontal plane with the collar *d*.

The two erecting oculars o_1 and o_2 are carried eccentrically, so that they can be accommodated to the distance between the eyes. The two objectives slide into grooves *t*. With the various oculars and objectives

Fig. 33.



supplied with the instrument, amplifications of 6·5 to 48 are obtained. For use as a monocular, one of the tubes may be brought parallel to the rack by means of the turn-plate *q*.

New Stand.*—Herr C. Reichert describes the new stand (No. VII *b*) shown in fig. 33, which forms a cheap instrument for mineralogical and

* Zeitschr. f. angew. Mikr., iii. (1897) pp. 74–5 (1 fig.).

geological purposes. The foot and column are cast in one piece, so that the instrument can safely be held and carried by the upper portion. Roberval's micrometer-screw is used for the fine adjustment, this being an advantage in small, though not in large, stands. The usual accessories for parallel and convergent polarised light are added.

Method of Using the Microscope.*—Mr. N. A. Cobb describes, in the following terms, an apparatus which he has found useful in the application of the Microscope to agricultural inquiries:—

"The apparatus I have to describe has been so very useful to me that I cannot but think it will be also useful to others in this and other countries, engaged as I am on the various scientific problems presented by agriculture; and if it turns out useful to them, even the farmer, who looks upon this technical article as of no service to him, will—whether he knows it or not—be indirectly benefited.

"This method of mounting and using a Microscope is one that has been gradually perfected through almost daily use since 1888. I have frequently been asked to publish the details, and have so far refrained from doing so only because I found that on each new Microscope mounted I was enabled to make a number of improvements; and so long as this was the case, any description would soon be antiquated, and so become—to me, at least—only a source of annoyance. On no less than ten separate occasions has this device been remodelled to suit differing circumstances, and it now stands in five laboratories under my supervision, viz. Sydney, Moss Vale, Wagga, Bathurst, and Pymble.

"The following is a key to the illustration (fig. 34):—

a a a, architrave of a window facing the sun.

b b b, 1/4-in. runners, 4 in. wide, in which the blind *d* slides.

c c, runners for the arm *j*, which carries the camera *m*.

d, perfectly opaque blind, made of American leather or enamelled cloth running on a spring roller at the top of the window. By raising this blind the whole apparatus may be flooded with sunlight if necessary.

e, a 1/4-in. board, 8 in. wide, hanging in an inch-deep slot in the board *f*, and riveted to the blind *d*, and hence rising and lowering with the blind. This board *e* slides in the runners *b b b*.

f f, an inch board, 8 in. wide, fitted to the side of the window and receiving the board *e*, into a median slot 1/4 in. wide, and 1 in. deep in its upper edge.

g, two sliding pieces of thin ebonite, placed one behind the other, each with a diamond-shaped opening cut out in the middle. By sliding these ebonite shutters, the opening *h* can be made of various sizes.

i i, the runners in which the two ebonites *g* slide. Behind the ebonites an elongated opening is cut in the board *e*, and this opening has a ground glass sliding over it in runners similar to *i i*, but fastened to the back side of *e*. All these latter appliances are for the purpose of varying the amount and character of the light coming through the diamond-shaped opening *h*.

j, wooden arm, 1 in. thick and 3 in. wide, carrying the micro-camera *m*, and sliding in the ways *c c*, capable of being clamped by the set-screws *w*. Any position of *j* may be recorded by means of scales marked on *c c*.

k, photographic plate-holder, half-plate size, as used on an ordinary tripod camera.

l, frame into which the slide *k* is pushed, in construction similar to the back of an ordinary tripod camera.

m, leather bellows of micro-camera, capable of extension to four or five feet.

* Reprint from Agric. Gaz. N.S. Wales, March 1897.

n, wooden front or head of camera, into which the barrel of the Microscope fits. This head is hollowed out, and carries a light ebonite shutter, actuated from the outside, by means of which the exposures are made. The wire lever actuating this shutter is shown as a dotted white line near *n* (see also fig. 35).

o, mirror of the Abbe camera lucida.

p, barrel of the Microscope.

q q, vertically sliding tables, the right-hand one being used as a drawing-board when the camera lucida is in use. Being adjustable, various magnifications can be secured. The higher *q* is placed the less magnification the drawing will show. A scale drawn on the architraves enables any position of *q* to be registered. The left-hand table is similarly adjustable, and is usually kept on a level with the Microscope stage. Both these sliding tables are cut away to suit the observer's body resting on the stool *v*. Both are braced so as to be quite rigid under the weight of the arms in drawing, &c.

r, head into which the foot of the Microscope is firmly clamped by means of easily removable wooden wedges.

s, pillar bearing the Microscope, preferably of iron and planted in cement beneath the building, and coming through the floor without contact with the building. If this is not feasible, *r* may be fixed to the window-sill. In three of my laboratories the ways *c c* are fixed to iron or wooden beams, also planted in the earth and coming through the floor without contact, thus making a very perfect arrangement for long photographic exposures with high powers where all tremor must be avoided.

t t, halves of wooden hand-clamps of large size (15 in. long and 2½ in. square). grooved to slide in the ways *u u*, and carrying the well-braced tables *q q*.

u u, two wooden table-ways, firmly fastened to the side of the building.

v, stool.

w, set-screw, to clamp the camera in position.

x x, four set-screws, to clamp the tables *q q* in position.

y, opaque cloth, sewed on to a rectangular opening cut in the board *f* to admit the light to the mirror of the Microscope. Slots to hold coloured glasses are arranged on the back side of this opening, to furnish monochromatic light for photography, &c. The various substage adjustments can be worked through the cloth, which, however, can be lifted in a second when necessary.

"After having made the different features of the drawing (fig. 34) clear, it will only remain to explain some of the advantages of this system of utilising the Microscope. Having used the Microscope for purposes of investigation almost daily for nearly twenty-five years, I feel justified in calling particular attention to opinions based on such extensive experience.

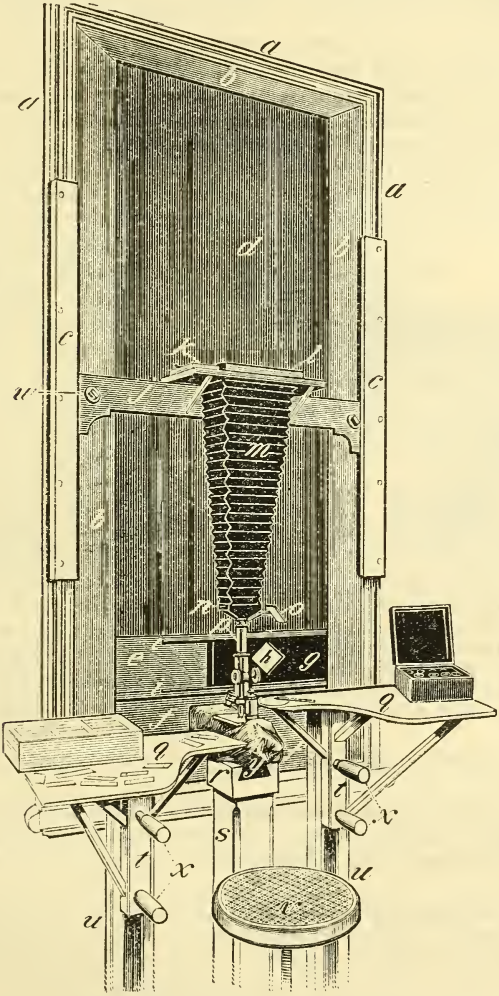
"The apparatus is adapted to the best of all lights—daylight. The perfection of the image as formed on the retina of the eye is very great; for if the room be darkened, and the blind *d* be closed, no light but that from the Microscope enters the eye. Few, even among experts, according to my observations, realise the evil effects of extraneous light when observing with the Microscope. Those who do realise this evil are usually found advocating the use of artificial light by night so as to avoid the evil. Here is a way to avoid it and still keep to the use of daylight. It need scarcely be pointed out that the cloth *y* is for the purpose of excluding extraneous light.

"The window faces the sun, so that, whenever it is desired, by simply raising the blind *d*, sunlight can be obtained on the top of the stage as well as under it.

"The whole apparatus is quite rigid.

"The arrangement for drawing with the camera lucida is of a high degree of perfection. I am often struck with the complication of the

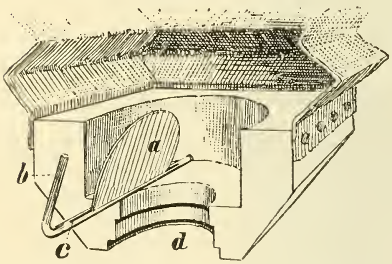
FIG. 34.



Perspective view of Microscope mounted for purposes of investigation by daylight. Dimensions may be gauged by the diameter of the top of the stool *v*, which is 1 foot.

various more or less expensive devices (always more or less imperfect too) attached to the camera lucida as now made, and having for their object the graduation of the light, so as to equalise the lights coming from the object and the drawing-paper respectively. This object is usually accomplished by inserting between the drawing-paper and the eye a glass having the correct neutral tint. It is usually found that the exact tint required cannot be obtained, either because the properly tinted glass has been lost or broken, or never existed. In any case, such glasses are in the way, and can only have been regarded as a necessary evil. In the system here described, the light coming through the Microscope is first graduated so as to be as perfect as possible, then the diamond-shaped opening *h* is set so as to exactly equalise the lights coming from the Microscope and from the drawing-paper located on the circle under the pencil shown in the illustration. This can be done in an instant and with the utmost precision. The ground glass behind *h* serves to destroy the image of outside objects which are formed when the aperture *h* is reduced in size. The difficulty of using the camera lucida with very high powers is well known. With this system there is no difficulty; whatever can be clearly seen can be drawn.

Fig. 35.



Section of head of Microscope-camera, one-half size—*a*, vulcanite shutter; *b*, arm or lever for opening and shutting the shutter *a* (this arm is outside the head); *c*, slot into which *a* is set; *d*, rabbited opening into which the draw-tube of the Microscope fits in a light-tight manner.

"When the left-hand table *q* is arranged on a level with the Microscope stage, the moving of objects on to and off the stage is conveniently accomplished.

"The sliding adjustment of the drawing-board or table (right-hand *q*) will commend itself at once to anyone who has used a camera lucida. Already a number of patents exist on this head, but all that I have seen are lacking in stability and convenience. Here, however, the artist may lie stretched at ease, and, having so adjusted the drawing-board as to secure the desired magnification, can work with comfort and with great precision.

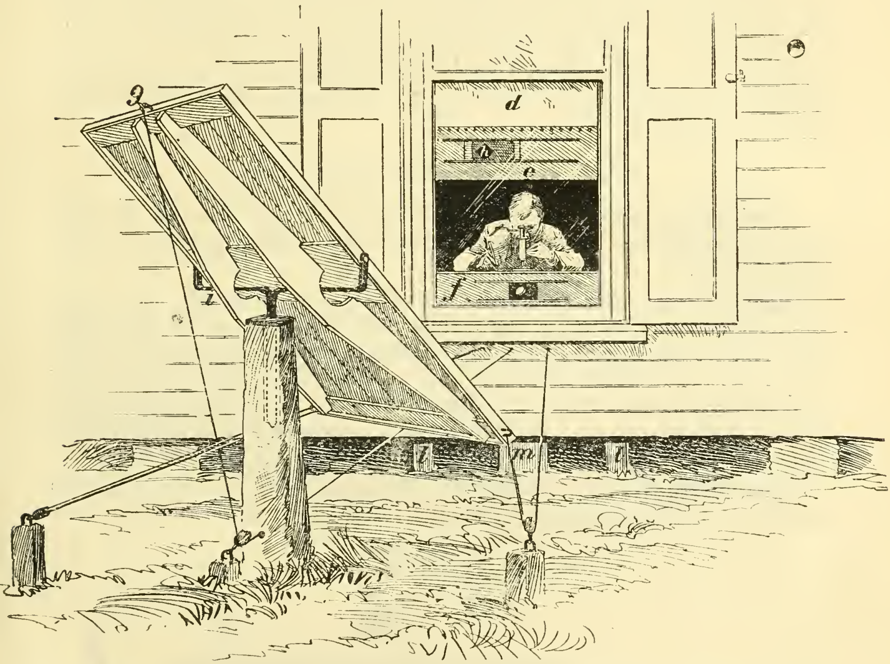
"The nice working of the fine adjustment is facilitated by the fact that the ball of the hand may at the same time rest on the table.

"The Microscope can be clamped in position, and is movable within limits.

"The photographic camera is in readiness for instant use, and is as rigid as possible. Being arranged on a vertical system, it is most convenient. Few, I imagine, having once fairly tried a good vertical system, will ever revert to any other. Its advantages are obvious. For instance, the stage remaining horizontal, the object does not tend to float and get out of focus; liquid backing on the plate does not flow; the focusing can be most easily and accurately done, especially when the ground glass is dispensed with, and a lens used instead; the bellows never bothers by sagging when long drawn out; and so forth, and so forth. My whole apparatus is made as low as possible, so that in focusing on the ground glass at *l* it is only necessary to stand up. If the camera has to be extended to 5 feet, it will be necessary to provide steps, as *l* thus comes up above the head of the standing operator. The focusing lens can rest on the ground glass, or swing on a vertical pivot fastened into the frame *l*, or be carried on a rack-stand resting near *k*.

"For long focusing, when it is inconvenient to reach the fine adjustment with the hand, I use a stick, the end of which carries a piece of metal

FIG. 36.



Back view of white screen having universal movements; *d, e, f,* and *h*, same as in fig. 34—that is: *d*, opaque blind; *e*, 1/4 in. board, 8 in. wide, attached to *d*, and rising and falling with it; *f*, 1 in. board, 8 in. wide, top of which is slotted to receive *e*; *h*, the same diamond-shaped opening shown in fig. 34; *g*, top of screen; *i*, forked wrought-iron spindle, shown black, except where it enters the post—the dots show its continuation; *l l*, uprights imbedded in the ground and passing up into the building without touching it, and supporting the Microscope-camera above the operator's head; *m*, pillar supporting the Microscope, imbedded in the ground, and passing up into the building without touching it. The cords and pulleys are for the purpose of moving the screen from inside the building. The small mirror mentioned in the text is placed on the front of the screen near *g*.

that fits into a slot filed in the top of the fine adjustment screw. When the adjustment is secured, the stick is removed. This convenient arrangement has often enabled me to take photomicrographs with great rapidity.

"The pillar *e* forms a model support for a dissecting stand, the tables *q q* being then placed at equal heights to serve as arm-rests.

"The light is obtained from a white screen, having universal movements, placed outside in the sunlight, and workable from the interior by means of cords and pulleys. The screen is a broad frame covered with bleached sheeting. On one end of the screen is a small mirror, so fastened as to indicate, by the sun's reflection, when the screen is reflecting the maximum amount of sunlight. This light reflected from the screen is superior to the proverbial white cloud, and eclipses any artificial light.

"I feel sure that, in the right hands, the appliances I have here described, if patented, could be made a source of profit; and the moral right to so use them is hereby freely given to whomsoever chooses to accept.

"It is with much pleasure that I acknowledge the aid, during the last few years, of Mr. E. M. Grosse in executing a number of the details of this system of using the Microscope. The accompanying illustrations are from his hand."

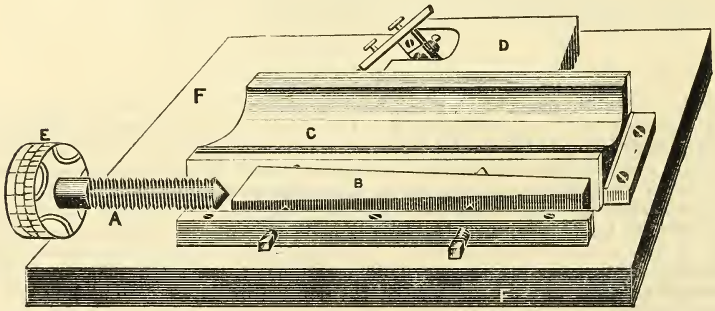
(3) Illuminating and other Apparatus.

Projection Lantern.*—M. H. Möhlenbruck describes an ordinary form of projection lantern for showing microscopic preparations and photographs.

Light-Filters and Colour-Screens.†—Dr. A. C. Stokes points out the unsatisfactory nature of the ordinary coloured glasses and fluid-cells. The best he has used is Clifford's malachite-green screen, but for continual use the light of this is trying to the eyes. For general use the author has a particular kind of blue glass (from Lovibond's tintometer) coated with a layer of "Walpole green" cement; this is pleasanter to the eyes, but does not give so good a definition as the Clifford screen.

Simple Machine for Micrometer Rulings.‡—Mr. D. W. Smith has devised a simple inexpensive machine for producing fine rulings, up to

FIG. 37.



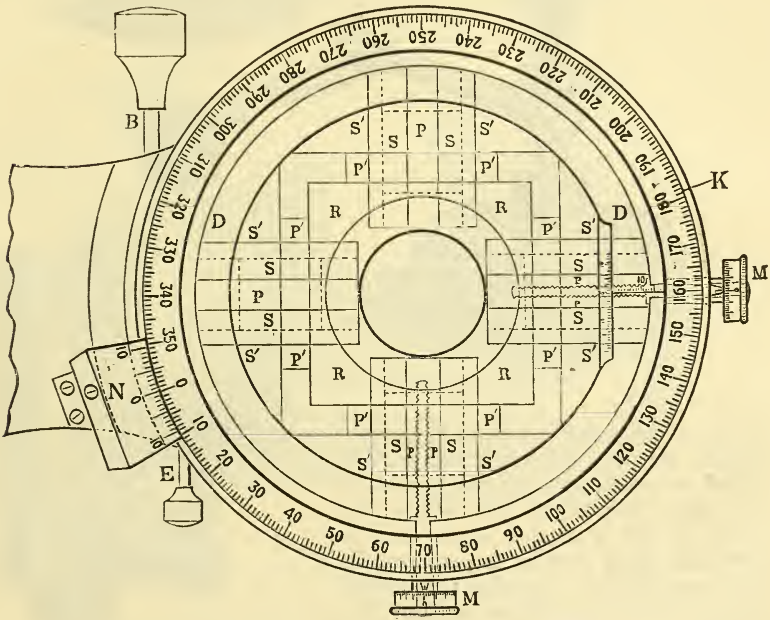
thirty or forty thousand to the inch, on glass. The micrometer-screw A (fig. 37), with graduated head E, imparts a longitudinal motion to a metal wedge B, which, for each turn of the screw, gives a lateral motion

* Arch. Sci. Phys. et Nat., iii. (1897) pp. 590-3.
† Journ. New York Micr. Soc., xiii. (1897) pp. 56-63.
‡ Tom. cit., pp. 53-5 (1 fig.).

of 1/1000 in. to the metal block C. The diamond-carrier D, which is worked to and fro by hand, is kept in contact with the block C by springs. The working surfaces are formed by slips of plate-glass. The necessary clamps and springs are not represented in the figure.

Covered Rectangular Motions for Stages.* — Dr. R. Brauns describes an improvement on the usual rectangular stage-motions when used

FIG. 38.



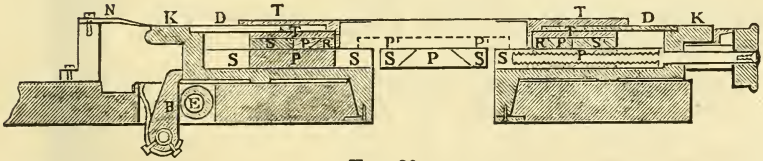


FIG. 39.

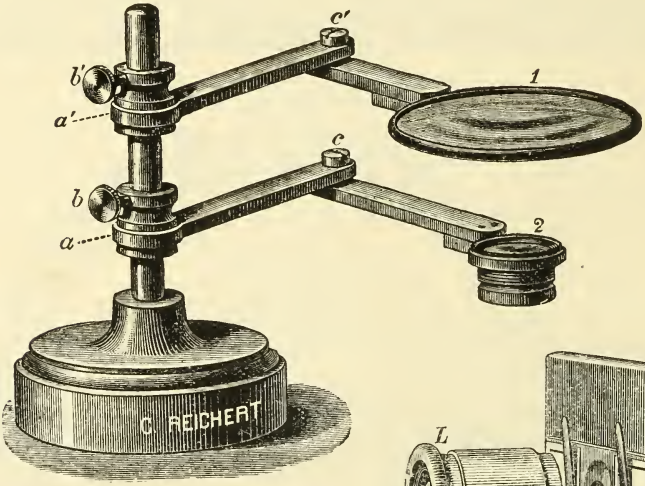
in connection with a graduated circle. The ordinary forms, in which the rectangular motions are above the circle, have the disadvantage of the graduations being often partly hidden and shadowed by the screws and slides; the mechanism is further unprotected from dust and reagents.

To the base-plate of the circle K (fig. 38) eight guides S are fixed, and between these the four prisms P move. To the last are fixed the

* Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 11–3 (2 figs.).

four prisms P′ which move between the prismatic edges of the frame R and the four guides S′. The frame R is fixed to the stage T, and to

Fig. 40.



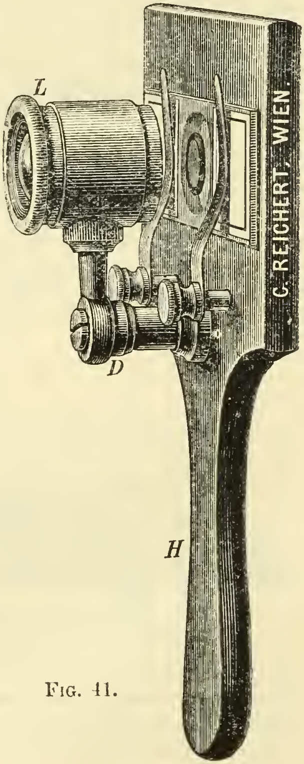


Fig. 41.

it the rectangular movements are imparted by the micrometer-screws M which work in two of the prisms P. All this mechanism lies within the body of the graduated circle, and is protected from dust by the annulus D. The eccentric E clamps the circle, and B is the fine-adjustment of the same.

The same arrangement can also be used with non-rotating stages. It is made by R. Brunnée, of the firm Voigt and Hochgesang, of Göttingen.

Lens-Support for Examining Seeds.* —Herr C. Reichert briefly describes the lens-support shown in fig. 40, which has been made according to the designs of Dr. von Weinzierl for the examination of seeds. The arms *c* and *c*′, carrying low-power lenses, are capable of horizontal and vertical movements, and are supported on a heavy base.

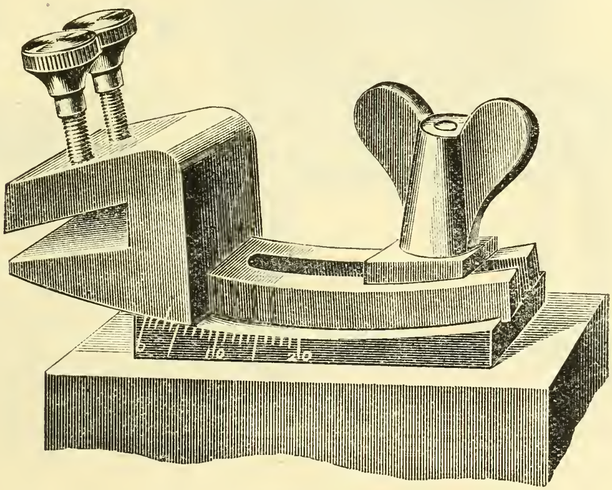
The lens-support shown in fig. 41 is mentioned here. The lens slips

* Zeitschr. f. angew. Mikr., iii. (1897) pp. 72–3 (2 figs.).

easily into a sleeve which is carried on the movable arm D, this being fixed, with the object-clips, to the ebonite hand-frame H.

Knife-Holder for Microtomes.*—Dr. R. Hesse describes a knife-holder (fig. 42), with which it is possible to vary the inclination of the knife from the horizontal position. The sliding arc has a radius of 15 cm. The graduations at the side are millimetres, 1 mm. corresponding to a movement of 0·8° of the knife. The holder is made by R. Jung, of Heidelberg.

FIG. 42.



(4) Photomicrography.

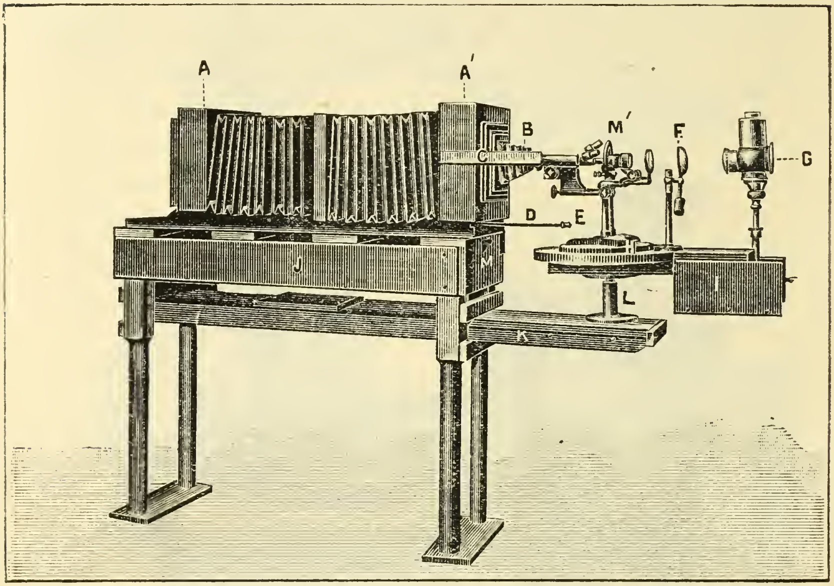
Systematic Photomicrography.†—Mr. J. B. Shearer points out that the time of exposures, &c., in photomicrography depends too often on guess-work, and suggests a systematic keeping of records of exposures which have been successful, in order to serve as a guide in future cases where the conditions are more or less similar. For this purpose he has had printed a book of forms to be filled in with the details as to lenses used, distances of the light and photographic plate, time of exposure, colour of object, &c.

The apparatus used by the author consists of a turntable L (fig. 43) carrying the Microscope, Welsbach lamp, and bull's-eye condenser. After the light, &c., has been arranged, the turntable is swung round, and the Microscope-tube is inserted in the camera front. The image is focused from the back of the camera by a rod D, which passes the whole length of the camera-bed and actuates a band passing over the fine adjustment of the Microscope. For the illumination of opaque objects, the lamp can be moved with respect to the Microscope. An arrangement, in

* Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 13–5 (1 fig.).
† Trans. Amer. Micr. Soc., xviii. (1897) pp. 117–130 (5 pls.).

which the body of the Microscope is vertical, for photographing objects in liquids, is figured. The procedure of developing the photographic plates is described.

Fig. 43.



B. Technique.*

(1) Collecting Objects, including Culture Processes.

Plankton-Methods.—Prof. J. Frenzel † discusses at some length the merits and demerits of the silk-gauze net. Even the details of the blocking of the gauze come to have importance in exact quantitative estimates of the Plankton. He recommends repeated use of hot water for cleaning the net, which he regards as fully useable when it remains constant in hot water.

Prof. V. Hensen ‡ also discusses the use of the silk-gauze net. To free it from adhering particles which tend to close the pores, the best plan is to rub it under water with a bath-sponge. This is much better than boiling, which Frenzel recommended.

Medium for differentiating the Bacillus typhosus from Bacterium coli commune.§—Dr. K. Kashida recommends the following medium for easily distinguishing between *Bacterium coli commune* and the bacillus

* 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.

† Biol. Centralbl., xvii. (1897) pp. 364–71. ‡ Tom. cit., pp. 540–42.

§ Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 802–4.

of typhoid fever :—A 1·5 per cent. agar solution, made by dissolving the agar in bouillon, is first prepared. This is then cleared up, strained, and filtered. To the filtrate are added 2 per cent. lactose, 1 per cent. urea, and 30 per cent. litmus tincture. This is then distributed into test-tubes (10 ccm.) and steam sterilised for 10–20 minutes. Cultivated in this medium, the difference as to production of acid between the two bacteria is rendered very striking. After inoculation, the medium may be poured into capsules and incubated at 37°. In from 16–18 hours, coli turns the blue colour of the medium quite red, the reaction of the condensation water being also acid. After 24 hours the medium again becomes blue, owing to ammoniacal decomposition of the urea. The colonies also turn blue, and the presence of ammonia can easily be rendered evident by touching the medium with a glass rod moistened with hydrochloric acid. When inoculated with typhoid bacilli there is no reaction to litmus, and the blue colour remains unchanged for 72 hours or more. The differences between the two may be rendered strikingly obvious by sowing them side by side in the same capsule.

Cultivating Gonococcus.—Dr. J. de Christmas,* in an interesting communication on *Gonococcus* and gonotoxin, states that he has found rabbit serum to be an excellent medium for the cultivation of this microbe, and that human albuminous fluids, such as blood-serum, ascitic fluid, or pleuritic exudation, mixed with peptonised gelose in the proportion of two to one, give abundant cultures. The preference is given to ascitic fluid, which is easy to obtain and easy to sterilise, as it will stand, without coagulating, a higher degree of heat than blood-serum. The mixture with gelose is perfectly clear, and stroke cultivations incubated at 35° develop abundantly in 24 hours. The cultures, however, die off in 3 or 4 days, and have, therefore, to be resown every 48 hours. This inconvenience is obviated by the use of coagulated rabbit serum, on which the microbe not only thrives freely but lives for at least 3 or 4 weeks. The difficulty in connection with rabbit serum is that it is obtainable only in small quantity, about 60 ccm. for one animal. For the study of gonotoxin such small amounts are quite insufficient, and the author used ascitic fluid mixed with peptonised bouillon in the proportion of 1 to 3. The bouillon was ordinary veal-bouillon, or was made with Liebig's extract (0·5 grm. to the litre). The reaction of the medium should be slightly alkaline.

Pure cultivations of *Gonococcus* were obtained by spreading a drop of the fresh pus upon the rabbit serum medium and incubating at 36°. In about 12 hours colonies of *Gonococcus* are well in advance of other organisms which may be present, and it is therefore quite easy, by once resowing, to obtain pure cultures. On rabbit serum the colonies are small, round, transparent, raised in the centre, isolated or confluent. Their chief characteristic is viscosity, which is well shown by the adhesion of the growth when touched with a platinum wire. The author explains the character of the distribution on cover-glass preparations as being due to this viscosity. It is also stated that the classic shape of *Gonococcus* always met with in pus is the least frequent in cultures.

* Ann. Inst. Pasteur, xi. (1897) pp. 609-30.

Dr. F. R. Hayner * has successfully cultivated *Gonococcus* from the fluids in joints and tendon-sheaths in the following media:—

(1) Albuminous urine agar. Acid urine containing 0·05 albumen or more is allowed to stand for 24 hours, and then boiled. The precipitate is then removed by filtration. The filtrate is again boiled, and agar, pepton, beef extract, and sodium chloride added in the proportions used for making ordinary agar. The reaction should be neutral or very slightly acid. The advantages of using albuminous urine are, firstly, that such urine contains albumens that are not coagulated by heat; and, secondly, the albumen that is coagulated acts as a clarifying agent in the removal of the salts that usually cause the cloudiness of the urine-agar.

(2) An ordinary agar-tube was melted and cooled to 46° C., and then about 5 ccm. of human blood-serum added, making the proportion one-third blood-serum and two-thirds agar. The resulting medium, which was perfectly clear, was then inoculated with three loopfuls of fluid from a joint. The inoculated medium was poured into a Petri's capsule and incubated at 37°. Colonies were observed after 48 hours.

(3) Pig-fœtus agar. This medium is prepared from fresh pig-fœtuses not exceeding 5 cm. in length, and free from placenta and membranes. The fœtuses are minced in a sausage machine, and then placed in an equal volume of distilled water, the mixture being allowed to macerate in a cool place for from 6–12 hours. The fluid is then passed through a Chamberland filter under a presssure of 150–200 lbs. Two per cent. sterilised agar is then melted and cooled down to 40°, and to it one-third of its volume of fœtus-infusion is added. The tubes are then slanted.

Protozoa Culture.†—Dr. F. Schardinger now uses a medium prepared in the following way:—To a suspension of about 30 grm. of hay in 1 litre of water, 1–1·5 grm. of powdered calcium hydrate are added, and, after having been well shaken, the mixture is incubated for 24–36 hours. The fluid is then filtered, and, the chalk having been precipitated with phosphoric acid, an equal quantity of meat infusion (made without pepton or salt) is added. The mixture is then alkalised with soda, and 1–1·5 per cent. of agar added. In this medium quite pure bacteria-free cultures of a Mycetozoon (*Protomonas Spirogyræ* Borzì) were obtained; and, if gelatin be substituted for agar, the above described fluid serves well for the preparation of a cultivation medium suitable for bacteria cultures.

(2) Preparing Objects.

Method for rapidly Examining for Bacteria in cover-glass preparations.‡—Dr. D. Kischensky recommends the following method for examining for micro-organisms in pure cultures, and also in pus, blood, urinary sediment and fæces. A drop of phenol-fuchsin solution (10 drops to 10 ccm. of water) is placed on a cover-glass or slide and mixed with a minute quantity of the culture. The cover-glass is then gently warmed and the mixed drop spread all over so as to make a film which will dry

* Bull. Johns Hopkins Hosp., viii. (1897) pp. 121–4.
† Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 3–5 (2 pls.).
‡ Tom. cit., xxi. (1897) pp. 876–7.

rapidly. By this procedure the bacteria are not only fixed, but deeply stained, and are quite ready for microscopical examination. For staining bacteria, in pus, fæces, and in urinary sediment, a better result is obtained by using a mixture of phenol-fuchsin and alcoholic solution of methylen-blue; for thereby the nuclei of the cells and the bacteria are stained blue, while the cell-protoplasm and degenerated bacteria are stained red.

Observing Nuclear Division in Equisetum and Chara.—Herr W. J. V. Osterhout* finds Flemming's mixture the best fixing material for observing the division of the nucleus in the spore-mother-cells of *Equisetum* (see p. 416). Microtome-sections 5 μ thick were stained with safranin, gentian violet, and orange G, and mounted in Canada-balsam.

The processes employed by Herr B. Debski † in observing the division of the nucleus in the vegetative cells and in the antheridial filaments of *Chara* (see p. 416) are described in detail. The best fixing material was found to be Flemming's mixture; and as a stain, iron-alum hæmatoxylin and Flemming's safranin-gentian-orange gave the best results. The material was left for 24 hours in the fixing fluid, then for 1–2 hours in running water; then placed for about 12 hours successively in 10, 15, 20, 30, 50, 75, 90 per cent. and absolute alcohol; and finally transferred through chloroform-alcohol and chloroform to chloroform-paraffin. The chloroform was slowly evaporated, and the material then imbedded in pure paraffin of 52° C. melting-point. Microtome-sections 5 μ thick were fixed to the slide by distilled water mixed with some albumen, and dried. The paraffin was removed by xylol, and the xylol by alcohol, and the sections were then stained.

Fixing, Imbedding, and Staining for Nuclear Division in Pollen-Grains.‡—The following are the methods employed by Miss E. Sargant for the researches described on p. 398:—

A. Fixing.—Anthers fixed in absolute alcohol were usually uncut. Those fixed in any of the three solutions given below were either halved transversely or cut at both ends to ensure penetration.

Hermann's Solution (*alcoholic*).—10 per cent. aqueous solution of platinic chloride, 3 ccm.; 1 per cent. osmic acid (aqueous), 8 ccm.; glacial acetic acid, 2 ccm.; absolute alcohol, 27 ccm. The anthers were left in this solution for 1½–2 hours, and then transferred to a 0·5 per cent. aqueous solution of platinic chloride for 24 hours. They were then placed in a 1 per cent. aqueous solution of platinic chloride for 24 hours.

Flemming's Solution (*aqueous*).— 1 per cent. aqueous solution of chromic acid, 30 ccm.; 1 per cent. osmic acid (aqueous), 8 ccm.; glacial acetic acid, 2 ccm. The anthers were left in this solution for about 2 hours, and then transferred to an aqueous 0·5 per cent. solution of chromic acid for 18 hours.

Chromic acid (*aqueous*).—The anthers were laid in a 0·5 per cent. aqueous solution of chromic acid for 18–24 hours.

After treatment in any of these ways, the anthers were rinsed in water, and transferred successively, at intervals of about 12 hours, to 30, 50, and 70 per cent. alcohol, and finally left for several days in

* Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) p. 159.
† Tom. cit., pp. 229–31.
‡ Ann. Bot., xi. (1897) pp. 218–20. Cf. this Journal, 1896, p. 698.

methylated spirit, changed as it became discoloured. These changes were made in the dark when the fixing solution had contained chromic acid.

The anthers were preserved in a mixture of equal parts absolute alcohol, glycerin, and distilled water.

B. Imbedding and Cutting.—For anthers fixed in mixtures containing chromic acid or platinic chloride, paraffin melting at 52° C. is hard enough. A softer paraffin can be used for anthers fixed in absolute alcohol. Sections 15 μ thick were cut from such material imbedded in paraffin melting at 45° C.

The sections were usually floated on the slide with distilled water, and made to adhere by careful drying without cement. But in the case of anthers showing the nuclear division within the nearly mature pollen-grain, a cement was used of collodion and clove-oil.

Great care must always be taken not to overheat the paraffin-ribbon on the slide. If the paraffin approaches the melting-point, the sections will be strained and their structure distorted.

Hand-sections are apt to be broken while they are being transferred from a stronger to a weaker solution of alcohol. To avoid this, the sections were placed in a small wide-necked bottle half filled with distilled water, on the top of which absolute alcohol had been poured gently. The alcohol floated for some time on the water, and the sections sank down through solutions of gradually increasing density until they lay in the pure water at the bottom. Then the alcohol was drawn off by a pipette.

C. Staining. (1) *Flemming's orange method for material fixed in Flemming's solution, Hermann's solution, or chromic acid.*—For early stages in the development of the pollen-mother-cell, the potassium permanganate was used as a mordant both before and after the treatment with safranin. The safranin and gentian-violet solutions were also of double the usual strength for these stages. For later ones—as the first nuclear division in the pollen-mother-cell—the ordinary treatment was sufficient.

(2) *Mayer's hæmalum for chromic material.*—The sections were placed for half an hour in a 0·5 per cent. solution of ferric chloride in water, rinsed, and transferred to Mayer's hæmalum, nearly full strength. They usually took about 2 hours to stain to the right depth. If the sections were kept alkaline by rinsing in hard water and by the use of neutral alcohols, they were of a brilliant blue, and very permanent.

(3) *Mayer's hæmalum for absolute alcohol material.*—The sections were treated as above, but with a 0·1 per cent. solution of ferric chloride for half an hour, and 10 per cent. solution of Mayer's hæmalum in 0·1 per cent. solution of potash-alum for about 12 hours.

(4) *Methyl-green and acid fuchsin for alcohol material.* — These colours were used in aqueous solution; their proportion varied to suit different stages.

(5) *Renaut's hæmatoxylic eosin for alcohol material.* (See this Journal, 1896, p. 699.)

Agar as Medium for Bacteriological Examination of Water.*—According to Herr F. Hesse, agar possesses several advantages over

* Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 932–7.

gelatin as a medium for the bacteriological examination of water, and merely on the ground that it does not liquefy, he recommends it. The medium should contain 1 per cent. of agar, and care must be taken that the water in the water-bath in which the agar tubes are placed is heated up to 38°–40° before any considerable quantity (e.g. 1 ccm.) of water is added. Instead of diluting germ-full water with germ-free water, he prefers to use only so little water that not more than 200 colonies develop on one plate; and in order to avoid mistakes incidental to this method, two at least control plates are made. Cold capsules must be previously heated in the incubator. The plates should be kept turned face down, as this position delays drying considerably, and also has other advantages. Four tables giving the results of observations made with Dresden water seem to confirm the author's statements.

Fixation and Staining of Cytoryctes vaccinæ.*—Dr. v. Wasielewski inoculated the cornea of 50 rabbits and 10 guinea-pigs with vaccine lymph, and, by staining with alum-fuchsin-hæmatoxylin and alum-fuchsin, was able to recognise the appearances which have been described by Guarnieri and others. The bodies are held to be parasitic in nature, and have been named *Cytoryctes vaccinæ.* In the 25 illustrations the parasite is depicted as lying within the nuclear membrane and without the chromatin network. The parasites vary in number and size. The fixatives used were chromic acid sublimate (saturated solution of sublimate 200 + water 250 + chromic acid 0·5), picric acid sublimate (saturated aqueous solution of picric acid 1000 + saturated solution of sublimate 1000 + glacial acetic acid 50 + water 2000), picric-acetic acid, Flemming's fluid, sublimate, and sublimate-nitric acid (equal parts of 3 per cent. nitric acid and saturated solution of sublimate in hot physiological salt solution). The sections were stained with alum-fuchsin for 24 hours (fuchsin 1, alum 3, water 100), and then decolorised with bichromate of potash (a mixture made immediately before use, of equal parts of 0·5 per cent. solution and 70 per cent. alcohol. The sections were then washed in distilled water and after-stained with Ehrlich's hæmatoxylin.

(3) Cutting, including Imbedding and Microtomes.

Proper Angle of Microtome Knife.†—Dr. B. Rawitz adduces experimental proof to show that the microtome knife should be placed at an acute angle rather than at a right angle. When placed at the latter angle, the sections, according to their thickness, are always more or less crowded together, thus distorting the finer structures of the tissues cut. The experimental proof consists of the measurement of the sections cut with the knife at a right angle and also at an angle of 45°. The sections were made from a block of paraffin measuring $20\frac{1}{2}$ by $11\frac{1}{2}$ mm., and were 15, 10, and 5 μ thick. With the knife at the acute angle they all measured 11 mm. in breadth, while with the knife at a right angle they measured $9\frac{1}{2}$ mm. for 15 μ, 9 mm. for the 10 μ, and 8 mm. for the 5 μ sections, thus showing a shrinkage of 2, $2\frac{1}{2}$ and 3 mm. respectively.

Technique of Celloidin Serial Sections.‡—The procedure recommended by Dr. J. Tandler for the manipulation and treatment of series

* Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 901–13 (1 pl.).
† Anat. Anzeig., xiii. (1897) pp. 65–80.
‡ Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 36–8.

of celloidin sections is as follows:—The individual sections are lifted from the knife and arranged on slides 36 by 76 mm. No adhesive is used. When a slide is full, the superfluous spirit is removed with filter paper, and then each slide is wrapped round with a strip of filter paper which is twice the length and the same breadth as the slide. The free ends of the strip are lapped underneath the slide, and on the top is placed another (empty) slide as a sort of weight. The whole is then placed in a pan (10 by 5 by 3 cm.) half filled with distilled water. In this pan the whole lot of slides—similarly prepared—are placed, one on top of the other. Staining is effected by means of a dilute solution of hæmatoxylin, and subsequently by a 1 per cent. alcoholic solution of eosin. The paper strips are replaced by others previously immersed in the hæmatoxylin solution, and the pan half-filled with tap water. Herein they remain for 5–24 hours, according to the strength of the hæmatoxylin solution and the stainability of the objects. When sufficiently stained the strips are replaced by clean ones, and the slides left in tap water for another 24 hours. They are next transferred to 95 per cent. alcohol, and then wrapped up in strips soaked with eosin solution. After a few hours the slides are dried with filter paper, and, having been covered with fresh strips soaked in strong spirit, are transferred to 95 per cent. alcohol for 4–6 hours; after which they are treated with carbol-xylol, and finally mounted.

Imbedding of Tissues without hardening in Alcohol.* —Microscopical examination of animal and vegetable tissues which contain substances soluble in alcohol and ether is always difficult, says Dr. A. Döllken, and a method for obtaining thin sections is still a desideratum. One method, which depends on the action of aceton vapour on gum arabic, consists in fixing in chrom-osmium-acetic acid and picric acid solution. The preparation imbedded in gum is then exposed for 24 hours at ordinary temperature to the action of aceton vapour. This procedure, though possessing the advantage of not damaging certain soluble substances, does not satisfy the principal requirement, i.e. does not produce sufficiently thin sections. Another procedure is to fix in formalin and place a piece (0·5–1 ccm.) in a capsule with 10–20 per cent. formalin, and then add a sufficient quantity of resorcin and some glycerin. In an hour's time some drops of dilute sulphuric acid are added. In a short while the mass stiffens, and is sectionable in a few hours. It is fixed to the block or microtome plate with water-glass or syndetikon, and should be sectioned at once, as after a time it becomes stony hard.

Very excellent results may be obtained by imbedding in soap made in the following way:—Castor oil or stearic acid is boiled for some time with 20–30 per cent. caustic soda. After having been allowed to cool and set, the alkali is entirely removed by pressure, dialysis, or by frequently dissolving the soap. The piece (about 1 cm. high) is transferred directly from the formalin solution to a 3–5 per cent. solution of the soap made with distilled water, in which it remains for 36–72 hours in a covered vessel. It is then solidified by evaporation, by removing the cover, or

* Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 32–5.

by means of coarsely powdered Glauber's salt. The block is fixed on with water-glass. The sections, which are cut dry, roll up a little, but are easily uncurled in water. Before staining, the soap should be washed out in frequent changes of water.

Should it be desired to orient the piece, the soap-mass may be rendered quite transparent by the addition of 5 ccm. of glycerin and of alcohol to 55 ccm. of the soap solution.

Straightening of Paraffin Sections.*—Though Strasser's adhesive is indisputably the best, says Dr. W. Gebhardt, it is liable to the inconvenience arising from the difficulty of straightening the section. This may be avoided by covering the adhesive layer with water. In this way the sections are easily located and straightened. The excess of water is poured off, and a somewhat longer time than usual allowed for its complete evaporation.

(4) Staining and Injecting.

Special Procedure for Staining Bacteria on Films and in Sections.†—The procedure recommended by Herren W. Semonowicz and E. Marzinowsky is intended to stain not only bacteria but histological elements. It consists in staining the preparations with an aqueous solution of phenolfuchsin, and after-staining them with Loeffler's methylen-blue. The carbolfuchsin solution is composed of one part of the ordinary solution and two parts of water. Cover-glass preparations are placed for 2 minutes in the phenolfuchsin solution, washed in water, and then treated for 3–4 minutes with the methylen-blue solution. Sections are left in the phenolfuchsin solution for 4–5 minutes, and, after having been washed in water, stained with the methylen-blue solution for a similar time. The preparations are thereupon treated in the usual way with alcohol, oil, and xylol, and imbedded in balsam. By this method the cell-nuclei and bacteria are stained blue, while the connective tissue and the protoplasm of the cells become red or rose-coloured. The bacteria are specially well stained by this procedure unless they are degenerated, when they are of a reddish hue.

Orcein Staining.‡—Dr. H. Triepel stains elastin in small objects with the following solution, after removal from 70 per cent. spirit:—Orcein, 0·5 grm.; alcohol (70 per cent.), 70 ccm.; hydrochloric acid, 20 drops. The object, which should not be more than 2 mm. thick, is transferred after 24 hours to hydrochloric acid alcohol (alcohol 70 per cent., with 1 per cent. of acid) for about half an hour. After this the object must be dehydrated in absolute alcohol for about 12 hours. The next steps are xylol, followed by paraffin sections.

Picrocarmine.§—In an article discussing the merits of picrocarmine, Prof. P. Mayer gives the following formulæ and their method of preparation.

(1) Magnesia-carmine. Carmine 1 grm. and burnt magnesia 0·1 grm. are boiled for 5 minutes with 20 ccm. of distilled water, and the

* Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 39–40.
† Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 874–6.
‡ Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 31–2. § Tom. cit., pp. 18–31.

solution afterwards made up to 50 ccm. After filtration, 3 drops of formalin are added. This solution will keep perfectly clear for months.

(2) Picric acid solution is made by mixing 0·5 grm. picric acid with 100 ccm. of distilled water.

(3) Magnesia-water. 0·1 grm. of burnt magnesia and 100 ccm. of tap water are kept for a week, being frequently shaken up the while, and then the supernatant clear fluid poured off.

(4) Picrate of magnesia. 200 ccm. of picric acid solution (No. 2) are boiled with 0·25 grm. of carbonate of magnesia, and, after having settled, filtered; or 0·6 grm. of solid picrate of magnesia are dissolved in 100 ccm. of distilled water.

(5) Weak magnesia-carmine. In 100 ccm. of magnesia water (No. 3) is dissolved 0·2 grm. carmine by boiling for half an hour, after which the solution is filtered and 5 drops of formalin added.

(6) Picro-magnesia-carmine is made by mixing 1 vol. of No. 1 with 9 vols. of No. 4, or by adding equal quantities of No. 4 and No. 5 together. To either solution a few drops of formalin should be added to every 100 ccm.

Differential Staining of Tubercle and Smegma Bacilli.*—According to Herr Honsell, the safest way to distinguish between tubercle and smegma bacilli is to stain with phenol-fuchsin in the usual way, wash and dry, and then place in acid-alcohol (absolute alcohol 97, hydrochloric acid 3) for 10 minutes. After this, wash in water, and stain with alcoholic methylen-blue diluted one-half with water. The author also notices that smegma bacilli of different origin behave differently as regards their resistance to alcohol. The method given is intended for the most resistant forms, and is far better than Grethe's or Czaplewski's.

Staining of Microbes and Phagocytes.†—Dr. N. A. Iwanoff used the following staining method in his researches on phagocytosis. Blood films were made on slides or cover-glasses, and incubated for 1–1½ hours at 110°–120° C. The fixed preparations were then treated with the staining mixture for 1, 2, or 3 minutes. The staining solution was rendered more effective by heating the preparations over the flame for 2–3 minutes. The staining solution was the Roux stain for diphtheria bacilli two or three times diluted, and was composed of 1 per cent. aqueous solution of dahlia 15·0, 1 per cent. aqueous solution of methylen-green 45·0, formaldehyd 10 drops. To 20–25 grm. of the diluted Roux stain 2–4 grm. of Ziehl's carbol-fuchsin were added.

Staining Hæmatozoa of Malaria.‡—Dr. E. Marchoux stained films of malarious blood with eosin and methylen-blue, but eventually discarded this procedure for a modification of Nicolle's carbolate of thionin. The formula given is :—Saturated solution of thionin in 50 per cent. alcohol, 20 ccm.; 2 per cent. carbolic acid, 100 ccm. It is necessary to let the mixture mature for a few days until the phenol has combined with the thionin.

* Arb. a. d. Pathol.-Anat. Inst. zu Tübingen, ii. (1896) p. 317. See Centralbl. Bakt. u. Par., 1te Abt. xxi. (1897) p. 700.

† Centralbl. Bakt. u. Par., 1te Abt, xxii. (1897) p. 119.

‡ Ann. Inst. Pasteur, xi. (1897) p. 645.

Staining Reaction of Diabetic Blood.*—Dr. L. Bremer diagnoses diabetes by the following procedure:—A drop of blood is spread over a third or half a slide, which is then incubated at 135° C. for 6 to 10 minutes. The exact temperature is of the greatest importance. The slides are then stained in 1 per cent. aqueous solutions of Congo-red, methylen-blue, or Biebrich scarlet, or with the Ehrlich-Biondi stain. Immersion for 1½–2 minutes in Congo-red stains diabetic blood barely or not at all, while normal blood is coloured red. Methylen-blue acts in a similar way, but Biebrich scarlet stains diabetic, but not non-diabetic blood. Ehrlich-Biondi solution stains diabetic blood orange, and non-diabetic deep violet. Successful specimens are made by means of contrast stains; thus an aqueous 1 per cent. methyl-green for 1½–2 minutes, followed by eosin solution for 8–10 seconds, imparts a green hue to the diabetic blood, while the non-diabetic is red.

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

Preservation of Pathological Preparations.†—Herr Melnikow-Raswedenkow recommends the following procedure for mounting museum specimens:—The fresh specimen is first treated with pure formalin, and after it has been sufficiently fixed with 25 per cent. spirit, the preparation is to be mounted in solution composed of acetate of potash 30, glycerin 60, and distilled water 100.

Fixation of Celloidin Sections.‡—M. A. Gravis has devised the following procedure for fixing celloidin sections to the slide by means of agar. Three grm. of agar, chopped up very finely, are soaked in 400 grm. of distilled water for a day. The mixture is then heated in a sand-bath and, when it has boiled for six minutes, is filtered through fine muslin into little bottles with wide mouths and ground glass stoppers. To each a small piece of camphor is added. As it cools, this 0·75 per cent. agar sets firm, and, though somewhat cloudy in bulk, is quite transparent in a thin layer. When required for use the agar is melted in a water-bath and a thickish layer brushed over the slide. Upon this the celloidin sections, immediately after removal from the microtome, are deposited, and then the whole series covered with another layer of agar. When the agar has cooled, the sections will be found firmly fixed. Though it is well to allow the agar to dry for 15–30 minutes, it is not advisable to carry the evaporation too far. When all the slides required are prepared, they are immersed in 94 per cent. alcohol till the next day. This method of dehydration imparts a firm consistence to the agar. Next day the slides are stained, cleared up, and mounted.

The foregoing procedure will allow of the prolonged action of eau de Javelle, of potash, of acids, but not that of distilled water, as this softens and swells the fixative.

As vegetable sections need not always be stained, it is sufficient to

* Centralbl. f. inn. Med., June 5, 1897. See Brit. Med. Journ., Epit., Aug. 28, 1897, p. 33.

† Centralbl. f. allgem. Pathol. u. pathol. Anat., vii. No. 2. See Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) p. 818.

‡ Bull. Soc. Belge de Microscopie, xxiii. (1896–7) pp. 137–40.

treat them with eau de Javelle and, having soaked them in glycerin, mount in glycerin or glycerin jelly. For stained and permanent preparations, the sections, after removal from eau de Javelle, should be neutralised by means of an aqueous 5 per cent. solution of sodium sulphite, and the sulphite eliminated with water mixed either with alcohol or glycerin. The sections may then be stained in an aqueous or alcoholic solution, and, having been dehydrated in alcohol, mounted in balsam. The various steps in the manipulation should be carried out in cylindrical vessels which will allow the slides, placed back to back, to stand upright. The various stages require several hours apiece, owing to the slowness with which the agar parts with the previous reagent. This is really the great inconvenience of the agar fixative.

(6) Miscellaneous.

Bichromates and the Nucleus.*—Dr. E. Burchardt has made a detailed study of the diverse influence of bichromates on the nucleus. One set of salts destroy the nuclear structure, namely salts of potassium, cæsium, rubidium, sodium, lithium, ammonium, magnesium, strontium, and zinc. Another set of salts preserve the nuclear structure, namely salts of calcium, barium, and (to a less extent) copper. What is preserved is usually the chromatin, not the achromatin portion of the nucleus. All bichromates, however, seem to have two mutually antagonistic effects on the formed and unformed constituents of the nucleus. According to the predominance of one or the other effect, and according to the state of the fluid nuclear sap, there is destruction or preservation of nuclear structure, or something between the two states. The zinc salt seems in its effects about midway in the series, with sodium, ammonium, potassium, &c., on the one side, copper, calcium, and barium on the other.

Method of Graphic Reconstruction from Serial Sections.†—Mr. W. McM. Woodworth describes a method of reconstructing from serial sections by means of measurements made with an ocular micrometer directly from the sections themselves, without the aid of camera lucida outlines; and as the measurements can be multiplied to any extent, reconstructions to any scale can be produced with any combination of objective and ocular. The method, however, is practically limited to transverse sections of bilaterally symmetrical objects, though it can be applied to objects of any shape or outline if they can be provided with a plane of definition at right angles to the plane of section. The example given is the reconstruction on a frontal plane of the intestinal canal of a small Trematode at a magnification of 100 diameters. The worm is 2 mm. long, and the sections are 20 μ thick. The latter are measured with a Zeiss AA objective and ocular micrometer 3, at a tube-length of 16 mm. Under these conditions the value of one division of the micrometer is $17 \cdot 2\ \mu$. On a sheet of paper draw a line 200 mm. long to represent the chief axis of the worm one hundred times enlarged, and at right angles to this draw 100 parallel lines at intervals of 2 mm.

* La Cellule, xii. (1897) pp. 337–73.

† Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 15–8.

($=20\,\mu \times 100$) representing the planes occupied by the sections. By means of the ocular micrometer the greatest diameter of each section is now measured, multiplied by 100, and half the resulting distance marked off on each side of the line representing the chief axis, and along that one of the parallel lines which corresponds to the section on which the measurement was made. For example :—The diameter of section 23 is 0·588 mm. (found by multiplying the value of one division of the ocular micrometer—17·2 μ—by the number of divisions covered by the diameter of the object, which, multiplied by 100, equals 58·8 mm., half of which is 29·4 mm.). This distance, then, is marked off on the twenty-third of the parallel lines and on both sides of the axial line, thus giving the diameter of section 23 multiplied one hundred times. By repeating this process for each section and then joining the points thus obtained, there results a symmetrical outline at the desired scale. The outlines having thus been fixed, to plot the intestinal tract or any organ, it is only necessary to take measurements from one margin of each section to the nearest and farthest limits of the organ desired in the reconstruction, multiply the distance by 100, mark off the results on the corresponding parallel lines, and join the points as before.

Though best suited for reproducing from transverse sections of bilaterally symmetrical objects, the method may be applied to any object of any shape, provided that a plane of definition at right angles to the plane of sectioning can be cut on some part of the object outside the organ which it is desired to reconstruct.

Penetrating Power of Formalin Vapour.* —The results of the experiments made by Herr W. A. Iwanoff relative to the bactericidal action of formalin vapour are in conformity with those of other observers. The effect of the vapour is increased by raising the temperature—that is to say, it acts more effectively at the body heat than at room temperature; and not only on superficial parts, but also on deep-lying organs. Yet it is rather slow in its disinfectant action on deep-lying parts even when used at a high temperature; for it took 3 hours to destroy fowl-cholera bacilli in quite small pieces of deep-lying organs, while 4 hours were required for Metschnikoff's vibrio, and 6 hours for anthrax, under similar conditions. When used at room temperature, it took from three to eight times as long. As might be expected, the action varies with the different organisms. A naked-eye inspection gives a pretty good notion whether the disinfection is complete or not. If complete, the piece has become a whitish-grey colour, and is of a firmer consistence than before.

Process for Soldering Aluminium in the Laboratory.†—Mr. A. T. Stanton says that it is not easy to solder aluminium by using an alloy of definite composition without a flux, and has found that cadmium iodide is more satisfactory than silver chloride. If it be fused on an aluminium plate, decomposition of the salt occurs long before the melting-point of the aluminium is reached; but the addition of zinc chloride obviates any great defects. Concentrated zinc chloride solution is mixed

* Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 50–8.
† Nature, lvi. (1897) pp. 353–4.

with a little ammonium chloride, evaporated in a round porcelain dish, and ignited at a low red heat, till a part of the ammonium chloride is volatilised. The fused chlorides are then mixed with cadmium iodide, the proportion of these ingredients being adjusted experimentally.

When the salts are completely fused together, a flux is produced which readily enables tin or other soldering alloy to unite perfectly with aluminium. The melted flux can be taken up in a pipette with india-rubber teat and dropped on to the surface to be soldered. Some powdered metallic tin is also sprinkled on the surface. The aluminium is then heated over the Bunsen flame till the flux just melts, and is then spread with a copper wire or thin glass rod. As the temperature is further raised, the flux decomposes, and the tin readily alloys itself with the surrounding surface of the aluminium. While the flux is decomposing, the tin can be spread in a continuous layer with the glass rod or copper wire.

Instead of cadmium iodide, fused lead chloride may be used.

Brownian Movement.*—Mr. K. M. Cunningham finds that the Brownian movements of particles of magnetic sand are arrested by the presence of a magnet. Some fragments of a magnetic fossil wood did not show the motion at all.

* Journ. New York Micr. Soc., xiii. (1897) pp. 64–7.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

DECEMBER 1897.

TRANSACTIONS OF THE SOCIETY.

VII.—*The Limits of Species in the Diatomaceæ.*

By Thomas Comber, F.L.S., F.R.M.S.

(*Read Oct.* 20*th*, 1897.)

It is well known in how variable a sense the term "species" has been used by authors. It may be well, therefore, for me to explain at the outset the sense in which I shall use the term.

Before the publication of the 'Origin of Species,' and while the belief in a special creation still prevailed, the following definition was drawn up by a leading British botanist: * "A species comprises all individual plants which resemble each other sufficiently to make us conclude that they are, or may have been, all descended from a common parent. These individuals may often differ from each other in many striking particulars, . . . but these particulars are such as experience teaches us are liable to vary in the seedlings raised from one individual."

This may, I think, be accepted as the meaning generally attached to the term at that time. In practice, systematists differed very widely in their opinions as to what forms should be included in a particular species; but in theory they were pretty well agreed as to what a species was.

But after the appearance of Mr. Darwin's work, and since the views therein expressed have been generally accepted and further developed, the conception as to what a species is has become very unsettled. Many naturalists hold that "it follows from the general fact of evolution that species are merely arbitrary divisions which present no deeper significance from a philosophical point of view than is presented by well-marked varieties, out of which they are in all cases believed to have arisen." † "It is not to be anticipated that any competent naturalist will nowadays dispute that the terms 'variety,' 'species,' and 'genus' stand for merely conventional divisions, and that whether a form shall be ranked under one or other of them is

* Bentham's 'Handbook of the British Flora,' 1858.

† Romanes, 'Darwin, and after Darwin,' ii. (1895) p. 60.

often no more than a matter of individual taste." * They thus renounce the belief "that species are 'definite entities,' differing in kind from 'varieties' on the one hand and from 'genera' on the other."

The obvious consequence of such views was expressed in a paper communicated to the Zoological Society in 1880 by Prof. Huxley: "As for species, no one zoologist has ever yet agreed with the estimate of another as to what should be considered species and what local varieties among wolves and foxes; and as there is no criterion by which the question can be tested, it is probable that such agreement never will be attained. The suggestion that it may be as well to give up the attempt to define species, and to content oneself with regarding the varieties of pelage and stature which accompany a definite type of skeletal and dental character in the geographical district in which the latter is indigenous, may be regarded as revolutionary, but I am inclined to think that sooner or later we shall have to adopt it." †

In the presence of such authorities it is necessary to speak with the greatest respect and the utmost possible caution; but I would ask, does it follow "as a necessary deduction from the theory of descent" that species are thus "merely arbitrary divisions"? Is it not open, even to those who accept unreservedly the theory of evolution, and have not the slightest vestigial belief that "such divinity doth still hedge in a species," to regard them as having some real existence in Nature?

As regards genera, families, orders, &c. there is nothing to be said. They may be granted to be purely conventional terms, adopted for convenience of classification, for the ready indication of natural affinity, and for facility of memory. For such purposes they are of use, without any question of their existence in Nature.

A "species," on the contrary, appears to me to be still possibly not a mere term, an idea, an arbitrary division for the convenience and assistance of naturalists, but to possess a real existence in Nature, inasmuch as it is marked by a clear distinction from the varieties out of which it originally sprang. Whether the distinction be one of "kind" or merely of degree, is of no consequence, so long as it suffices to render the species *physiologically* distinct, and thereby to constitute it an "organic unit."

This distinction, I venture to suggest, lies in the degree of differentiation of the sexual elements, or of those elements which in conjugation coalesce to perform the reproductive function, however little we may know of the nature or of the cause of such differentiation.

Mr. Darwin, summing up the results of his experiments on 'The Cross- and Self-fertilisation of Plants,' ‡ writes, "It is an extraordinary fact that, while many species of flowers fertilised with their own pollen are either absolutely or in some degree sterile; if fertilised

* Tom. cit., p. 254. † Proc. Zool. Soc., 1880, p. 286. ‡ P. 455.

with pollen from another flower on the same plant, they are sometimes (though rarely) a little more fertile; if fertilised from another individual or variety of the same species, they are fully fertile; but if with pollen from a distinct species, they are sterile in all possible degrees, until utter sterility is reached. We thus have a long series, with absolute sterility at the two ends; at one end due to the sexual elements not having been sufficiently differentiated, and at the other end to their having been differentiated in too great a degree, or in some peculiar manner."

Regarding this as a so-called "law of Nature," must not a natural division into "species" result from its operation?

The cause of the cross-sterility, after a certain differentiation of the sexual elements has taken place, will probably some day be discovered, and will then be found to be an entirely natural one. This does not in any way affect the argument. We have to do, not with its cause, but with its effect; and that is to cut up the originally continuous chain of related forms into separate sections, incapable of completely fertile crossing. Such sections are what appear to me to be natural species, sufficiently distinct and separable from each other, without any reference to special creation. Hybrids between them can be raised and maintained artificially, or may even occur in a state of nature; but in the latter case they do not last. In the struggle for existence they cannot contend against their more perfectly fertile competitors, and are suppressed.

So long as the individuals and varieties forming a group are capable of interbreeding freely, their offspring, being fully fertile, survive in the struggle for existence. The characters of the entire group may be gradually changed by the action of natural selection, but through continual crossing they are changed together. Such a group constitutes only a single species. By the interbreeding of all, even the extreme, forms of it, a series of intermediate forms is produced, however unlike the extremes may be. A visit to a poultry or dog show will give an example of how far they may differ. When, however, through isolation, geographical or otherwise, and from part of the group being exposed to different conditions of life, a differentiation in the sexual elements of the individuals composing that part is brought about, so that they can no longer produce fully fertile offspring when crossed with the others, the more or less sterile hybrids no longer hold their own. They are handicapped out of existence; by their elimination a gap in the series of intermediate forms is caused; a new "species," as I understand the term, comes into existence; and it is afterwards maintained, distinct from the original species, by the same sterility, in a greater or less degree, of the hybrids.

Mr. Darwin, with his characteristic accuracy and thoroughness, after describing the more or less complete sterility of what he terms the "illegitimate" unions of heterostyled plants, points out that "we have no right to maintain that the sterility of species when first crossed, and of their hybrid offspring, is determined by some cause fundamentally different from that which determines the sterility of the individuals, both of ordinary and heterostyled plants, when united in various ways." * Even if there be no difference, it does not affect the point at present under consideration. As previously observed, we have to do, not with the cause of the sterility, which may eventually prove to be completely the same, but with its effect, which is certainly quite different. In the case of the comparatively few plants which have become heterostyled, illegitimate unions must seldom occur; and the effect of their sterility is neutralised by the complete fertility of the legitimate unions, for the consummation of which, by means of insect agency, special facilities are provided. There is, therefore, no cessation of interbreeding, and no consequent disappearance of intermediate forms. In the case of the far greater number of plants which have not acquired the highly specialised condition of the heterostyled, there does ensue the hindrance to interbreeding, and thence the breach of continuity already described.

It is this interruption of the series of intermediate forms, as they now exist, which appears to me to supply the practical means of discrimination between the species of the present time. It is obviously necessary to thus confine our attention to contemporary forms. If we do otherwise, and bring into view fossil forms which formerly existed, it is evident that what are now distinct species, incapable of intercrossing, and therefore with a gap between, might be found, at a comparatively recent geological period, to graduate into one another. Indeed, but for the imperfection of the geological record, every existing species of whole orders and classes would be found connected by complete series of transitional forms with their common remote ancestor.

This view of species appears to receive some degree of support even from the late Mr. Romanes; for in the second part, published after his death, of his 'Exposition of the Darwinian Theory,' among his "logically possible definitions of a species," the second runs as follows: † "A group of individuals, which, while fully fertile *inter se*, are sterile with all other individuals—or at any rate do not generate fully fertile hybrids." He remarks that "This purely physiological definition is not nowadays entertained by any naturalists"; but he afterwards ‡ observes, "As species have been actually constituted by systematists, the test of exclusive fertility does not apply. For my own part I think this to be regretted, because I believe that such is the only natural—and therefore the only firm—basis on which specific distinctions can be reared. But, as previously observed, this is not the view which has been taken by species-makers."

The non-adoption by systematists of "exclusive fertility" as the

* 'Cross- and Self-Fertilisation of Plants,' p. 466.
† 'Darwin, and after Darwin,' part ii. p. 229. ‡ Tom. cit., p. 236.

criterion of "species" is probably due to its hardly ever being directly applicable. However efficient in theory, it is in practice very seldom capable of experimental proof. Only in the case of domesticated or cultivated species, or in those few genera, such as *Salix* and *Verbascum*, in which intercrossing habitually takes place in a state of nature, is it directly available as a test. Indirectly, however, it is more widely applicable. As perfect fertility must result in the production of an unbroken series of intermediate forms, conversely the contemporaneous existence of such a series may fairly be held to indicate the power of producing fully fertile progeny. Consequently, even the extremes of such a series should be regarded as constituting nothing more than varieties of a single species. This test, though indirect, is available for purposes of classification; and it appears to me that, while the direct criterion enables us to form a definite conception of what a natural species is, and what a systematic species ought to be, the indirect application suffices to establish practical limits for the latter.

It will be seen that what Kerner terms "good" and "bad" species may alike be due to a "hiatus" between one series of forms and another; but while in the latter case the hiatus is merely the result of imperfect observation on the part of naturalists, in the former it arises from cross-sterility established by Nature itself.

No justification is afforded for any gradation of species, such as was proposed by Mr. H. C. Watson,* into super-species, ver-species, and sub-species. The last are described by Mr. B. Syme † as differing "from ver-species only in having the distinctions between themselves slighter, or less generally recognised, or in apparently shading off more gradually into one another." If this "shading off" consists of an unbroken series of intermediate forms, the "sub-species" may be more than usually pronounced varieties, but are still only varieties. If there is a gap in the series, the forms separated by it should be ranked as species, at any rate until such time as additional forms, filling up the gap, may be subsequently found to exist.

No better example of the working of the criterion can be given than *Rubus fruticosus*, so familiar to British botanists. Of this group Mr. Syme remarks that, "although the extreme forms are widely different, they are so completely connected by intermediate ones that I find it utterly impossible to separate them into any groups answering to the usual idea of a species." ‡ Yet he admits no less than 41 sub-species. Of the same group Sir J. D. Hooker observes, "Whereas in the fruticose *Rubi* the four or five most distinct British forms are connected by so many links that various excellent botanists regard them as forms of one species; in *Rosa*, on the contrary, the five most distinct British forms are connected by so few (comparatively) intermediates, that no good botanists have

* 'Cybele Britannica.' † Engl. Bot., 1863.
‡ Op. cit., iii. (1864) p. 162, footnote.

reduced them to one species." * In treating of the New Zealand forms of *Veronica*, Sir J. D. Hooker writes, "The species are exceedingly difficult of discrimination, present numerous intermediate forms between many most distinct-looking ones, and hybridise most freely. . . . Between the first 19 species it is most difficult to draw any contrasting specific characters; they appear to present a graduated scale of forms." † The two last extracts are quoted because the recognition of only one species in the case of *Rubus*, of 19 in that of *Veronica*, serves to illustrate the varying sense in which even the same author uses the term species.

Turning now from the general question of species throughout the Animal and Vegetable Kingdoms to the much narrower one of species amongst Diatoms, we are met, so far as theory is concerned, with one initial difficulty. Nothing is known of any process of sexual reproduction amongst these minute organisms. We cannot even be confident that the process of conjugation between two individuals, which has been observed amongst them, does more than approach a really sexual method. ‡ Until this has been ascertained, and the course of conjugation has been traced throughout, at any rate in some instances, we can only proceed on the assumption that as, among the higher plants, a differentiation of the sexual elements prevents cross-breeding, and thus produces a break in the series of intermediate forms, so, among the diatoms, a corresponding differentiation of the elements which coalesce in the process of conjugation brings about similar results. On this assumption we may adopt, as the practical criterion of specific distinction, the existence, or non-existence, of an unbroken series of intermediates. This appears to me to be, at any rate, a more reliable criterion, and to rest upon a more scientific basis, than the purely arbitrary system which has of late been adopted, of regarding every difference, however slight, as sufficient grounds for constituting a new species. It certainly presents a consistent means of classification.

There is no order of plants in which the "shading off" of one reputed species into another is more frequent, and in which, consequently, there has existed a wider divergence of opinion as to what constitutes a species. As an instance, it is only necessary to note that Mr. Rattray quotes, as synonyms of *Actinocyclus Ehrenbergii*, no less than 119 of Ehrenberg's species; and yet, while he himself enumerates 49 species of *Actinocyclus*, and 290 species of *Coscinodiscus*, another diatomist, Mr. Cox, reduces all the species of the two genera, 339 in all, to only seven species; and Prof. Van Heurck, in his recent treatise on the Diatomaceæ,§ quotes this opinion with approval, so far, at least, as the genus *Coscinodiscus* is concerned.

* 'Student's Flora,' ed. 1870, p. 120.

† 'New Zealand Flora,' 1864, p. 204.

‡ The late Mr. Buffham is the only observer who has described, as occurring in a diatom, a conjugating process which he regards as "distinctly sexual," and as forming a step towards . . . the sexual process in those "algæ which produce antherozoids."

§ P. 101.

In previous papers which have appeared in the Society's 'Transactions,' I have endeavoured to show how misleading the indiscriminate system of species-making has proved. In the first, 'On the Unreliability of Characters generally accepted for Diagnosis,' * your attention was drawn to the frequent relinquishment of species established by the earlier observers in such genera as *Actinocyclus*, *Eunotia*, &c., and to the great variation, both in relief and striation, which sometimes exists between the two valves of the same frustule, or between different frustules of the same filament. In the second, 'On the Development of the Young Valve of *Trachyneis aspera*,' † instances were given of the changes which take place in the course of growth of the valve, sufficient to cause what are merely stages of growth to be regarded as distinct species. In the third, 'On the Occurrence of Endocysts in *Thalassiosira*,' ‡ I recalled the observations long ago made by Mr. Lauder, and since confirmed by other observers, that there exists in the genera *Bacteriastrum* and *Chætoceros* what Mr. George Murray has termed a sort of dimorphism; so that forms which had previously been referred, not only to different species, but even to distinct genera, were in reality but different phases in the life-history of a single species.

This has led me to the conviction that to establish new species for each trifling variation, whether in outline, in striation, or in the relative size or form of blank spaces, is entirely misleading and detrimental to the interests of science. While some diatomists have continued to follow this course, others have taken, more or less, the broader view which I have endeavoured to justify. The very different estimates which have been attached to the term "species" by the best known authors on diatoms, the unequal criteria which they have adopted, and the consequent confusion which has prevailed in the nomenclature of the order, will be seen from the following particulars.

Prof. W. Smith, in his 'Synopsis of the British Diatomaceæ,' seldom explicitly mentions any series of intermediate forms; but any character with respect to which such intermediates occur he usually refers to as "variable" or "inconstant," and does not rely on it for his diagnosis of species. Thus he writes of *Tabellaria flocculosa* and *T. ventricosa*, that "with regard to the character on which Kützing relies as separating" them, "viz. the relative sizes of the central and terminal inflations, I have only to say that, in the numerous specimens in my possession, I find these characters exceedingly variable. . . . I therefore feel myself obliged to unite all these specimens under one designation." § Again, concerning *Pinnularia biceps* Greg.: "The absence or presence of the costæ at the centre of the valve appears to be an accidental circumstance, as numerous frustules may be found in which the interruption is more or less complete. I cannot, therefore, at present admit Dr. Gregory's new species." ‖

* Journ. R. Micros. Soc., 1894, pp. 428–32. † Op. cit., 1895, pp. 400–3.
‡ Op. cit., 1896, pp. 489–91. § Synops. Brit. Diat., ii. p. 45.
‖ Tom. cit., p. 96.

Mr. Ralfs, when writing the section on the Diatoms for Pritchard's 'Infusoria,' 1861, rejected certain characters, in the recognition of which Smith had followed Ehrenberg, e.g. the number of rays, or of processes, in the disciform genera, and of dorsal elevations in the genera *Eunotia* and *Himantidium.* He therefore constituted such species as *Actinocyclus Ehrenbergii* (already mentioned), *Eunotia Ehrenbergii,* under which he placed 14 of Ehrenberg's species, and *Eunotia robusta,* including 14 of Ehrenberg's species. The following quotation is sufficient to indicate his view on the subject immediately under consideration: "*Surirella lata* differs from *S. fastuosa* in its form, and usually in its larger size, but the markings are similar in both. As Prof. Gregory finds intermediate states, they may be, as he supposes, mere varieties." *

Dr. Gregory, although a good many of his species, especially of *Amphora,* have been united by later authors on the detection of connecting forms, nevertheless held the broad view of species. In his paper on the 'Diatoms of the Clyde'† he writes as follows: "In many species, though by no means in all, the shape as well as the size of the forms, and even the striation, all vary to a great extent. In such cases it is most important that every author should figure a sufficient number of selected forms to show the real extent of the species. These variable species ought to be thus treated individually, by which means many existing species would be got rid of and reduced to a smaller number."

Among the many species published by Dr. Greville are some which later observers have found to rest on insufficient characters, or have joined together, on proof that they belong to only one species, as, for instance, his *Triceratium Hardmanianum, T. trilineatum,* and *T. acceptum,* which, along with the previously published *T. radiatum* Brightwell, are only the upper or lower valves, or inner or outer plates of one form, for they have all been observed by Prof. Brun together in a single filament. But Dr. Greville's conception of a species did not differ materially from that of the authors already mentioned. Nowhere does he knowingly propose to separate as species more than one form belonging to a continuous series.

Dr. Heiberg also regarded species as comprehensive, and founded such aggregates as *Cymbella encyonema, C. variabilis, Cocconeis communis.*

A great change in the valuation of species becomes perceptible in the writings of Prof. Grunow, at any rate in those published up to 1880. His species are very numerous, but are frequently based upon comparatively trivial characters. In his revision of the genus *Nitzschia,*‡ many of the species, described and named, differ extremely little from others, and are indeed frequently, by his own admission, of an intermediate character. His species of *Navicula,* too, are often open to the same objection, so that later authors have deemed it

* Pritchard's 'Infusoria,' p. 797. † 1857, p. 63. ‡ 'Arctic Diatoms,' 1880.

necessary to unite them. Thus Dr. Cleve * reduces to varieties of *Caloneis Liber* the following species of Prof. Grunow: *Navicula linearis*, 1860, *N. bicuneata*, 1860, *N. excentrica*, 1860, and *N. elongata*, 1864; and, indeed, Prof. Grunow has himself seen fit to reduce to varieties forms which he originally regarded as distinct species. In his work on the Caspian Diatoms (1878) he expresses the following view regarding species: " I have discussed the preceding group (that of *Nitzschia Sigma*) because, like so many others, on more extended examination, it convinces us that previously conceived notions of species are untenable. Certainly hardly any one would consider such extreme forms as *N. maxima* and *N. anguillula* or *N. Clausii* as belonging to the same species, and yet there exists between them an uninterrupted connection. It is, however, truly an altogether idle question whether this or that form should be considered as a species, subspecies, or variety, the important point in systematic natural history being to discover the connection between organic forms; and for this is required yet much more protracted and thorough study. But, where the connection of a large group is clearly known, this should be indicated in the nomenclature; and this can only be effected by the utmost possible extension of the conception of a species, and the arrangement of all related forms as varieties; whether this or that, the one or the other, be regarded as good or as intermediate species." †

Numerous species have also been established by Adolf Schmidt, whose beautiful and accurate figures are so valuable a record of forms, and so great an assistance in identification. He explains quite candidly the principle upon which he has worked: " Cleve refers all (the) forms 7–18 to *C. heteroidea*. No one can expect that I can agree to this, since I have for already forty-four years, on the ground of quite irrefutable facts, rejected the Lamarckian mania for combination, at that time believed, as an offence against science; have completely converted the most pronounced Lamarckian, Rossmäsler; and have recommended as the first duty of naturalists, the strict emphasising of perceptible distinctions."

In the earlier part of his Atlas, he rightly figured many doubtful, or, as he calls them, " critical " forms, without naming them, leaving it to be decided, from further observation of specimens, whether or not they were regarded as entitled to specific rank. But, as later authors did not hesitate to confer on the forms he figured names of their own, even when they had not even seen a specimen, but knew the forms only from his figures, he felt himself compelled to attach specific names to all his figures. He has done so even when the forms represented approach so closely to each other as those represented on plates 194–6 of the Atlas, related to *Cocconeis pellucida*, *C. pseudomarginata*, and *C. heteroidea*, many of which Dr. Cleve refers to the last named species.

* 'Synopsis of the Naviculoid Diatoms,' part i. (1894) pp. 54–5. † P. 23.

A persistent species-maker was the late Mr. Rattray, who, in his monographs of several of the disciform genera, admits many forms as species which appear to me to graduate into each other, or to be distinguished by such trifling variations as sometimes occur in the valves of the same frustule. From Schmidt's figures he names 23 as specifically distinct, although the original observer, who had the opportunity of examining the specimens, did not so regard them.

With reference to the excessive multiplication of species, the following remarks of Mr. H. C. Watson are appropriate, although originally penned with reference to higher plants. "The 'splitters' will too often 'make a species,' resting on difference of a very slight kind or degree, if they expect or hope to find them constant—rather that nobody will find them inconstant. Usually, all they look for is some difference which can be expressed in technical language or shown in portrait drawings, while they leave to others the far less facile task of trying whether the difference is constant or inconstant, of proving that the characters of the two alleged species are convertible, if such be the case. . . . However injudicious or precipitate he may be, the species-maker has thus the chances largely in his favour for maintaining the species, truly or falsely so-called."

In the most recently published important treatises on diatoms, there is an evident reaction against such extreme "splitting." Dr. Van Heurck, in his 'Synopsis des Diatomes de Belgique,' * expressed his views thus: "If it be difficult, when treating of the higher plants, to define the relative value of forms, it is still more so when treating of very minute diatoms, and it is almost impossible, with our present knowledge at any rate, to fix with certainty the limits of species, or even to admit the existence of them. Practically the forms are so closely connected, that in many cases intermediate forms may be referred indifferently to two different types. It is by studying attentively numerous diatoms that we can see that these organisms form a continuous chain, which we break up artificially to form links, the number and importance of which vary according to individual opinion." This was in 1880; sixteen years afterwards, he writes, "With reference to species my ideas have not undergone any alteration." He refers to "primordial species," and adds, "It may be assumed that our many existing forms sprang from one or from several primitive forms. These primordial forms have given birth to secondary, tertiary forms, &c., which were differentiated in certain directions, and which have continued to evolve more or less in those directions." † And again: "It is therefore more logical to admit that the apparent transitions recorded arise from the fact that authors have created different 'species' at the expense of varieties or of races of the same specific type-form, and that true species are in reality much less numerous than has hitherto been imagined. It cannot happen, therefore, till research has been much further prolonged, that

* P. 41. † P. 99.

the many living or fossil forms, as yet unknown to us, can be compared and connected with one another, that studies can be guided by evolution, i.e. genealogical descent, and that it will be possible to soundly appreciate the relative value of the forms of diatoms."

In Dr. Cleve's 'Synopsis of the Naviculoid Diatoms' (1894 and 1896), the author's opinion as to species may be gathered from his remarks under *Diploneis crabro*: * "This species comprises a considerable number of forms, differing in size, number of costæ, breadth of lunulæ, and in the amount or absence of constriction of the middle. . . . If only a few forms be examined, it is easy to found on them apparently well defined species; but the greater the number of intermediate forms observed, the greater becomes the difficulty of finding any definite distinctions between them. There are all intermediate transitions from purely elliptical to strongly constricted forms, from forms with no lunulæ to others with broad lunulæ. . . . . I have distinguished the following forms, which diatomists fond of species-making may consider as specifically distinct." He then describes a number of varieties, arranged in three series, and comprising eighteen species of other authors. He constitutes several similar aggregate species, such as *Caloneis Liber*, *C. Silicula*, *Trachyneis aspera*, *Achnanthes brevipes*, *Cocconeis dirupta*, *C. Scutellum*, *Navicula Hennedyi*, and *N. Lyra*, each including a good number of species previously considered distinct. But Dr. Cleve is not always consistent. In not a few cases he keeps, as separate species, forms described as graduating into each other. Under *Navicula rhynchocephala*, for instance, he observes that this species and its variety *Amphiceros* "pass into each other; the latter graduates into *N. avenacea* and *N. viridula*," yet the three species are kept up. Again, under *Pleurosigma formosum*, "all the forms from *P. speciosum* are very nearly connected, and might be united into one single species. . . . Between *P. formosum* and *P. decorum* there is absolutely no specific difference, and by numerous varieties *P. formosum* graduates into *P. pulchrum* and *P. speciosum*;" yet four species are maintained.

Such divergent views as to what should constitute a species have necessarily produced very great confusion, have burdened the literature of diatoms with a vast load of synonyms, and have led, in this country at least, to an indisposition to study the order. When a valued correspondent of mine proposed to take up its study, a scientific friend contemptuously remarked to him, "Diatoms! you might as well collect and attempt to classify wall-papers." Can no uniform system be adopted, which will prevent such a reproach? It is quite true that diatoms are, so to speak, kaleidoscopic. Their characters are notoriously transitional, and have not so nearly condensed round certain definite types as is the case with most other orders of plants. Specific limitation and specific diagnosis are correspondingly difficult. But does not this render the order more worthy

* Part i. p. 100.

of study, and make it all the better a field for investigation of "species"?

It must not be thought that I in the least advocate the disregard of intermediate forms as such; on the contrary, I believe they should receive more careful attention than has hitherto generally been given to them. The indiscriminate multiplication of species which I deprecate is in most cases due to the attention of systematists having been too much concentrated on what they have considered to be "typical" specimens; while those which might be referred to either of two types have been neglected and passed over. Equal attention ought to be paid to such intermediates, in order to ascertain whether they are sufficiently numerous and close to completely connect the types between which they stand. Such work is more likely to lead to good results, and to increase our knowledge, than the establishment of any number of "new species" on hasty and insufficient observation.

If Nature is found not to support the ideas of systematists as to what a "species" should be, systematists will eventually have to conform to the teaching of Nature as to what a "species" is; or will, at any rate, be guided to a decision as to whether "species" exist in Nature at all.

To scientifically determine this latter point, it is requisite to observe and record with care, not merely casually but systematically, all intermediate forms, with the special view of ascertaining whether living diatoms do indeed form the "continuous chain" of Dr. Van Heurck, or whether there now exist definite gaps, dividing them into what, I submit, should then be regarded as "natural" species. Should this be found to be the case, we can next inquire whether fossil forms, partially or entirely, bridge over these gaps; and if so, at what horizon of time and space. Such an investigation will throw light not only on the fact of evolution, but possibly also on its history. The ultimate result may indeed be a revolution, perhaps in the direction indicated by Prof. Huxley, compelling us to relinquish altogether the idea of species as "definite entities"; but perhaps only, I venture to think, in the direction of greatly extending our idea of their comprehensiveness.

So far as my own acquaintance with diatoms has gone, I believe they tend to support the latter view; but I freely confess that my own knowledge, and I think also the investigations of other diatomists, are not sufficient to justify a confident opinion. All I venture to contend, therefore, is, that the question should still be regarded as an open one.

VIII.—*A Contribution to the Freshwater Algæ of the South of England.*

By W. West, F.L.S., and G. S. West, A.R.C.S.

Communicated by A. W. Bennett, F.L.S., F.R.M.S.

With Appendix by A. W. Bennett, F.L.S., F.R.M.S.

(*Read Oct.* 20*th*, 1897.)

Plates VI. and VII.

Although much has already been done towards our knowledge of the distribution of these interesting plants in this part of the country, and this paper is intended to supply a further addition to this knowledge, yet many large districts still remain from which careful collecting is required. The chief workers in this field during recent years have been Mr. W. Joshua, Mr. A. W. Bennett, and Mr. E. D. Marquand; and the districts included in their researches are portions of Surrey, Hampshire, Wiltshire, Devonshire, and Cornwall. The following is a list of the more important papers dealing with Freshwater Algæ from the South of England since the publication of Hassall's 'British Freshwater Algæ' in 1845, and Ralfs' 'British Desmids' in 1848:

1. Joshua, W. Notes on British Desmidieæ. Journ. Bot., xx. (1882) p. 300.
2. Marquand, E. D. The Desmids and Diatoms of West Cornwall. Trans. Penzance Nat. Hist. & Antiq. Soc., i. (1882–3) pt. 3.
3. Joshua, W. Notes on British Desmidieæ. Journ. Bot., xxi. (1883) p. 290.
4. Marquand, E. D. Freshwater Algæ of the Land's End District. Trans. Penzance Nat. Hist. & Antiq. Soc., 1885.
5. Bennett, A. W. Freshwater Algæ of North Cornwall. Journ. Roy. Micr. Soc., Feb. 1887.
6. „ „ Freshwater Algæ and Schizophyceæ of Hampshire and Devonshire. Journ. Roy. Micr. Soc., Feb. 1890.
7. Roy, J. Freshwater Algæ of Enbridge Lake and Vicinity, Hampshire. Journ. Bot., xxviii. (Nov. 1890).
8. Bennett, A. W. Freshwater Algæ and Schizophyceæ of South-west Surrey. Journ. Roy. Micr. Soc., Feb. 1892.

Also in part the two following papers:—

9. West, W. and G. S. New British Freshwater Algæ. Journ. Roy. Micr. Soc., Dec. 1893.
10. „ „ On some New and Interesting Freshwater Algæ. Journ. Roy. Micr. Soc., April 1896.

EXPLANATION OF PLATES

(see pp. 468, 469).

The results here set forth have been obtained by the gradual examination for many years of a large and extensive series of algæ-gatherings ranging over many of the counties of the south and south-west of England. A more detailed account of the collections (which were for the most part made by the authors) will be found below.

All the species recorded for Frensham, the New Forest, and Dartmoor, are additional to those found at these respective localities by Mr. Bennett.

In these gatherings no less than 52 species of Desmids have been observed with zygospores, many of them for the first time in that state.

As might be expected, the more alpine and "wet-rock" species (such as *Cosmarium anceps, C. Holmiense, C. nasutum, Staurastrum Meriani, S. Kjellmani*, &c.) are, as far as we have observed, absent from all the eastern counties of the South of England.

As it is impossible to accurately identify, from sterile specimens, the majority of plants belonging to the families Œdogoniaceæ and Zygnemaceæ, no species of these orders are recorded in this paper unless they were seen in abundant fruit, with the exception of *Œdogonium undulatum*, which even in its barren state is unmistakable.

The classification set forth in this paper is the one which we think to be the most natural, after taking into consideration all the

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Plate VI.

(Explicatio iconum.)

a, a' = front view (a basi visa).
b = vertical view (a vertice visa).
c = side view (a latere visa).
d = basal view of semi-cell (a basi visa).

Fig. 1, 2.—*Closterium Siliqua* sp. n. × 520.
„ 3. „ *lanceolatum* Kütz. var. *parvum* var. n. × 520.
„ 4. „ *Pritchardianum* Arch. Apex of semi-cell, × 520.
„ 5. „ „ Zygospore formed by the conjugation of three cells. × 120.
„ 6.—*Sphærozosma Wallichii* Jacobs var. *anglicum* var. n. *a* et *d*, × 520; *a'*, × 830.
„ 7. „ *vertebratum* (Bréb.) Ralfs var. *latius* var. n. × 520.
„ 8, 9.—*Penium subtile* sp. n. 8, × 520; 9, × 660.
„ 10.—*Cosmarium Blyttii* Wille var. *Novæ Sylvæ* var. n. × 520.
„ 11. „ *fastidiosum* sp. n. × 520.
„ 12. „ *ocellatum* B. Eichl. and Gutw. var. *incrassatum* var n. × 520.
„ 13, 14. „ *sphagnicolum* sp. n. × 520.
„ 15.—*Xanthidium concinnum* Arch. × 740.
„ 16.—*Arthrodesmus octocornis* Ehrenb. Zygospore × 520.
„ 17.—*Cosmarium bioculatum* Bréb. Zygospore × 520.
„ 18.—*Staurastrum rostellum* Roy and Biss. var. *erostellum* var. n. × 660.
„ 19.—*Cosmarium subpunctulatum* Nordst. × 520.
„ 20. „ *subbroomei* Schmidle, forma. × 520.
„ 21. „ *Ungerianum* (Näg.) De Bary var. *subtriplicatum* var. n. × 520.
„ 22.—*Staurastrum trachytithophorum* sp. n. × 520.
„ 23. „ *nodosum* sp. n. × 660.
„ 24.—*Cosmarium bioculatum* Bréb. var. *hians* var. n. × 520.
„ 25.—*Staurastrum tetracerum* Ralfs var. *validum* var. n. × 520.
„ 26.—*Cosmarium Cucurbita* Bréb. Zygospore × 520.
„ 27.—*Staurastrum gracile* Ralfs. Zygospore × 520.

recent work at this group of plants. For the filamentous Myxophyceæ (Cyanophyceæ), i.e. the Nostochaceæ Heterocystæ and Nostochaceæ Homocystæ, we follow the classification and also the nomenclature of Bornet and Flahault's 'Revision des Nostocacées Hétérocystées' and Gomont's 'Monographie des Oscillariées.'

The following is a more detailed account of the collections. To save space, contractions are used (throughout the paper) for the localities.

I. *Essex.*—The only part investigated was Epping Forest, in which gatherings were made from ditches, bogs, squeezings of *Sphagnum* and *Hypnum* from several ponds, and washings of *Myriophyllum* and *Potamogeton* from a deep fish-pond.

Ep. = Epping Forest.

II. *Middlesex.*—Mostly collections from ponds and ditches in various parts of the county.

Bg. = Bow Green.	No. = Northwood.
Ha. = Harefield.	Pi. = Pinner.
Hy. = Hyde Park.	Ru. = Ruislip Reservoir.
Ki. = Kingsbury.	U. = Uxbridge Common.
Kg. = Kingsbury Green.	Wh. = Welsh Harp.

III. *Surrey.*—By far the most numerous and varied gatherings were made in this county, during several years and at all seasons of the year. In the northern portion of the county, Esher West-end Common, Chobham Common, and Bisley Common, were much more productive than any of the other surrounding commons. In the south-east corner of the county a few very interesting species were obtained from some large ponds north of Felbridge, one locality quoted as "Mill-pond E. of Chapel Wood" being very rich. In the south-west corner, the Frensham district was fairly productive, but Thursley and Puttenham Commons were much the best. On the

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PLATE VII.

Fig. 1, 2.—*Scenedesmus granulatus* sp. n. × 520.
„ 3.—*Cosmarium truncatellum* Perty. × 520.
„ 4, 5.—*Tetraëdron horridum* sp. n. × 520.
„ 6, 7.—*Œdogonium macrospermum* sp. n. × 520.
„ 8.—*Rhaphidium polymorphum* Fresen. var. *tumidum* var. n. × 520.
„ 9–13. „ „ var. *mirabile* var. n. × 520. *x*, moving corpuscle.
„ 14.—*Staurastrum margaritaceum* (Ehrenb.) Menegh. var. *robustum* var. n. × 520.
„ 15–17. „ „ var. *subcontortum* var. n. × 520.
„ 18.—*Dactylococcus bicaudatus* A. Br. var. *exilis* var. n. × 520.
„ 19. „ *dispar* sp. n. × 520.
„ 20.—*Arthrodesmus Incus* (Bréb.) Hass. var. *subquadratus* var. n. × 520.
„ 21–23.—*Tetraëdron minimum* (A. Br.) Hansg. × 520.
„ 24.—*Cosmarium adoxum* sp. n. × 740.
„ 25–28.—*Ammatoidea Normanii* gen. et sp. n. × 520.

former is a fine bog in which *Rhynchospora fusca* is plentiful, along with abundance of submerged and floating *Sphagnum contortum*, *Hypnum scorpioides*, and better still, *Utricularia minor* coated with a brownish-green slime of almost pure Desmids. Squeezings of *Sphagnum* and *Utricularia minor* from General's Pond, Puttenham Common, also yielded some uncommon species.

B. = Barnes Common.
Bh. = Blindley Heath (S.E.).
Bi. = Bisley Common.
Bo. = Bolder Mere.
Br. = Brockham Green (to Betchworth).
C. = Chobham Common.
Co. = Near Cobham Common.
Cr. = Crowhurst (S.E.).
Di. = Ditton Marsh.
Dj. = Devil's Jumps, Frensham.
Do. = Dorking.
E. = Esher Common.
Ea. = Earlswood Common.
Ew. = Esher West-end Common.
F. = Felbridge.
Fg. = Frensham Great Pond.
Fh. = Frogit Heath (S.E.).
Fl. = Frensham Little Pond.
Hk. = Hackbridge.
M. = Mitcham Common.
Mi. = Mitcham Grove.
Mp. = Mill-pond E. of Chapel Wood (S.E.).
Pt. = Putney Heath (nr. Pt. = Roehampton Lane).
Pu. = Puttenham Common.
Ra. = Ranmore Com. (pond).
Rp. = Richmond Park.
Th. = Thursley Common.
Wa. = Wandsworth Common.
We. = Bog by R. Wey, Frensham.
Wi. = Wimbledon Common.
Wk. = Canal at Woking.
Wo. = Whitemoor Common, Worplesdon.
Wt. = Witley Common.

IV. *Kent.*—Collections were made from a few small ponds on Hayes Common, and also from two large ponds, as well as from a small bog, on Keston Common. These ponds were crowded with *Potamogeton*, *Scirpus*, &c., and yielded many good species.

Bm. = Bromley.
Cb. = Cobham.
Hc. = Hayes Common.
Ks. = Keston Common.

V. *Oxfordshire.*—Collections were kindly made by Mr. S. Wood from a few small ponds in the south-east of the county.

Go. = About $2\frac{1}{2}$ miles N.E. of Goring.

VI. *Hampshire.*—The gatherings in this county were limited to a few ponds and some very rich bogs in the New Forest. Mr. W. West, jun., collected some rich gatherings of Desmids from *Utricularia minor* in Ashurst Bog, near Lyndhurst Road.

N. = New Forest.

VII. *Devonshire.*—The best gatherings made in this county were from some fine bogs in the neighbourhood of Hey Tor, Dartmoor. The Lea on Slapton Sands also yielded some good material.

D. = Dartmoor (Hey Tor).
Dl. = Dawlish.
Gp. = Grimspound, Dartmoor.
S. = Slapton Sands.
Tq. = Torquay.

VIII. *Cornwall.*—These gatherings were obligingly made at our request by Mr. R. V. Tellam, of Bodmin. Some of them were very rich, and all were more or less productive of good things. A small collection was also made by Mr. Ll. J. Cocks from Tremethick Moor.

G.	= Gunwen Moor.	P.	= Penhargurd Wood.
H.	= Halgavor Moor.	R.	= Roughter Moor.
Hl.	= Helmentor Moor.	T.	= Tintagel.
K.	= Kynance Valley.	Tm.	= Tremethick Moor.
L.	= Lanlivery Moor.	W.	= Withiel.

Those species (about 60) not previously recorded for the British Isles are prefixed by an asterisk.

We have noted a very large number of Diatoms, but, as much of the material has not as yet been examined with regard to this class of plants, we leave them for future publication.

Class FLORIDEÆ.

Fam. **Batrachospermeæ.**

Genus *Batrachospermum* Roth.

1. *B. moniliforme* Roth. II. In canal, Ha. IV. Ks. VI. N. VII. D.
   Var. *confusum* (Hass.) Cooke. IV. Cæsar's Well, Ks.
2. *B. vagum* (Roth) Ag. III. In pond, Dj. In bogpool, Th.

Class CHLOROPHYCEÆ.

Ord. *Confervoideæ Heterogamæ.*

Fam. **Coleochætaceæ.**

Genus *Coleochæte* Bréb.

1. *C. scutata* Bréb. I. Ep. II. Wh. III. Ew., Fg., Wo. V. Go. VI. N.
2. *C. soluta* Prings. I. Ep. III. Bi., Fg.
3. *C. orbicularis* Prings. III. Cr.

Fam. **Œdogoniaceæ.**

Genus *Bulbochæte* Ag.

1. *B. polyandra* Cleve. VIII. W.
2. *B. setigera* (Roth) Ag. III. Mp., Rp. IV. Ks.
*3. *B. nana* Wittr. V. Go.
4. *B. mirabilis* Wittr. III. Th.
5. *B. rectangularis* Wittr. III. Ew., Mp.

Genus *Œdogonium* Link.

1. *Œ. Petri* Wittr. III. Ew. VI. N.
2. *Œ. cryptoporum* Wittr. var. *vulgare* Wittr. II. Wh.

*3. *Œ. obsoletum* Wittr. V. Go.
*4. *Œ. zig-zag* Cleve.

Vegetative cells slightly thicker and spermogonia bicellular.

Crass. cell. veget.	19–23 μ;	altit.	$2\frac{1}{2}$–4-plo major;
,, oogon.	53–57 μ;	,,	50–55 μ;
,, cell. spermogon.	19 μ;	,,	6–7·5 μ.

II. Ha.

*5. *Œ. nobile* Wittr. II. Ha.
6. *Œ. paludosum* (Hass.) Wittr. III. C.
*7. *Œ. oblongum* Wittr. II. Wh.
8. *Œ. platygynum* Wittr. VIII. L.
*9. *Œ. obtruncatum* Wittr.

Œ. dioicum, nannandrium; oogoniis 4-continuis, globoso-ellipsoideis, oosporis oogonia complentibus; nannandribus oblongo-pyriformibus, curvatis, unicellularibus, in oogoniis sedentibus.

Crass. cell. veget.	17–20 μ;	altit.	4–5-plo major;
,, oogon.	48–53 μ;	,,	48–53 μ;
,, oospor.	47–52 μ;	,,	47–51 μ;
,, cell. suffult.	26 μ;		
,, nannandr.	9·5–14 μ.		

II. Wh.

This plant comes nearest to the partially described *Œ. obtruncatum*, agreeing with it in all those characters mentioned by Wittrock. We therefore describe the additional characters observed in the specimens.

10. *Œ. undulatum* (Bréb.) A. Br. VIII. W.
*11. *Œ. cyathigerum* Wittr. II. Ha.
12. *Œ. Braunii* (Kütz.) Prings. II. Ha.
13. Œ. MACROSPERMUM sp. n. (Pl. VII. figs. 6, 7.)

Œ. dioicum, nannandrium, oogoniis singulis, magnis, subdepresso-globosis, circumscissilibus cum rima angustissima submediana; oosporis subdepresso-globosis, oogonia complentibus, membrana glabra; cellulis suffultoriis eadem forma ac cellulis vegetativis ceteris: nannandribus in cellulis suffultoriis sedentibus, paullo curvatis, bicellularibus (?)

Crass. cell. veget.	13–13·5 μ;	altit.	4–5-plo major;
,, oogon.	44–46 μ;	,,	39–40 μ;
,, nannandr.	11·5 μ;	,,	38 μ.

II. Ha.

The nearest species to this is *Œ. propinquum* Wittr., from which it is distinguished by its slightly greater thickness and proportionately longer cells, its much larger oogonia and oospores, which are depressed, and the circumscissile oogonia.

14. *Œ. macrandrum* Wittr. I. Ep.
15. *Œ. cardiacum* (Hass.) Wittr., var. *carbonicum* Wittr. III. M.

*16. *Œ. lautumniarum* Wittr. The spermogonia were about 8-celled, and the supporting cells of the oogonia a little inflated. II. Wh.

Ord. *Siphoneæ.*

Fam. **Vaucheriaceæ.**

Genus *Vaucheria* DC.

1. *V. sericea* Lyngb. II. Ki.
2. *V. aversa* Hass. II. Ru.
3. *V. sessilis* (Vauch.) DC. II. Ki. III. M. VI. N.
4. *V. geminata* (Vauch.) DC. III. C. IV. Ks.
 Var. *racemosa* Walz. III. B., F.
5. *V. hamata* (Vauch.) Lyngb. II. Ki., Ru.
6. *V. terrestris* Lyngb. IV. Bm.

Fam. **Hydrogastraceæ.**

Genus *Botrydium* Wallr.

1. *B. granulatum* (L.) Grev. III. Ew., July 1893; also Oct. 1893, abundant. M. (L. A. Boodle; 1892).

Ord. *Confervoideæ Isogamæ.*

Fam. **Ulvaceæ.**

Genus *Monostroma* Thur.

1. *M. bullosa* (Roth) Wittr. III. M. (L. A. Boodle; 1891).

Genus *Prasiola* Ag.

1. *P. crispa* (Lightf.) Ag. II. Bg., U. III. Kingston. IV. Hc.

Fam. **Ulotrichaceæ.**

Sub-fam. Ulotricheæ.

Genus *Hormidium* Kütz.

1. *H. murale* (Lyngb.) Kütz. (*Ulothrix radicans* Kütz.). I. Ep. III. Wi.
2. *H. parietinum* (Vauch.) Kütz. (*Ulothrix parietina* Kütz.). I. Ep. II. Pi. III. Esher. Frensham, Kingston, Wi. IV. Bm.

Genus *Hormiscia* Fries; Aresch.

*1. *H. subtilis* (Kütz.) De Toni. IV. Hc.
 Var. *variabilis* (Kütz.) Kirchn. (*Ulothrix variabilis* Kütz.). I. Ep. II. Hy. III. Dj., E., Ew., Mp., Wi. IV. Cb., Ks. V. Go.
 Var. *tenerrima* (Kütz.) Kirchn. (*Ulothrix tenerrima* Kütz.). I. Ep. II. Ru. III. E., Rp., Wi.

2. *H. æqualis* (Kütz.) Rabenh. var. *catæniformis* (Kütz.) Rabenh. I. Ep. II. Wh. III. B. IV. Ks.
3. *H. moniliformis* (Kütz.) Rabenh. I. Ep. II. Ha. V. Go.
4. *H. zonata* (Web. et Mohr.) Aresch. II. Canal, Ha.

Genus *Hormospora* Bréb.

1. *H. mutabilis* Bréb. VI. N. VII. D. VIII. W.
2. *H. plena* Bréb. VIII. L.

Sub-fam. CHÆTOPHOREÆ.

Genus *Herposteiron* Näg.

1. *H. repens* (A. Br.) Wittr. (*Aphanochæte repens* A. Br.). I. Ep. II. Ha., Hy., No., Wh. III. Bh., C., Th. V. Go.

Var. GRACILIS var. n.

Var. cellulis minoribus, diametro 2–3-plo longioribus, setis tenuioribus et distincte articulatis.

Long. cell. 7–15 μ; lat. cell. 4–7 μ. II. U., on *Œdogonium* sp.

Genus *Nordstedtia* Borzì.

1. *N. globosa* (Nordst.) Borzì. III. E., Fg., M., Tb. V. Go. VI. N. VIII. T., W.

Var. *depressa* nob. (*Aphanochæte globosa* var. *depressa* West). III. Mp. VI. N.

Genus *Chætophora* Schrank.

1. *C. pisiformis* (Roth) Ag. II. Ru. III. Ew., Mp.
2. *C. elegans* (Roth) Ag. I. Ep. III. Fg., Canal at Woking. VII. S.
3. *C. Cornu Damæ* (Roth) Ag. (*C. endivæfolia* auct.). III. M. VII. S.
4. *C. tuberculosa* (Roth) Ag. IV. Ks.

Genus *Draparnaudia* Bory.

1. *D. glomerata* (Vauch,) Ag. III. M. IV. Ks. VI. N.

Obtained with spores from Mitcham Common, Surrey, and Keston Common, Kent. Spores thick-walled; walls rusty brown and rough; chlorophyll parietal.

Var. *distans* (Kütz.) —. III. Ew.

2. *D. plumosa* (Vauch.) Ag. I. Ep. II. Ru. III. Ew., Pu. VII. D. VIII. G. H.

Genus *Stigeoclonium* Kütz.

1. *S. tenue* (Ag.) Rabenh. III. Do., E. IV. Hc.
2. *S. protensum* (Dillw.) Kütz. III. Th. VII. D.
3. *S. fastigiatum* Kütz. III. M.

Sub-fam. CONFERVEÆ.

Genus *Conferva* L.; em. Lagerh.

1. *C. bombycina* Ag. Generally distributed and abundant. Forma *minor* Wille. General and abundant.
2. *C. Raciborskii* Gutw. VI. N.

Genus *Microspora* Thur.; em. Lagerh.

1. *M. floccosa* (Vauch.) Thur. I. Ep. II. Ha., Pi.
2. *M. Wittrockii* (Wille) Lagerh. III. C.
3. *M. abbreviata* (Rabenh.) Lagerh. II. Pi.
4. *M. fontinalis* (Berk.) De Toni. VII. Street.

Fam. **Chroolepidaceæ.**

Genus *Microthamnion* Näg.

1. *M. strictissimum* Rabenh. 1863. (*M. vexator* Cooke 1882). I. Ep. III. B., Br., Di., Ew., M., Pt., Wi. VI. N.

There is no doubt that Cooke gave the name *M. vexator* to the plant previously described by Rabenhorst as *M. strictissimum.* Dr. Nordstedt (in K. Sv. Vet.-Akad. Handl., Bd. xxii. No. 8, p. 15) suggests that they are identical. Cooke (Brit. Freshw. Alg., p. 188) states that his species is "very much more slender than *M. strictissimum,*" and gives as the diameter ·003 mm. Nordstedt's measurements of *M. vexator* are 3–4 μ (diam.) Rabenhorst's measurements of *M. strictissimum* are 1/700–1/600 of a Paris line (= 3–4 μ); therefore Cooke, in giving the above statement, must have made a mistake in converting Rabenhorst's measurements to mm.

*2. *M. Kützingianum* Näg. I. Ep. III. E., Pu., Rp. IV. Cb. V. Go.

Fam. **Cladophoraceæ.**

Genus *Cladophora* Kütz.

1. *C. flavescens* Ag. II. Wh. III. Cr., Ra.
2. *C. crispata* (Roth) Kütz. II. No. III. Bh.
3. *C. glomerata* (L.) Kütz. II. Ha., Hy. VI. N.

Ord. *Conjugatæ.*

Fam. **Zygnemaceæ.**

Sub-fam. MESOCARPEÆ.

Genus *Mougeotia* Ag.

1. *M. scalaris* Hass. III. Ew.
2. *M. recurva* (Hass.) De Toni. VI. N.
3. *M. parvula* Hass. I. Ep. III. Ew., Wi. VIII. T.
4. *M. genuflexa* (Dillw.) Ag. II. No., U. III. Ew., Wi. VI. N.

*5. *M. calcarea* Wittr. VI. N.
6. *M. capucina.* III. Ew. VI. N.
7. *M. quadrangulata* Hass. III. Dj.
8. *M. viridis* (Kütz.) Wittr. I. Ep. III. Ew., Pu., Th., We.
9. *M. gracillima* (Hass.) Wittr. I. Ep. III. C., Ew., Wi.

Genus *Gonatonema* Wittr.

1. G. BOODLEI sp. n.

G. cellulis vegetativis diametro 12–15-plo longioribus; aplanosporis maturis e fronte et e latere visis ellipticis, apicibus late acuteve rotundatis, membrana distincte punctata, lutescente.

Crass. fil. veget. 5–5·5 μ; long. aplanospor. 17–23 μ (plerumque 21 μ); lat. aplanospor. 13–17 μ (plerumque 15 μ). III. M.

This interesting genus has been but once previously found in this country, when Hassall (1845) described from Notting Hill a plant which he named *Mesocarpus notabilis*, and which has since been placed by Wittrock (1878) under *Gonatonema* as *G. notabile* (Hass.) Wittr. *G. Boodlei* differs from *G. ventricosum* Wittr. in being slightly smaller, and in having elliptical aplanospores when seen from either the front or side; these aplanospores are never oblique, the apices are never truncate, and the spore-membrane is punctate. It was found in abundance mixed with *Spirogyra* sp. in a gathering made by Mr. L. A. Boodle in 1894 in a ditch on Mitcham Common, Surrey.

Sub-fam. ZYGNEMEÆ.

Genus *Debarya* Wittr.

1. *D. glyptosperma* (De Bary) Wittr. VI. N. (very fine, April 1897).
2. *D. lævis* (Kütz.) nob. [*Mougeotia lævis* (Kütz.) Arch.]. III. M.

Crass. fil. veget. 25 μ; spor. 42–50 × 28–32 μ.

There seems to be no doubt whatever that this plant is a true *Debarya*, as the whole of the contents of the conjugating cells unites to form a true zygospore. The adult zygospores are dark coloured, with thick walls, and are ornamented with large scrobiculations.

Genus *Zygnema* Ag.; em. De Bary.

1. *Z. anomalum* (Hass.) Cooke. IV. Ks.
2 *Z. leiospermum* De Bary. III. Ew. VIII. T.
3. *Z. atrocæruleum* sp. n.

Z. cellulis vegetativis diametro 2½–5-plo longioribus; zygosporis globosis vel subglobosis, membrana lævis, homogenea, et atrocœrulea, in una cellularum conjugatarum inclusis; cellulis fructiferis valde inflatis circa zygosporas.

Crass. fil. veget. 14·5–17 μ (plerumque 15–16 μ); diam. zygosp. 23–26 μ (usque ad 29 μ long.). V. N.

This species comes nearest to *Z. melanospermum* Lagerh. and *Z. cyanospermum* Cleve. It differs from the former in its narrower filaments, in its subglobose zygospores, and in having the fructiferous cells much inflated round the zygospores; from the latter, in its narrower filaments and much smaller zygospores, which are not situated in the conjugating tube between the filaments.

4. *Z. ericetorum* (Kütz.) Hansg. I. Ep. III. Pu., Th., Wi.
5. *Z. pectinatum* (Vauch.) Ag. VI. N.

Genus *Spirogyra* Link.

1. *S. tenuissima* (Hass.) Kütz. II. Ha., U., Wh. III. M.
2. *S. inflata* (Vauch.) Rabenh. III. Ew., M.
*3. *S. Spréeiana* Rabenh. III. Ew.
4. *S. Weberi* Kütz. II. Ru. III. Ra.
*5. *S. calospora* Cleve.

The cells are 4 to 7 times longer than broad; sporiferous cells very slightly inflated to accommodate the zygospore, which is a little broader than the vegetative cells. The zygospores were usually oblong-elliptic, and only 1½ times longer than broad although occasionally twice as long. The median spore-membrane is covered so densely with large somewhat angular scrobiculations of variable size, that its surface view appears a mere reticulation. Petit's figure (Spirogyræ des envir. Paris, pl. ii. f. 13) of an enlarged portion of the zygospore of this species is very incorrect.

Crass. cell. veget. 31–36·5 μ; crass. cell. fruct. 41–52 μ; long. zygosp. 75–87 μ; lat. zygosp. 40–50 μ. II. Ru.

6. *S. gracilis* (Hass.) Kütz. var. *flavescens* (Hass.) Rabenh. II. Ru.
7. *S. catæniformis* (Hass.) Kütz. III. M. VI. N.
8. *S. affinis* (Hass.) Petit. III. E., M.
9. *S. varians* (Hass.) Kütz. II. Ru. III. B. VII. Street.
10. *S. porticalis* (Müll.) Cleve. IV. He.
11. *S. decimina* (Müll.) Kütz. III. Fh.

Var. CYLINDROSPERMA var. n.

Var. zygosporis exacte cylindricis, diametro 2–3½-plo longioribus, apicibus late rotundatis, cellulas fructiferas pæne complentibus.

Crass. cell. veget. 40–44 μ; long. zygosp. 92–140 μ; lat. zygosp. 39–43 μ. III. Fl.

12. *S. nitida* (Dillw.) Link. II. Ha. III. Fl., Wi.

13. *S. setiformis* (Roth) Kütz. III. Fl.
14. *S. bellis* (Hass.) Cleve. II. Ki., U., Wh.
15. *S. crassa* Kütz. III. Cr. IV. He.

Fam. **Desmidiaceæ.**

Genus *Gonatozygon* De Bary.

1. *G. Ralfsii* De Bary. III. Ew., M. VI. N. VII. D.
2. *G. Brebissonii* De Bary. III. Ew., Fg., Rp., Th. IV. Ks. VI. N. VIII. H.
3. *G. minutum* West. III. Ew. VI. N. VIII. H.
4. *G. læve* Hilse. I. Ep.
5. *G. Kinahani* (Arch.) Rabenh. III. Rp., Wi.

Genus *Spirotænia* Bréb.

1. *S. condensata* Bréb. III. Th. VII. D. VIII. H., Hl., L., W.
2. *S. obscura* Ralfs. III. Ew., Wi.

Very abundant from Wimbledon Common, Surrey, Oct. 1892, and from Esher West-end Common, Oct. 1893.

Genus *Mesotænium* Näg.

1. *M. De Greyi* W. B. Turn. III. Pu. VIII. T.
2. *M. violascens* De Bary. III. Dj.
*3. *M. Endlicherianum* Näg. var. *grande* Nordst. I. Ep.

Genus *Cylindrocystis* Menegh.

1. *C. diplospora* Lund. I. Ep. III. C., Th. VIII. T.
2. *C. crassa* De Bary. I. Ep. III. B., Bi., C., E., Th., Wi. VIII. H., Hl., T., W.

Pure gatherings from Chobham, Surrey.

3. *C. Brebissonii* Menegh. III. Bo., C., Rp., Th. (with zygospores), Wi., Wo. IV. Ks. VII. Gp. VIII. R., T., W.

Genus *Penium* Bréb.

1. *P. margaritaceum* (Ehrenb.) Bréb. III. E. VI. N. VII. D. VIII. G., H.

Var. *punctatum* Ralfs. VII. D.

2. *P. cylindrus* (Ehrenb.) Bréb. III. Pu., Th. (with zygospores).
3. *P. cuticulare* West & G. S. West. III. Th. (with zygospores).
4. *P. exiguum* West forma *Lewisii* West & G. S. West (*Penium Lewisii* W. B. Turner). III. Bi., E. VIII. W.
5. *P. spirostriolatum* Barker. III. Pu. VIII. H., T.
6. *P. digitus* (Ehrenb.) Bréb. (inclus. *P. lamellosum* Bréb.).

I. Ep. III. Bi., C., E., Ew., Pu., Th. IV. Ks. VII. D. VIII. G., H., Hl., T., W.

Var. *constrictum* West. VI. N.

7. *P. interruptum* Bréb. III. Pu.
8. *P. Nägelii* Bréb. III. Th. VI. N.

Long. 115 μ; lat. 25 μ.

9. *P. libellula* (Focke) Nordst. (*P. closterioides* Ralfs). III. C., Th., Wo. VII. D. VIII. H.

Forma *interrupta* West. III. C.

10. *P. Navicula* Bréb. I. Ep. III. E., Ew., Fh., Th. IV. Ks. VI. N. VII. D. VIII. H., L.
11. *P. rufescens* Cleve (*P. rufopellitum* Roy). III. Bi.
12. *P. curtum* Bréb. III. Pu., Th. VII. Gp.

Forma *major* Wille. III. Mp.

Long. 59 μ; lat. 30–32 μ.

13. *P. suboctangulare* West. VI. N. (with zygospores).
14. P. SUBTILE sp. n. (Pl. VI. figs. 8, 9.)

P. minutissimum, pæne 1½-plo longius quam latum, ellipticum, apicibus subtruncatis, medio cum sutura mediana delicatissima (levissime constrictum); a vertice visum exacte circulare; membrana achroa, delicatissime et indistincte punctulata, punctulis sparsis circiter 12 in semicellula unaquaque.

Long. 14–15 μ; lat. 10–11 μ. III. Th.

This minute species was in abundance and was perfectly constant in its characters. The widest part of the cell is always *in the middle*, and the apices are always flattened.

It can be compared with *Disphinctium sparsipunctatum* Schmidle (in Œsterr. botan. Zeitschrift, 1895, No. 7, p. 14 (sep.) t. xv. f. 1–6), from the unconstricted form of which it differs in the form of its cells, its much more delicate punctulations, and its circular vertical view.

15. *P. truncatum* Bréb. VII. D. VIII. T., W.
16. *P. polymorphum* Perty. III. C. VIII. P.
17. *P. inconspicuum* West. III. Pu. IV. Ks.
18. *P. cruciferum* (De Bary) Wittr. I. Ep. III. Wi.
19. *P. cucurbitinum* Bissett. I. Ep. III. Th.
20. *P. minutum* (Ralfs.) Cleve. III. C., Pu., Th. VI. N. VII. D. VIII. R., W.

Genus *Roya* West & G. S. West.

1. *R. obtusa* (Bréb.) West & G. S. West var. *montana* West & G. S. West. I. Ep. III. Ew.

Genus *Closterium* Nitzsch.

1. *C. abruptum* West. III. Pu., Wi. VI. N. VII. D.
2. *C. didymotocum* Corda. III. C., Th. VII. D. VIII. H., P.

Some slender forms of this species were observed from the New Forest (long. 405–418 μ; lat. 28–34 μ), with rather more attenuate and slightly recurved apices; some of these were distinctly but minutely asperulate, being covered with somewhat irregular and depressed granules.

3. *C. turgidum* Ehrenb. I. Ep. III. Th. VI. N. VIII. L.
4. *C. prælongum* Bréb. III. Mp.
   Forma *brevior* West. I. Ep. II. Rv. (with zygospores). III. Fh.
5. *C. Pritchardianum* Arch. VIII. Tm. (with zygospores).
   Long. 440–590 μ; lat. 35–46 μ; lat. apic. 7–8 μ; diam. zygosp. 83–108 μ.

This species was observed with zygospores in quantity. The cells were of the same proportions as those described by Archer, but the apices were generally a little narrower. The cell-membrane was of a uniform golden-brown colour, and the fine striolations, which consisted of a series of fine puncta, were arranged subspirally as in forma *crassa* Gutw. (in Rosprawy Akad. Umiej. Kratow. Wydzial. mat.-przyr., t. xxiii. (1896) p. 38, t. v. f. 13). Towards the apices, however, these puncta became irregular (cf. Pl. I. fig. 4). One zygospore was noticed which had been produced by the conjugation of three individual cells (Pl. VI. fig. 5).

6. C. Siliqua sp. n. (Pl. VI. figs. 1, 2.)
   C. submediocre, cellulis diametro circiter 10-plo longioribus, leviter curvatis, dorso modice curvato, in medio subrecto, et prope apices levissime concavo, ventre levissime concavo, parte mediana cellularum cum lateribus subparallelis, apices versus gradatim attenuatis, apicibus subangustatis, levissime recurvatis subrotundatisque; membrana achroa glabra; pyrenoidibus in serie singula subirregulariter dispositis, in semicellula unaquaque 7 vel 8; locellis apicalibus terminalibus et corpuscula oblonga singula includentibus.
   Long. 217–250 μ; lat. 21–24 μ; lat. apic. 4 μ. III. Ew.

This species is distinguished from *C. Pritchardianum* Arch. by its much smaller size, its much more tapering and narrower extremities, as well as by its smooth and colourless membrane. From *C. littorale* Gay it differs in being a little longer, in the absence of the slight ventral inflation, and in the blunter and slightly recurved apices. It may also be compared with *C. subangulatum* Gutw., from which it differs in the subparallel median portion of the cells, in the absence of the ventral inflation, in the more convex dorsal margin, as well as in the recurved apices. From all the above, the living examples are distinguished by the terminal locellus possessing but one oblong movable corpuscle.

*7. *C. littorale* Gay. II. Kg. VIII. Tm.

8. *C. acerosum* (Schrank) Ehrenb. General; zygospores from Kingsbury, Middlesex.

9. *C. lanceolatum* Kütz. I. Ep. (with zygospores). II. Ki., Wh. III. B., Do., Fh. IV. Hc.

Var. PARVUM var. n. (Pl. VI. fig. 3).

Var. duplo minor. Long. 183 μ; lat. 21 μ.

III. Do., in ditch amongst *Spirogyra* sp.

10. *C. lunula* (Müll.) Nitzsch. I. Ep. III. B., E., Ew., Pu., Th. IV. Ks. VIII. G., H., L.

11. *C. Ehrenbergii* Menegh. I. Ep. II. Ha. III. B., C., Ew., Fh., Pt., Wi. (with zygospores). IV. Cb.

A pure gathering was obtained from a ditch in Roehampton Lane, Putney Heath, Surrey.

12. *C. Malinvernianum* De Not. III. Ew., Fh.

Forms were observed with rather more attenuate apices, which were obliquely subtruncate. Long. 284–359 μ; lat. 41–48 μ; lat. apic. 7 μ. VIII. Tm.

13. *C. moniliferum* (Bory) Ehrenb. General and abundant.

14. *C. Leibleinii* Kütz. I. Ep. II. Ha., No., Wh. III. Cr., Ew., M., Mp., Ra., Rp., Wi., Wt. V. Go. (with zygospores). VI. N. VII. S.

15. *C. Dianæ* Ehrenb. I. Ep. III. C., D., Ew., Mp., Wi. VIII. H., L., T., Tm., W.

16. *C. pseudodianæ* Roy. III. Th.

17. *C. parvulum* Näg. General; zygospores from Esher West-end and Mitcham Commons, Surrey.

18. *C. calosporum* Wittr. forma *major* West & G. S. West. V. Go. (with zygospores).

19. *C. Venus* Kütz. I. Ep. III. Ew. (very abundant in April 1895), Mp., Pu. VI. N. VIII. G., L.

20. *C. trochiscosporum* West & G. S. West. V. Go. (abundant with zygospores).

21. *C. Jenneri* Ralfs. III. Bi., Mp., Pu., Th. VI. N. VIII. T., Tm.

22. *C. Cynthia* De Not. III. Pu. VI. N.

23. *C. Archerianum* Cleve. VI. N. VIII. G.

24. *C. costatum* Corda. I. Ep. II. Ru. III. E., Ew., Pu., Th. IV. Ks. V. Go. VI. N. VIII. G., H., Hl., T., Tm.

25. *C. regulare* Bréb. III. Pu., not uncommon. Small forms; long. 226–232 μ; lat. 24–26 μ.

26. *C. striolatum* Ehrenb. General; pure gathering from a pool on Wimbledon Common, Surrey.

Var. *orthonotum* Roy. III. Dj., E., Fh., Pt., Wi. IV. Ks. VI. N. VII. D. VIII. H., T.

27. *C. intermedium* Ralfs. III. Bi., E., Th., We., Wi. VII. D., Gp. VIII. H.
    Var. *hibernicum* West. III. Mp.
28. *C. directum* Arch. III. E., Mp.
29. *C. angustatum* Kütz. III. Th. VI. N. VIII. G., R., W.
30. *C. juncidum* Ralfs. I. Ep. III. Bi., Ew., Pu. VIII. G., H., T. (with zygospores).
31. *C. lineatum* Ehrenb. I. Ep. III. Ew. IV. Ks. VI. N. (with zygospores). VIII. H.
32. *C. Ralfsii* Bréb. IV. Ks.
    Var. *hybridum* Rabenh. III. Pu., Th.
33. *C. attenuatum* Ehrenb. I. Ep. III. Ew., M., Pu., Th. VI. N. VIII. Tm.
34. *C. rostratum* Ehrenb. General and abundant. Zygospores from Epping Forest, Essex; Esher West-end, Mitcham, Puttenham and Wimbledon Commons, Richmond Park and Frensham, Surrey.
    Var. *brevirostratum* West. III. Ew., Wi. (with zygospores).
35. *C. setaceum* Ehrenb. III. Pu., Th. (with zygospores). VIII. G.
36. *C. Kützingii* Bréb. I. Ep. III. Ew., Fl., M., Mp., Ra., Rp. V. Go. (with zygospores). VI. N. VIII. L.
37. *C. Cornu* Ehrenb. I. Ep. II. Ru. III. M. IV. Ks. V. Go. VIII. G., H., L., T.
38. *C. gracile* Bréb. I. Ep. III. E., Ew., Pu., Th. V. Go. (with zygospores.) VI. N. (with zygospores). VII. D. VIII. G.
39. *C. pronum* Bréb. I. Ep. VI. N. VIII. K.

A form of this was noticed with the membrane colourless and without any trace of striation. There were ten pyrenoids in each semicell. Long. 375 μ; lat. 9 μ. III. Rp.

40. *C. acutum* (Lyngb.) Bréb. I. Ep. II. Ru. III. Fh., M., Wa., Wi. V. Go. (with zygospores). VIII. W.
41. *C. linea* Perty. I. Ep. III. Bi., Dj., E., Ew., M., Mp., Rp., Th. IV. Ks. VIII. W.
42. *C. Ceratium* Perty. III. E., Wi.

Genus *Docidium* Bréb.

1. *D. baculum* Bréb. VI. N.

Genus *Pleurotænium* Näg.

1. *P. coronatum* (Bréb.) Rabenh. III. Th. VI. N.
    Var. *nodulosum* (Bréb.) West. III. E., Th. VI. N. VIII. W.

2. *P. Ehrenbergii* (Bréb.) De Bary. I. Ep. III. C., Ew., Mp., Pu., Th. (with zygospores), Wa., Wi., Wo. IV. Hc., Ks. V. Go. VII. D. VIII. G., H., L., T., Tm., W.
   Diam. zygosp. 70 μ.
3. *P. Trabecula* (Ehrenb.) Näg. (*P. maximum* (Reinsch) Lund. var. *occidentale* West). I. Ep. III. Fg., Mp., Ra., Rp., Th., Wi. VI. N. VII. D.
4. *P. truncatum* (Bréb.) Näg. III. B., C., Di., Ew., M., Mp., Wi.

Genus *Tetmemorus* Ralfs.

1. *T. Brébissonii* (Menegh.) Ralfs. III. C., E., Th. VII. D., Gp. VIII. H.
2. *T. granulatus* (Bréb.) Ralfs. I. Ep. III. Bi., C., E., Th., Wa. IV. Ks. VII. D., Gp. VIII. G., H., L., T. (with zygospores), W.
3. *T. lævis* (Kütz.) Ralfs. I. Ep. III. Bi., C., E., Pu., Th., Wi. IV. Ks. VII. D., Gp. VIII. G., H., Hl., T.

Genus *Euastrum* Ehrenb.

1. *E. verrucosum* Ehrenb. III. Mp., Pu. IV. Ks. VI. N. VIII. G., Tm.
2. *E. oblongum* (Grev.) Ralfs. I. Ep. III. Ew., Mp., Pu. IV. Ks. VII. D., Gp. VIII. G., H., Tm.
3. *E. crassum* (Bréb.) Kütz. III. C., Th. VII. D. VIII. H., W.
   Var. *scrobiculatum* Lund. VI. N.
4. *E. ventricosum* Lund. III. Th.
5. *E. humerosum* Ralfs. VIII. H.
6. *E. affine* Ralfs. III. C.
7. *E. ampullaceum* Ralfs. III. C., Dj.. Th. VII. D.
8. *E. insigne* Hass. III. C. VII. D.
9. *E. didelta* (Turp.) Ralfs. III. Bi., C., E., Pt., Th. IV. Ks. VI. N. VII. D., Gp. VIII. H.
   Forma *scrobiculata* Nordst. VI. N.
10. *E. cuneatum* Jenner. III. Th.
11. *E. ansatum* Ehrenb. I. Ep. III. Bi., E., Pu., Th. IV. Ks. VII. Gp. VIII. G., H., L., T., W.
12. *E. sinuosum* Lenorm. III. Th. VI. N. VII. D.
13. *E. pectinatum* Bréb. I. Ep. III. Bi., Mp., Th. (with zygospores). IV. Ks. VI. N. VII. D. VIII. G. (with zygospores), H., L., T., Tm., W.
14. *E. gemmatum* (Bréb.) Ralfs. VII. D. VIII. H.
15. *E. rostratum* Ralfs. VII. D. VIII. G.
16. *E. elegans* (Bréb.) Kütz. I. Ep. III. Bi., Pu., Th. IV. Ks. VI. N. (with zygospores). VII. D., Gp. VIII. G., H.
   Var. *bidentatum* (Näg.) Jacobs. III. Ew., Mp., Pu. V. Go. VI. N. VII. Gp. VIII. L.

17. *E. inerme* (Ralfs) Lund. III. Th. VII. D.
18. *E. erosum* Lund. var. *notabile* West. I. Ep. III. Bi. VIII. L.
19. *E. pyramidatum* West. III. Th. VIII. W.
20. *E. insulare* (Wittr.) Roy. VI. N.
21. *E. binale* (Turp.) Ehrenb. I. Ep. III. Bi., C., E., M., Mp., Pu., Th. IV. Ks. VI. N. (with zygospores). VII. D., Gp. VIII. G., H., Hl., K., L., R., W.
    Forma *minor* West. III. Pu.
    Var. *elobatum* Lund. III. Ew.
22. *E. denticulatum* (Kirchn.) Gay. III. Bi., C., E., Ew., Mp., Th. IV. Ks. VI. N. VII. D. VIII. L.

Genus *Micrasterias* Ag.

1. *M. mucronata* (Rabenh.). III. C., Th.
2. *M. americana* (Ehrenb.) Ralfs. III. Mp.
3. *M. angulosa* Hantzsch. III. Th. VI. N.
4. *M. denticulata* Bréb. III. C., E., Ew., Th. (with zygospores). IV. Ks. VII. D. VIII. H. (with zygospores), Hl., R., Tm., W.
5. *M. rotata* (Grev.) Ralfs. III. Pu. IV. Ks. VII. D., Gp. VIII. L., R., Tm.
6. *M. Thomasiana* Arch. III. C., Th.
7. *M. radiosa* Ralfs. III. Mp.
8. *M. papillifera* (Bréb.). III. Th. VII. D. VIII. L.
9. *M. truncata* (Corda) Bréb. III. Bi., C., E., Th. VII. D. VIII. G., Hl., W.
    Var. *Bahusiensis* Wittr. VI. N.
10. *M. Jenneri* Ralfs. III. Th. VI. N.
    Var. *simplex* West. VI. N.

Genus *Xanthidium* Ehrenb.

1. *X. armatum* (Bréb.) Rabenh. III. C., E., Th. VII. D. VIII. H., R., W.
2. *X. fasciculatum* Ehrenb. III. Ew., Mp. VIII. H.
3. *X. cristatum* Bréb. VI. N. VIII. G., H.
4. *X. antilopæum* (Bréb.) Kütz. I. Ep. III. Mp., Th. (with zygospores). VI. N. VII. D. VIII. G., H.
5. *X. Smithii* Arch. var. *variabile* Nordst. III. Dj. (with zygospores), E., Th.
6. *X. concinnum* Arch. (*Arthrodesmus hexagonus* Boldt).

The typical form is rather more deeply constricted than the var. *Boldtianum*; there are two small mucros at the apical angles, but only one at the lateral angles, this character being well seen in vertical view. (Pl. VI. fig. 15.)

Long. 9–9·5 μ; lat. s. mucr. 9·5–10·5 μ; lat. isthm. 2·5–3 μ; crass. 7 μ. III. Pu., Th.

Var. *Boldtianum* West (*Arthrodesmus hexagonus* Boldt forma Boldt). III. Th.

Genus *Cosmarium* Corda.

1. *C. quadratum* Ralfs. I. Ep. III. Bh., Mp., Pu., Th., Wi. IV. Ks. V. Go. VI. N. VIII. G., T., W.
2. *C. Nymannianum* Grun. III. Th.
3. *C. Hammeri* Reinsch. VIII. G.
4. *C. granatum* Bréb. I. Ep. III. Fg., Rp. IV. Ks. VI. N. VII. D. VIII. K.

   Var. *subgranatum* Nordst. I. Ep. III. Rp. VII. S.
5. *C. trilobulatum* Reinsch. VI. N.
6. *C. tetragonum* (Näg.) Arch. I. Ep.
7. *C. Cucumis* Corda. I. Ep. III. Ea., Mp., Pu. V. Go. VIII. H., P.

*8. *C. subcucumis* Schmidle (in Berichte der Naturf. Gesellsch. Freiburg, Bd. vii., Heft 1, p. 98, t. iv. f. 20–22).

The forms seen were relatively longer and the sinus was rather more open. There were two large pyrenoids in each semi-cell. The relative proportion of breadth to length in Schmidle's specimens was 1:1·42; that of ours was 1:1·79.

Long. 64–77 μ; lat. 38–44 μ; lat. isthm. 13·5–18 μ; crass. 25–27 μ. III. Ew. (abundant Feb. 1894), Wi.

9. *C. Ralfsii* Bréb. III. C. VII. D.
10. *C. pachydermum* Lund. III. M., Mp. VIII. Tm.
11. *C. canaliculatum* West & G. S. West. V. Go.
12. *C. pyramidatum* Bréb. III. Bi., C., Rp., Th. VII. D., Gp. VIII. G.
13. *C. pseudopyramidatum* Lund. III. Th. VII. S.
14. *C. variolatum* Lund. III. Th. IV. N.

*15. *C. ocellatum* B. Eichl. & Gutw. (in Rospr. Akad. Umiej. Krakow. Wydz. matem.-prz., ser. ii. tom. viii. vol. xxviii. (1895) p. 164, t. iv. f. 7.

Var. INCRASSATUM var. n. (Pl. VI. fig. 12.)

Var. sinu semper aperto; semicellulis apicibus subtruncatis, in centro incrassatis et luteo-fuscis, cum scrobiculis parvis 3–6; a latere visis circularibus; a vertice visis ellipticis, incrassatis, et leviter tumidis, ad medium utrobique.

Long. 28–30 μ; lat. 24–26 μ; lat. isthm. 5·5–6·5 μ; crass. 14·5–15 μ. III. Th. VI. N.

The thickened area in the centre of the semi-cells is always more or less coloured, and possesses a central larger scrobiculation surrounded by a variable number of somewhat smaller ones.

16. *C. nitidulum* De Not. III. Th.
17. *C. subtumidum* Nordst. III. Dj. IV. Ks. VIII. H.

*18. *C. Klebsii* Gutw. VI. N.

19. *C. Phaseolus* Bréb. II. Wh. III. Bi., Dj., E., Fg., Mp., Th. VII. S. VIII. G., T.
Forma *minor*.
Long. 21 μ; lat. 18 μ; lat. isthm. 5·5 μ; crass. 10 μ; VII. Gp.
20. *C. fontigenum* Nordst. III. Pu.
Long. 22 μ; lat. 25 μ; lat. isthm. 6 μ; crass. 11·5 μ.
21. *C. tetrachondrum* Lund. III. Mp.
22. *C. Scenedesmus* Delp. I. Ep. III. Th.
23. *C. pseudoprotuberans* Kirchn. I. Ep. III. Th. (with zygospores). VI. N.
24. *C. rectangulare* Grun. III. C., Dj., E.
25. *C. inconspicuum* West & G. S. West. III. M. (with zygospores).
26. *C. bioculatum* Bréb. II. U. III. Bi., E., Ew., Mp., Pu. (with zygospores), Th., Wi. VIII. W.
Diam. zygosp. s. spin. 17–19 μ; c. spin. 26–28 μ. (Pl. VI. fig. 17.)
Var. *depressum* Schaar. I. Ep. IV. Ks.
Var. HIANS var. n. (Pl. VI. fig. 24.)
Var. sinu apertiori extrorsum, marginibus inferioribus semicellularum convexis, apicibus rectis vel levissime retusis; membrana distincte punctata.
Long. 17–19 μ; lat. 15–18 μ; lat. isthm. 3·5–4 μ; crass. 7·5–8·5 μ. III. Pu., Th.

This comes nearest to *C. bioculatum* var. *excavatum* Gutw., but is proportionately shorter; the apex of the sinus is subacute; the apices of the cells are straight or very slightly retuse; and the membrane is punctate.

*27. *C. aspherosporum* Nordst., var. *strigosum* Nordst. III. Pu.
Long. 10·5–11 μ; lat. 9·5 μ; lat. isthm. 3·5 μ; crass. 5 μ.
28. *C. tinctum* Ralfs. I. Ep. III. Di., E., Ew., Pu., Th., Wi. IV. Ks. VI. N. VII. D., Gp. VIII. G., H., T.
29. *C. succisum* West. III. Pu.
30. *C. abbreviatum* Racib. I. Ep. II. U.
31. *C. pygmæum* Arch. III. Mp.
32. *C. truncatellum* Perty. III. C.
Long. 9·5–10·5 μ; lat. 12·5–14·5 μ; lat. isthm. 5·5 μ; crass. 5 μ. (Pl. VII. fig. 3.)
*33. *C. geometricum* West & G. S. West. III. Pu.
*34. *C. hexangulare* Nordst. III. Th.
*35. *C. Heimerlii* West & G. S. West. (*C. minutissimum* Heimerl non Arch.) III. Mp., Th. IV. Ks.
36. C. SPHAGNICOLUM sp. n. (Pl. VI. figs. 13, 14.)
C. minutissimum, paullo latius quam longum, modice con-

strictum, sinu brevi et aperto; semicellulæ subtrapeziformes, angulis superioribus oblique truncatis, lateribus divergentibus sursum, apicibus latis, rectis vel levissime retusis; a latere visæ subcirculares; a vertice visæ elliptico-oblongæ, polis subacutis, medio utrobique leviter tumidæ, polos versus utrobique papilla instructæ; pyrenoidibus singulis.

Long. 10·5–11·5 μ; lat. 11–13·5 μ; lat. isthm. 5–5·5 μ; crass. 6·5 μ. III. Th.

We also have this minute species in immense quantity among *Sphagnum* from Mossdale Moor, Widdale Fell, N. Yorks. It is most nearly related to some forms of *C. Heimerlii* in vertical view, but the front view is quite distinct. The figures are all taken from Yorkshire specimens.

37. *C. Regnellii* Wille. I. Ep. II. Ha. III. Bi. VII. S.
38. *C. impressulum* Elfv. I. Ep. II. U. III. Fg., Mp. VII. S. VIII. Tm.
39. *C. venustum* (Bréb.) Arch. VI. N. VII. D. VIII. G., K., L.
    Var. *majus* Wittr. III. Th. VI. N.
40. *C. læve* Rabenh. I. Ep. IV. Hc. VIII. T.
    Var. *septentrionale* Wille. I. Ep. II. Wh. III. Pu.
41. *C. Meneghinii* Bréb. General.
    Forma *octangularis* Wille. II. Wh. III. B., Di., M., Mp., Wi. IV. Ks. V. Go. VIII. G., P., T.
    Var. *Wollei* Lagerh. VII. D.

*42. *C. difficile* Lütkem. III. Th. VI. N. VIII. T.
    *Var. *sublæve* Lütkem. VIII. T., W.

*43. *C. umbilicatum* Lütkem. II. Wh., abundant.
44. *C. concinnum* (Rabenh.) Reinsch. III. Pu., Th.
45. *C. obliquum* Nordst. III. C.
46. *C. Regnesii* Reinsch. III. Th. (with zygospores), Pu., abundant. VI. N.
47. *C. montanum* Schmidle (*C. Pseudoregnesii* West & G. S. West). I. Ep.

*48. *C. Novæ Semliæ* Wille var. *sibiricum* Boldt. VI. N., very abundant, June 1897.
49. *C. cymatonotophorum* West. III. Th. VI. N.

*50. *C. Sinostegos* Schaarsm. var. *obtusius* Gutw. III. Pu.
51. C. ADOXUM sp. n. (Pl. VII. fig. 24.)

C. minutissimum, paullo longius quam latum, profunde constrictum, sinu lineari; semicellulæ late pyramidato-trapeziformes, angulis basalibus oblique rotundo-truncatis et leviter divergentibus, lateribus (superioribus) subrectis vel levissime retusis, apicibus late truncatis rectisque; a vertice visæ ellipticæ, polis rotundatis, cum papilla prominente ad medium utrobique.

Long. 10–11 μ; lat. 9·5 μ; lat. isthm. 3 μ; crass. 5 μ. VI. N.

This minute species is nearest to *C. Sinostegos* Schaars. var. *obtusius* Gutw., but differs in being proportionately longer, in the more rounded and more rectangular basal angles, and in the rounded poles of the vertical view. It is very distinct from typical *C. Sinostegos.*

52. *C. substriatum* Nordst. III. Dj., Fg., Fl., Mp., Rp. V. Go. VI. N. VII. S. VIII. H.
53. *C. notabile* Bréb. VIII. T., W.
 *Forma *media* Gutw. VI. N.
 Long. 25 μ; lat. 16 μ; lat. isthm. 9 μ.
54. *C. crenatum* Ralfs. III. Di., Ra., Wi. VIII. H., P., T.
55. *C. subcrenatum* Hantzsch. I. Ep. II. Wh. III. Wt.
56. *C. hexalobum* Nordst. var. *minus* Roy et Biss. I. Ep.
57. *C. undulatum* Corda. III. Di., Ew.
58. *C. cymatopleurum* Nordst. var. *tyrolicum* Nordst. VIII. Tm.
59. *C. tetraophthalmum* (Kütz.) Menegh. III. B., Th. IV. Ks. VI. N. VIII. G., T.
 Var. *Lundellii* Wittr. I. Ep. III. Fg., Rp. VIII. G., T.
60. *C. ovale* Ralfs. VI. N.
 *Var. *subglabrum* West & G. S. West. VI. N.
61. *C. Brebissonii* Menegh. III. Th. IV. Ks. VII. D. VIII. H., R., W.
 Forma *erosa* West. III. Ew. VIII. T., W.
62. *C. latum* Bréb. II. Wh.
63. *C. margaritatum* (Lund.) Roy et Biss. III. Fg., Th., very abundant. VI. N.
64. *C. conspersum* Ralfs. IV. Ks. VIII. T.
65. *C. margaritiferum* (Turp.) Menegh. II. Ki. III. C., Rp., Wi. IV. Ks. VII. D. VIII. T.
66. *C. reniforme* (Ralfs) Arch. III. Mp., Th. IV. Ks. V. Go. VIII. K., T.
67. *C. Portianum* Arch. III. Mp., Pu., Th. VII. D. VIII. G.
 *Var. *orthostichum* Schmidle. III. Pu.
68. *C. amœnum* Bréb. III. Th. VIII. H., L.
69. *C. Logiense* Biss. I. Rp. VII. S.
70. *C. punctulatum* Bréb. II. U., Wh. III. C., Pu., Wi. IV. Ks. VII. D., S. VIII. T.
71. *C. subpunctulatum* Nordst. III. Rp., Th. VI. N. VIII. H., T.

Numerous specimens of this species were observed from the New Forest, all of which had rather more prominent central granules than the original examples from New Zealand. (Pl. VI. fig. 19.)

Long. 33 μ; lat. 31 μ; lat. isthm. 9 μ; crass. 18 μ.
Var. *Börgesenii* West. III. Fl., Mp.

C. trachypleurum Lund. var. *minus* Racib. forma Borge (in Bih. till K. Sv. Vet.-Akad. Handl., Bd. 19, Afd. iii. p. 28, t. ii. fig. 30) is *C. subpunctulatum* var. *Börgesenii*, and not a form of *C. trachypleurum*.

72. *C. sphalerostichum* Nordst. III. Th. VII. Gp. VIII. T., W.
73. *C. abruptum* Lund. VIII. H.
74. *C. Blyttii* Wille. III. Bi., Th.

Var. Novæ Sylvæ var. n. (Pl. VI. fig. 10.)

Var. paullo major, oblongo-subrectangularis, crenis lateralibus prominentibus et truncatis, serie singula granulorum (10) intra margines, in centro semicellularum cum annulo granulorum 5, eo superiori maximo.

Long. 22 μ; lat. 17·5 μ; lat. isthm. 5·5 μ; crass. 10 μ. VI. N.

This variety was in abundance, and is nearest to *C. Blyttii* subsp. *Hoffii* Börgesen, from which it differs in being proportionately longer, in its more pronounced lateral crenations, and in the central granules of the semi-cells. In comparing our variety with Börgesen's, we have taken his figure, which is almost as broad as long; his measurements indicate that it is $1\frac{1}{3}$ times longer than broad, and are evidently incorrect. His figure is also under a wrongly stated magnification.

75. *C. Bœckii* Wille. III. Mp., Rp., Wi. IV. Hc. VI. N. VIII. H.
76. *C. subcostatum* Nordst. I. Ep. II. Ha., U. III. M. (very abundant), 1894, Mp., Pu., Th. IV. Hc.
77. C. fastidiosum sp. n. (Pl. VI. fig. 11.)

C. parvum, paullo longius quam latum, profunde constrictum, sinu angusto lineari extremo ampliato; semicellulæ angulari-semicirculares, angulis basalibus rotundatis, apicibus late truncatis, in margine laterali unoquoque granulis 7 (vel 8), apicibus glabris, granulis minutis paucis intra margines subconcentrice ordinatis, in centro granulis majoribus depressis 3–4; a latere visæ globosæ; a vertice visæ ellipticæ; ad medium utrobique cum granulis latis depressis tribus, polis granulatis cum granulis minutis in seriebus transversis ordinatis, in centro glabro; pyrenoidibus singulis magnis.

Long. 37–38·5 μ; lat. 33–36 μ; lat. isthm. 11 μ; crass. 21 μ. V. Go., frequent.

This species approaches *C. subreniforme* Nordst., *C. subcostatum* Nordst., and *C. Bœckii* Wille, but differs sufficiently from all of them.

*78. *C. alatum* Kirchn. VII. S.
79. *C. Gregorii* Roy et Biss. III. Pu. VII. S.
80. *C. Kjellmani* Wille subsp. *grande* Wille. III. Ra.

*81. *C. Nathorstii* Boldt. III. Mp.

82. *D. formosulum* Hoff. II. Ha., Ru., Wh. III. Ew, Pu., Ra., Wt. IV. Hc.

83. *C. quinarium* Lund. III. Mp. VI. N.

84. *C. præmorsum* Bréb. II. Wh. III. Ew. IV. Ks. VII. S. VIII. T.

85. *C. Botrytis* (Bory) Menegh. General and abundant; zygospores from Harefield, Middlesex; Frensham Great Pond, and Mill-pond E. of Chapel Wood, Surrey.

Var. *mediolæve* West. III. Ew. IV. Hc.

Var. *tumidum* Wolle. I. Ep. V. Go. (with zygospores in abundance).

This variety does not differ from the type sufficiently to warrant its being placed as a species (*C. subbotrytis* Schmidle). Moreover, the zygospores are precisely similar to those of the typical form.

86. *C. Turpinii* Bréb. (Inclus. *C. Turpinii* var. *Lundellii* Gutw.). III. Mp., Ra., Rp. VII. S.

87. *C. eboracense* West. III. Rp.

88. *C. Quasillus* Lund. III. Ew., Wi.

89. *C. Corbula* Bréb. I. Ep. III. C., Ew., abundant.

90. *C. Sportella* Bréb. I. Ep.

91. *C. biretum* Bréb. II. Wh., pure gathering. III. Di., Ew., Wk.

92. *C. Broomei* Thwaites. III. Mp.

*93. *C. subbroomei* Schmidle. III. Mp.

Long. 42 μ; lat. 38 μ; lat. isthm. 12 μ; crass. 23 μ. (Pl. VI. fig. 20.)

We are a little uncertain exactly where to place this plant; it is certainly not *C. Broomei* Thwaites, nor is it *C. pseudobroomei* Wolle, and is a species we have not previously observed. It appears to be nearer to Schmidle's species (in Ber. d. Nat. Gesellsch. Freiburg, Bd. vii. Heft i. p. 104, t. v. f. 22–24) than any other, but the granules are more numerous, and those in the centre of the semi-cells do not project so prominently when seen in vertical view.

94. *C. confusum* Cooke var. *regularius* Nordst. III. Bi., Mp., Pu., Th. (with zygospores). VI. N. VII. D. VIII. G., H.

Subsp. *ambiguum* West. III. Pu., Th.

95. *C. ochthodes* Nordst. I. Ep. III. Ew., Mp., Wi. V. Go. VIII. G., H., Tm.

96. *C. orthostichum* Lund. III. Th. VI. N.

*97. *C. Ungerianum* (Näg.) De Bary var. Subtriplicatum var n. (Pl. VI. fig. 21.)

Var. semicellulis oblongo-rectangularibus, angulis superioribus rotundatis.

Long. 67 μ; lat. 54 μ; lat. isthm. 22 μ; crass. 36 μ. III. Mp., frequent.

This variety is of the same dimensions as the typical form, and has the same arrangement of granules, but the outward form of the semi-cells is characteristically subrectangular. At first we considered it might be a large variety of *C. triplicatum* Wolle; but on comparison with specimens of that species, we found that, although the form was the same, yet the English plant was of larger size, and the arrangement of the granules was quite different (but like that in *C. Ungerianum*).

98. *C. cœlatum* Ralfs. I. Ep. IV. Ks. VII. Gp.

99. *C. commissurale* Bréb. II. Ha.

100. *C. ornatum* Ralfs. III. Mp., Th. (with zygospores). VI. N. (with zygospores). VII. D. VIII. G., H., L.

101. *C. cristatum* Ralfs. III. Th.

102. *C. speciosum* Lund. I. Ep.

103. *C. isthmium* West. III. Pu.

104. *C. orbiculatum* Ralfs. III. Bi. VI. N.

105. *C. contractum* Kirchn. III. Pu.

106. *C. ellipsoideum* Elfv. III. Th.

* Var. *minus* Racib. III. Th.

Long. 18 μ; lat. 13·5 μ.

107. *C. arctoum* Nordst. VI. N.

A small and rather irregular form. Long. 14 μ; lat. 19·5 μ; lat. isthm. 7 μ; crass. 7·5 μ.

108. *C. pseudarctoum* Nordst. III. Ew.

*109. *C. subarctoum* (Lagerh.) Racib. III. Ew.

Long. 15–17 μ; lat. 13·5 μ; lat. isthm. 8·5 μ; crass. 8·5 μ.

110. *C. globosum* Buln. VII. D., abundant.

*Var. *minus* Hansg. I. Ep.

This was in great abundance. and most nearly approaches the form figured by Nordstedt in Ofvers. K. Vet.-Akad. Förh., 1872, No. 6, t. vii. f. 25; and as Hansgirg includes Nordstedt's form in his variety, we place it under this variety. It is smaller than the typical form, with depressed apices similar to those of *C. pseudarctoum*, but the constriction is different from that in the latter species, and the vertical view is elliptical.

Long. 17–20 μ; lat. 13–14·5 μ; lat. isthm. 9·5 μ; crass. 9 μ.

111. *C. moniliforme* (Turp.) Ralfs. III. B., E., Th. VII. D. VIII. G., R., W.

A form of this was observed from the New Forest with obovate semi-cells and subtruncate apices; long. 41 μ; lat. 20 μ; lat. isthm. 7 μ. Many examples were seen, and they constantly retained the same characters.

Forma *panduriformis* Heimerl. III. Th. VIII. W.

112. *C. connatum* Bréb. III. Pu., Th. VI. N.
113. *C. pseudoconnatum* Nordst. VI. N.
*114. *C. gonioides* West and G. S. West. III. Th.

The specimens were rather smaller than those originally described, and the vertical view was not perfectly circular.

Long. 14·5–15·5 μ; lat. 7·5 μ.

115. *C. Cucurbita* Bréb. III. Bi., C., E., Th. (with zygospores). IV. Ks. VII. D., Gp. VIII. Hl., R., T.
Diam. zygosp. 30–32 μ. (Pl. VI. fig. 26.)
116. *C. obcuneatum* West. VII. D., abundant.
117. *C. Thwaitesii* Ralfs. II. Ru. III. Mp.
118. *C. annulatum* (Näg.) De Bary. VIII. T.
119. *C. elegantissimum* Lund. III. Th. VI. N.

Genus *Cosmocladium* Bréb.

1. *C. saxonicum* De Bary. III. Th.

This is referred with hesitation to this species; it always occurred in twos or in fours within a very firm gelatinous investment, and the cells were not arranged in one plane. No trace of connecting filaments could be observed in preserved specimens. It is rather smaller than the published dimensions of this species, but the cells were elliptic-reniform, and it otherwise seemed to agree.

Long. 15–17 μ; lat. 13·5–14·5 μ; lat. isthm. 4·5 μ; crass. 8–9 μ.

Genus *Spondylosium* Bréb.

1. *S. pulchellum* Arch. VIII. G.

Genus *Staurastrum* Meyen.

1. *S. connatum* (Lund.) Roy et Biss. VII. D. VIII. G.
2. *S. dejectum* Bréb. I. Ep. III. Bi., C., E., Pu., Th. VI. N. VII. D. VIII. G., H., R., T., W. Subsp. *Tellamii* West. VIII. G.
3. *S. apiculatum* Bréb. III. C., Th. (with zygospores). VIII. T.
4. *S. mucronatum* Ralfs. IV. Ks.
5. *S. Dickiei* Ralfs. III. E., Fg., Pu. (with zygospores), Th. IV. Ks. VI. N. (with zygospores).
Forma *punctata* West. III. Th.
Var. *semicirculare* W. B. Turner. III. Th.
6. *S. glabrum* (Ehrenb.) Ralfs. III. Bi.
7. *S. brevispinum* Bréb. III. Th. VI. N.
8. *S. cuspidatum* Bréb. I. Ep. III. M., Pu., Th. IV. Ks. V. Go. VI. N. (with zygospores). VII. D.

Var. *divergens* Nordst. IV. Ks. (with zygospores).
Var. *maximum* West. I. Ep.

9. *S. O'Mearii* Arch. III. Pu., Th. VIII. H.
10. *S. sibiricum* Borge, forma *trigona* West and G. S. West. III. Dj.
11. *S. lanceolatum* Arch. III. Th., abundant. VI. N., abundant (with zygospores). VIII. H.
    Var. *compressum* West. VI. N.
12. *S. corniculatum* Lund. III. Th. (with zygospores). VI. N.
13. S. TRACHYTITHOPHORUM sp. n. (Pl. VI. fig. 22.)

S. parvum, tam longum quam latum, profunde constrictum, sinu aperto et subrectangulari; semicellulæ late ellipticæ, polis mamillatis et seorsum curvatis, annulis duobus granulorum minutorum circa polum unumquemque; a vertice visæ triangulares, lateribus subrectis (levissime convexis), angulis leviter productis, cum annulis duobus granulorum minutorum.

Long. 30–34 μ; lat. 29–32·5 μ; lat. isthm. 10·5–11·5 μ. III. Th.

This species seems to be quite distinct from any other.

14. *S. lunatum* Ralfs. I., Ep. V. Go. VI. N.
    Var. *subarmatum* West. I. Ep.

*15. *S. tunguscanum* Boldt. III. Pu.

16. *S. denticulatum* (Näg.) Arch. I. Ep.
17. *S. Avicula* Bréb. VII. D. VIII. G.
    Var. *subarcuatum* (Wolle) West. I. Ep. VI. N.
18. *S. furcatum* (Ehrenb.) Bréb. (*S. spinosum* Ralfs). III. Th. VIII. H.
    Var. *subsenarium* W. VII. D.
19. *S. armigerum* Bréb. (*S. pseudofurcigerum* Reinsch). III. Bi., Pu., We. VI. N. VII. D., Gp.
20. *S. arcuatum* Nordst. I. Ep. VI. N. VIII. G.
21. *S. Reinschii* Roy. III. C., Dj., E., Th. VIII. R.
22. *S. rostellum* Roy et Biss. VI. N.
    Var. EROSTELLUM var. n. (Pl. VI. fig. 18.)

Var. minor, profundius constricta, spina magna prope constrictionem nulla; a vertice visum triangulare, angulis rotundatioribus.

Long. s. spin. 19·5 μ; lat. s. spin. 19·5 μ; lat. isthm. 6·5 μ. III. Th.

Although the character giving the name to this species is absent, still the number, size, and arrangement of the spines is exactly the same; the form of the semi-cells also would be just the same if the constriction were less deep.

23. *S. Hystrix* Ralfs. III. Di., Dj., Th.
24. *S. teliferum* Ralfs. III. Bi., Pu., Th. VII. D., Gp. VIII. G., H., L., W.

25. *S. gladiosum* W. B. Turn. VIII. G.
Long. s. spin. 41 μ; c. spin. 51 μ; lat. s. spin. 37·5 μ; c. spin. 48 μ; lat. isthm. 12 μ.
26. *S. polytrichum* Perty (*S. Pringsheimii* Reinsch). III. Ew., Pu., Th. VI. N.
27. *S. saxonicum* Buln. VI. N.
28. *S. pilosum* (Näg.) Arch. I. Ep. III. Bi., C., Ew., Mp., Th., Wi. IV. Ks. V. Go. VI. N. VII. D. VIII. H., R., T., W.
29. *S. hirsutum* (Ehrenb.) Bréb. I. Ep. III. Dj., Ew., We, Wi. IV. Ks. VII. D.
30. *S. muticum* Bréb. I. Ep. III. Th., Wi. VII. S. VIII. G.
*Var. *minus* Wolle. VI. N.
Long. 17·5 μ; lat. 16·5 μ; lat. isthm. 4·5 μ.
31. *S. orbiculare* (Ehrenb.) Ralfs. III. Bi., C., Ew., Th. VI. N. VII. D., Gp. VIII. G., H., L., T.
Var. *depressum* Roy et Biss. III. C., Wt. VI. N.
32. *S. cosmarioides* Nordst. VI. N.
33. *S. Bieneanum* Rabenh. I. Ep. V. Go. (with zygospores). VI. N.

Some of the New Forest examples had from two to three apiculi on each semi-cell, sometimes near the angles and sometimes between them.

Var. *ellipticum* Wille. III. Pu. IV. Ks. VI. N.
34. *S. pachyrhynchum* Nordst. III. Th., frequent. VI. N., June 1897, frequent.
Long. 38–41 μ; lat. 35–39 μ; lat. isthm. 9·5–10·5 μ.
35. *S. punctulatum* Bréb. Frequent; zygospores from "Devil's Jumps" near Frensham.
36. *S. pygmæum* Bréb. III. Bi., C., M., Mp. VII. S. VIII. H., P., T.
37. *S. turgescens* De Not. III. Wi.
38. *S. muricatum* Bréb. I. Ep. III. C., Dj., Wi. VI. N.
39. *S. pyramidatum* West. IV. Ks.
40. *S. spongiosum* Bréb. III. M., Mp., Th. VII. D. VIII. H.
Var. *perbifidum* West. III. Th. (3- and 4-ended).
41. *S. Meriani* Reinsch. VIII. T.
42. *S. alternans* Bréb. I. Ep. III. Th. (with zygospores). IV. Ks. V. Go. VII. D., S. VIII. W.
43. *S. dilatatum* Ehrenb. III. Bi. VI. N. VII. D. VIII. H., L.
Var. *obtusilobum* De Not. III. Pu. V. Go.
44. *S. subpygmæum* West. III. Th., frequent.
45. *S. tumidum* Bréb. III. Th. VI. N. VII. D. VIII. W.
46. *S. brachiatum* Ralfs. III. Dj., E., Pu., Th. (with zygospores). VII. D. VIII. R., W.
47. *S. læve* Ralfs. III. Th., very abundant.

48. *S. inconspicuum* Nordst. III. Dj., Th. VI. N. VII. D. VIII. R.

49. S. NODOSUM sp. n. (Pl. VI. fig. 23.)

S. minutum, circiter tam longum quam latum (cum processibus), profunde constrictum, sinu aperto lateribus subrectis et apice acuto; semicellulæ late rectangulari-oblongæ, angulis superioribus in processus breves uninodulosos divergentes truncatos productis, angulis inferioribus subrectangularibus, apicibus concavis; a vertice visæ triangulares, lateribus concavis, processibus truncatis binodulosis; membrana glabra.

Long. s. proc. 11 μ, c. proc. 21 μ; lat. c. proc. 19 μ; lat. isthm. 5 μ. III. Th.

This differs from *S. inconspicuum* Nordst. in its marked and deep constriction, and in its triradiate vertical view with much smaller body.

50. *S. micron* West & G. S. West. III. Pu., abundant.

51. *S. iotanum* Wolle. III. Pu.

52. *S. tetracerum* Ralfs. III. Pu., Th. IV. Ks. VI. N. VII. D. VIII. G., H., W.

Forma *trigona*. III. Th. VI. N. VII. D. VIII. W.

Forma *tetragona*. VIII. R.

Var. VALIDUM var. n. (Pl. VI. fig. 25.)

Var. corpore longiori, processibus validioribus non attenuatis et 5-nodulosis.

Long. s proc. 18 μ, c. proc. 42 μ; lat. s. proc. 13 μ, c. proc. 37 μ; lat. isthm. 5 μ. III. Mp.

53. *S. hexacerum* (Ehrenb.) Wittr. (*S. tricorne* Ralfs). II. U. III. C., Di., Dj., Ew., Fg., M., Mp., Ra. IV. Ks. VI. N. VII. S. VIII. G., L.

Var. β Ralfs. VIII. H., K.

54. *S. cyrtocerum* Bréb. III. Ew., M., Mp., Th. VI. N. VII. D. VIII. G., L.

55. *S. inflexum* Bréb. I. Ep. III. Bi., C., Ew., Mp., Rp., Th., Wi. IV. Ks. VI. N. VII. D.

56. *S. polymorphum* Bréb. I. Ep. III. C., E., Th., Wi. VIII. H., Tm.

57. *S. crenulatum* (Näg.) Delp. II. U. III. Th. IV. Ks. V. Go.

*58. *S. Heimerlianum* Lütkem. var. *spinulosum* Lütkem. III. Th.

59. *S. gracile* Ralfs. I. Ep. III. Ew., Th. (with zygospores). V. Go. VI. N. VII. D., S.

Zygospora globosa, spinis obsessa; spinis dilatatis ad basin et dichotome furcatis ad apicem.

Diam. zygosp. s. spin. 32 μ, c. spin. 60 μ. (Pl. VI. fig. 27.)

Var. *nanum* Wille. III. Bi., Mp. V. Go. VI. N.

60. *S. paradoxum* Meyen. III. Bi., E., Th. V. Go. VI. N. VIII. G., Hl.
    Forma *parva* West. III. Th. IV. Ks. VI. N.
61. *S. oxyacanthum* Arch. III. Th.
62. *S. controversum* Bréb. III. Bi., Pu. VI. N. VIII. H.
63. *S. aculeatum* (Ehrenb.) Menegh. III. Th. VI. N. VIII. W.
64. *S. vestitum* Ralfs. III. Th. VI. N.
    Var. *semivestitum* West. III. Pu. VIII. G.
65. *S. anatinum* Cooke & Wills. VI. N.
66. *S. pseudosebaldi* Wille. III. Th.
67. *S. Arachne* Ralfs. III. Th. VI. N.
68. *S. proboscideum* (Bréb.) Arch. I. Ep. III. Mp.
69. *S. asperum* Bréb. III. Th. VI. N. VII. D.
70. *S. subscabrum* Nordst. VI. N.
71. *S. sexcostatum* Bréb. III. Ew.
    Subsp. *productum* West. VI. N.
72. *S. margaritaceum* (Ehrenb.) Menegh. I. Ep. III. Bi., C., Dj. (up to 9-ended; with zygospores), Ea., Th., Wo. VI. N. VII. Gp. VIII. R.
    Var. SUBCONTORTUM var. n. (Pl. VII. figs. 15–17.)
        Var. cellulis a vertice visis 6–7 radiatis, processibus truncatis et curvatis ut in *S. cyrtocero.*
        Long. 26 μ; lat. 25–27 μ; lat. isthm. 9 μ. III. Dj.
    Var. ROBUSTUM var. n. (Pl. VII. fig. 14.)
        Var. validior, semicellulis late ellipticis (sine proc.), ad basin processuum non contractis; a vertice visis quinqueradiatis, cum verruca parva emarginata ad basin processuum utrobique.
        Long. 25·5 μ; lat. 27 μ; lat. isthm. 8 μ. II. U.

This variety approaches *S. ornatum* (Boldt) W. B. Turn. (*S. margaritaceum* var. *ornatum* Boldt), but has much shorter and stouter processes. It may be also compared with *S. foliatum* W. B. Turn., but Turner's figure is too indistinct to admit of a detailed comparison.

73. *S. furcigerum* Bréb. I. Ep. III. M. VI. N.
74. *S. eustephanum* (Ehrenb.) Ralfs. VI. N.

Genus *Arthrodesmus* Ehrenb.

1. *A. bifidus* Bréb. III. Pu., Th. VIII. R.
    Var. *truncatus* West. III. Th. IV. Ks.
2. *A. octocornis* Ehrenb. III. E., Rw., Pu. (with zygospores), Th. VI. N. VIII. H.
    Diam. zygosp. s. spin. 15 μ, c. spin. 28 μ. (Pl. I. fig. 16.)
3. *A. Incus* (Bréb.) Hass. III. C. (with zygospores), Dj., E. (with zygospores), Th. VII. D. VIII. H., L., R., W.
    Var. SUBQUADRATUS var. n. (Pl. VII. fig. 20.)

Var. minus constricta, semicellulis subquadratis.
Long. s. spin. 15–17 μ; lat. s. spin. 11 μ; long. spin. 5·5–7 μ; lat. isthm. 7·5 μ; crass. 8 μ. III. C.
4. *A. Ralfsii* West. I. Ep. III. Bi., Ew., Pu., Wi.
5. *A. convergens* Ehrenb. III. Mp., Th. VI. N.

Genus *Onychonema* Wallich.

1. *O. filiforme* (Ehrenb.) Roy et Biss. VIII. G.

Genus *Sphærozosma* Corda.

1. *S. vertebratum* (Bréb.) Ralfs. III. M.
Var. LATIUS var. n. (Pl. VI. fig. 7.)
Var. cellulis latioribus ($1\frac{2}{3}$-plo latioribus quam longis), sinu angustiori profundiorique, dorso convexiori.
Long. 15–16 μ; lat. 25–27 μ; lat. isth. 5·5–7·5 μ. III. Ew.
2. *S. excavatum* Ralfs. I. Ep. III. C., E., Pu. (with zygospores), Th. (with zygospores), Wi. VI. N. (with zygospores). VII. D., Gp. VIII. T., W.
3. *S. granulatum* Roy et Biss. I. Ep. III. Mp., Pu.
*4. *S. Wallichii* Jacobs. var. ANGLICUM var. n. (Pl. VI. fig. 6.)
Var. apicibus semicellularum subarctis, sinu minore, granulis 2 vel 3 ad margines laterales semicellarum, cum granulis sparsis trans semicellulas irregulariter ordinatis.
Long. 10–11·5 μ; lat. 10·5–11 μ; lat. isthm. 6 μ; crass. 5·5 μ. VI. N. abundant, July 1897.

Genus *Desmidium* Ag.

1. *D. cylindricum* Grev. III. Th. VI. N.
2. *D. Swartzii* Ag. III. Mp., Th. VIII. H., W.

Genus *Gymnozyga* Ehrenb.

1 *G. moniliformis* Ehrenb. III. Bi., C., Th. VI. N. VIII. H., R.

Genus *Hyalotheca* Kütz.

1. *H. mucosa* (Dillw.) Ehrenb. III. C. Th. VIII. G. W.
2. *H. dissiliens* (Sm.) Bréb. Frequent; zygospores from Bisley, Chobham, Esher West-end, and Thursley Commons, Surrey; Keston Common, Kent; Roughtor Moor, Cornwall.
Forma *tridentula* Nordst. III. Ew. VIII. H., L.
Var. *hians* Wolle. III. Ew. (pure gathering, April 1895).
*3. *H. neglecta* Racib. III. Th. VI. N. (with zygospores).
Long. cell. 28–34·5 μ; lat. cell. 11·5–13 μ.

This species was in great abundance from Thursley Common, Surrey, and from the New Forest, Hants. It occurs in long filaments, which are easily overlooked on account of their resemblance to some confervaceous algæ; the filaments have a very wide gelatinous sheath (up to 54 μ diam.).

There is an almost imperceptible constriction at the middle of the cells, and on each side of it a very minute inflation, often causing the widest part of the cell to be in the middle. In a gathering made in August 1897, from a bog in the New Forest, it was obtained with zygospores.

> Zygosporæ globosæ, glabræ, nonnunquam mamillatæ ad polos oppositos. Diam. zygosp. 23–28 μ.

Some filaments showed the formation of aplanospores, breaking up into separate cells during their formation. These spores were elliptical or oblong-elliptical, with acutely rounded poles, and when mature had a strong yellowish punctate membrane. Long. aplanosp. 20–31 μ; lat. 9·5–11 μ.

Ord. *Protococcoideæ.*

Fam. **Volvocineæ.**

Genus *Volvox* Ehrenb.

1. *V. globator* (L.) Ehrenb. I. Ep. II. U.

Genus *Eudorina* Ehrenb.

1. *E. elegans* Ehrenb. II. Ki. III., Ew., M., Mp., Pu., Wo. V. Go.

Genus *Pandorina* Bory.

1. *P. morum* (Müll.) Bory. General.

Genus *Gonium* Müller.

1. *G. pectorale* Müller. I. Ep. III. B., Ew., Mp., Ra., W., Wt. V. Go.

Genus *Tetragonium* West & G. S. West.

1. *T. lacustre* West & G. S. West. III. E.

Genus *Chlamydomonas* Ehrenb.

*1. *C. Kleinii* Schmidle. II. U. III. B., C., E., Wi.

Fam. **Palmellaceæ.**

Sub-fam. Cœnobieæ.

Genus *Hydrodictyon* Roth.

1. *H. reticulatum* (L.) Lagerh. I. River Lea (J. H. Vanstone, 1893).

Genus *Cœlastrum* Näg.

1. *C. sphæricum* Näg. Very frequent.
2. *C. microporum* Näg. III. C., Ra., Rp. IV. Hc.
3. *C. cambricum* Arch. IV. Ks.
4. *C. cubicum* Näg. IV. Ks.
5. *C. verrucosum* Reinsch. III. E.

Genus *Sorastrum* Kütz.

1. *S. spinulosum* Näg. VI. N. VIII. H.

*2. *S.* (?) *simplex* Wille. VIII. K.

Genus *Pediastrum* Meyen.

1. *P. Boryanum* (Turp.) Menegh. Common.
   Var. *granulatum* (Kütz.) A. Br. I. Ep. III. Fg., Mp. IV. Ks. VII. S.
2. *P. glanduliferum* Bennett. III. Bi.
   Arms delicate, faintly rough, converging and often crossing one another; diam. cell. peripher. 22–27 μ.
3. *P. constrictum* Hass. II. U. III. Ra., Rp.
4. *P. duplex* Meyen (*P. pertusum* Kütz.). II. Ha., Wh. III. Bi., C., Fl., M., Pu., Ra., Rp., Wt. IV. Ks.
5. *P. integrum* Näg. III. Fg., Pu.
6. *P. angulosum* (Ehrenb.) Menegh. III. Ra., Wt.
7. *P. tetras* (Ehrenb.) Ralfs. I. Ep. II. U. III. Bi., Fl., Mp., Pu., Ra. IV. Hc. Ks. V. Go. VI. N. VII. D., S. VIII. G.

Genus *Crucigenia* Morren.

1. *C. rectangularis* (Näg.) A. Br. III. Bi., Mp., Ra. V. Go. VII. S. VIII. H., K., L.

This was noticed from Frensham, Surrey, with families of 128 cells.

Sub-fam. Pseudocœnobieæ.

Genus *Sciadium* A. Br.

1. *S. Arbuscula* A. Br. I. Ep. II. Ha. III. B., M., Wi. IV. Hc., Ks.

Abundant on Wimbledon Common, Surrey, in the autumn of 1892, and again in the autumn of 1894. Also exceptionally fine from a pond on Hayes Common, Kent.

Genus *Ophiocytium* Näg.

1. *O. cochleare* (Eich.) A. Br. General.
2. *O. majus* Näg. III. E., Mp.

Genus *Mischococcus* Näg.

1. *M. confervicola* Näg. II. Ru.

Sub-fam. Rhaphidieæ.

Genus *Dactylococcus* Näg.

1. *D. Debaryanus* Reinsch. II. Ki.
2. *D. bicaudatus* A. Br. var. exilis var. n. (Pl. VII. fig. 18.)

Var. cellulis multo minoribus angustioribusque, apicibus in cornibus longioribus et tenuioribus productis; contentus chlorophyllosus cellularum cum granulis numerosis parvis.

Long. c. corn. 17–36 μ; long. corn. 9·5–15 μ; lat. 3·5–5 μ. I. Ep., in ditches.

3. D. dispar sp. n. (Pl. VII. fig. 19.)

D. cellulis parvis, diametro triplo quadruplove longioribus, fusiformibus, obliquis et sæpe sublunatis, apice altero acuto, apice altero acutissimo vel producto; contentus chlorophyllosus cellularum homogeneus (rare cum granulis magnis paucis).

Long. 8·5–21 μ; lat. 2–5·7 μ. III. Do. On old wood.

The form of the cells at once distinguishes this species from *D. infusionum* Näg. and *D. obtusus* Lagerh. The nearest species is probably *D. rhaphidioides* Hansg.

Genus *Scenedesmus* Meyen.

1. *S. bijugatus* (Turp.) Kütz. (*S. obtusus* Meyen). I. Ep. III. Ew., Ra., Rp., Wi. IV. Ks.
2. *S. alternans* Reinsch. II. Th. IV. Ks. VIII. T.

Var. *apiculatus* West. VI. N.

3. S. granulatus sp. n. (Pl. VII. figs. 1, 2.)

S. cellulis plerumque quaternis, oblongis, diametro circiter 3-plo longioribus, polis conicis, in seriem rectam conjunctis; membrana cellularum granulata, granulis minutis in seriebus tribus longitudinaliter ordinatis.

Long. cell. 20–21 μ; lat. cell. 6–6·5 μ. III. Rp.

Compare with *S. Hystrix* Lagerh. and *S. aculeolatus* Reinsch.

4. *S. denticulatus* Lagerh. I. Ep.

Var. *linearis* Hansg. II. U. III. Ew., Fg., M., Mp., Pu. IV. Ks. V. Go.

5. *S. quadricauda* (Turp.) Bréb. General and abundant.

Var. *abundans* Kirchn. II. U. III. Mp., Pu., Ra. IV. Ks. VI. N.

6. *S. antennatus* Bréb. III. Pu. IV. Ks.
7. *S. obliquus* (Turp.) Kütz. (*S. acutus* Meyen). Frequent.

Var. *dimorphus* (Kütz.) Rabenh. II. U. III. E., Fh., Pu.

Genus *Rhaphidium* Kütz.

1. *R. polymorphum* Fresen. var. *falcatum* (Corda) Rabenh. General and abundant.

Var. *aciculare* (A. Br.) Rabenh. General.

Var. *duplex* (Kütz.) Rabenh. III. Fh.

Var. TUMIDUM var. n. (Pl. VII. fig. 8.)

Var. cellulis solitariis vel subsolitariis, curvatis, in medio inflatis, apicibus acutissimis.

Long. 61–73 μ; lat. 4·5–6·5 μ. III. Pu., abundant.

Var. MIRABILE var. n. (Pl. VII. figs. 9–13.)

Var. cellulis semper solitariis, longissimis, variabiliter curvatis (nonnunquam sigmoideis), apicibus acutissimis. Long. usque 117 μ; lat. 2–3·5 μ.

III. Wi.; in a pond amongst *Conferva*, July 1894; in same pond, Jan. 1895.

The regularly curved forms of this variety are with difficulty distinguished from a minute *Closterium*. At or near the middle of the cells is a clear space, the chromatophores being *completely* interrupted, and towards the apices there is often present a clear space containing one minute moving corpuscle, *but beyond this clear space there is sometimes a portion of the green cell-contents.* The cell-contents are very irregular, and frequently much vacuolated. In a remark concerning the moving granules present towards the apices of the cells in the genus *Closterium*, Archer states (Quart. Journ. Micr. Sc., ii. 1862, pp. 257–8) that "In *Ankistrodesmus* there are no such granules." The latter genus is synonymous with *Rhaphidium*, and this plant was undoubtedly a *Rhaphidium*, and one which possessed these moving granules.

2. *R. convolutum* (Corda) Rabenh. III. Rp.

Genus *Selenastrum* Reinsch.

1. *S. Bibraeanum* Reinsch. IV. Ks.

*2. *S. gracile* Reinsch. III. Pu.

Genus *Lagerheimia* (De Toni) Chodat.

*1. *L. genevensis* Chodat. III. Mp.

Genus *Tetraëdron* Kütz.

1. *T. minimum* (A. Br.) Hansg. III. Fg., Mp., Th. IV. Ks.

This was in large quantity from a pond on Keston Common, Kent. Many specimens showed the reproduction as described and figured by Lagerheim (Stud. Arktisc. Cryptog. I., Tetraëdron u. Euastropsis, Tromsö Mus. Aarsh. 17, 1894). Cf. Pl. VII. figs. 21–23.

2. *T. trigonum* (Näg.) Hansg. I. Ep. III. Bi., Mp.
3. *T. tetragonum* (Näg.) Hansg. III. Di.
4. *T. caudatum* (Corda) Hansg. (*Polyedrium pentagonum* Reinsch). III. Fg.

Forma *incisa* Lagerh. II. U. III. Ra. IV. Ks.

5. *T. regulare* Kütz. (*Polyedrium tetraëdricum* Näg.). III. Mp., Pu., Th.
6. *T. enorme* (Ralfs) Hansg. I. Ep. III. Fg. VI. N.
7. T. HORRIDUM sp. n. (Pl. VII. figs. 4, 5.)

T. magnum, irregulariter tetragonum, pentagonum, hexagonum, vel suboblongatum, compressum, angulis acutis vel rotundatis (rare submamillatis); membrana firma, ad angulos incrassata et spinis validis rectis curvatisque (nonnunquam bi- vel trifurcatis) singulis vel geminatis vel pluribus præditis, etiam spinis brevibus paucis inter angulos dispositis; a latere visum ellipticum vel oblongum.

Diam. s. spin. 27–42 μ, c. spin. 33–61 μ; crass. 19–21 μ. I. Ep. III. Pt.

This species differs from *T. irregulare* (Reinsch) De Toni in being more irregular, in not having the angles produced, and in the irregular nature and disposition of the spines.

Sub-fam. CHARACIEÆ.

Genus *Characium* A. Br.

*1. *C. Nägelii* A. Br. II. Wh.
*2. *C. Pringsheimii* A. Br. III. B., M. VIII. G.
3. *C. Siebaldii* A. Br. VI. N.
4. *C. heteromorphum* (Reinsch) (*Hydrianum heteromorphum* Reinsch). Common.
5. *C. ornithocephalum* A. Br. III. Fg.
*6. *C. longipes* Rabenh. II. U.

Sub-fam. TETRASPOREÆ.

Genus *Schizochlamys* A. Br.

1. *S. gelatinosa* A. Br. I. Ep. III. C.
2. *S. delicatula* West. III. Bi., Ew., Mp. VII. D.

Genus *Palmodactylon* Näg.

1. *P. subramosum* Näg. I. Ep. III. Ew. V. Go.
2. *P. varium* Näg. II. Ha.

Genus *Apiocystis* Näg.

1. *A. Brauniana* Näg. II. Ha. III. Ew., M., Wt. VII. S.

Genus *Tetraspora* Link.

1. *T. gelatinosa* (Vauch.) Desv. III. B., Ew.
2. *T. lubrica* (Roth) Ag. IV. Ks. VIII. near Bodmin.

Genus *Palmella* Lyngb.

1. *P. mucosa* Kütz. II. Wh. III. E.
2. *P. hyalina* Bréb. IV. Ks.

Sub-fam. Dictyosphærieæ.

Genus *Dimorphococcus* A. Br.

1. *D. lunatus* A. Br. III. Th., very rare.

Genus *Tetracoccus* West.

1. *T. botryoides* West. I. Ep. III. Ra., VII. L.

Genus *Botryococcus* Kütz.

1. *B. Braunii* Kütz. I. Ep. III. Bi., C., Mp., Pu., Th. IV. Ks. V. Go. VII. D., Gp. VIII. W.

Ineffigiata gen. n.

Cellulæ submagnæ, irregulariformæ, angulari-oblongæ, angulari-ellipticæ vel subtrapezicæ, familias valde irregulares libere natantes cellularum 2–8 formantes; cellulæ cum processibus brevibus irregularibus et spinis paucis valde variabilibus, irregulariter curvatis et irregulariter dispositis; contentus chlorophyllosus cellularum viridissimus et granulas multas includens.

1. I. neglecta sp. unica.

Character idem ac generis.

Diam. cell. sine spin. et proc. 21–40 μ; long. spin. et proc. 5·5–19 μ; diam. fam. 76–115 μ. III. Ew., Mp., Pu., Th. V. Go.

We have long had this alga under observation as something which required investigating. The cells are rather large with very irregular outlines, and each possesses a few irregularly disposed processes or spines. These spines are straight or curved, of very variable length, and are often somewhat subcapitate or otherwise irregular; they are also the chief agents in uniting the cells into irregular families. The exact structure of the cells and families is exceedingly difficult to observe, owing to their extreme irregularity and the opacity of the densely packed granulose chlorophyll.

It is more or less abundant throughout the British Islands and the United States of America, and often occurs in quantity in tanks, water-barrels, &c. We find it frequently in gatherings of the smaller algæ, and can find no mention of anything approaching it.

It may be regarded as nearest to *Botryococcus* Kütz.

The name was suggested by its indefinite misshapen form and it evident neglect by algologists.

Genus *Dictyosphærium* Näg.

1. *D. Ehrenbergianum* Näg. I. Ep. II. Wh. III. E., M., Mp., Ra., Rp., Wi. IV. Hc. V. Go. VI. N. VIII. L.
2. *D. reniforme* Buln. I. Ep.

Sub-fam. Glœocystideæ.

Genus *Nephrocytium* Näg.

1. *N. Agardhianum* Näg. IV. Ks.
2. *N. Nägelii* Grun. III. Ea., M.
3. *N. ecdysiscepanum* West & G. S. West. V. Go.
4. *N. lunatum* West. III. Th.

Genus *Oocystis* Näg.

1. *O. solitaria* Wittr. I. Ep. III. Bi., E., Ew., Fg., Rp., Th. IV. Ks. VI. N. VII. S. VIII. G., T., W.
   Forma *major* Wille. III. Th.
2. *O. crassa* Wittr. III. Mp. VIII. L.
3. *O. gigas* Arch. var. *incrassata* West. VIII. G.
4. *O. Novæ Semliæ* Wille. V. Go.
   Forma *major* Wille. VI. N.
   Var. *maxima* West. VI. N.
5. *O. elliptica* West. III. Mp.
6. *O. asymmetrica* West. III. Bi., C., Mp.
7. *O. panduriformis* West. VIII. G.

Genus *Glœocystis* Näg.

1. *G. gigas* (Kütz.) Lagerh. [*Chlorococcum gigas* (Kütz.) Grun.; *Glœocystis ampla* (Kütz.) Rabenh.] I. Ep. II. Ha., No., Wh. III. B., M., Mp. IV. Ks. V. Go. VIII. G., L., R., W.
   Var. *maxima* West. III. E.
2. *G. vesiculosa* Näg. I. Ep. II. Ha., Ki., Ru. III. Ea., M., Mp., Rp., Th., Wi. IV. Hc., Ks. VI. N. VIII. P.
3. *G. infusionum* (Schrank). [*Chlorococcum infusionum* (Schrank) Menegh.] III. B., Ew., Wi. VII. D.
4. *G. regularis* nob. (*Chlorococcum regulare* West). I. Ep. III. Bi., Ew., Th. VII. D. VIII. Hl., L.

Genus *Kirchneriella* Schmidle.

1. *K. obesa* (West) Schmidle (*Selenastrum obesum* West). III. Bi., Fg., Mp., Pu.

Genus *Urococcus* Kütz.

1. *U. insignis* (Hass.) Kütz. III. Bi., C., E., Th. VII. S. VIII. T.

Sub-fam. Protococcaceæ.

Genus *Stichococcus* Näg.

1. *S. bacillaris* Näg. II. Ki., Pi. III. Nr. Pt., Wi., Boxhill.
2. *S. flaccidus* (Kütz.) Gay. III. B., Rp.

*3. *S. dissectus* Gay. III. Damp walls about London.

Genus *Eremosphæra* De Bary.

1. *E. viridis* De Bary. I. Ep. III. Bi., C., E., Th. IV. Ks. VII. D., Gp. VIII. R.

Genus *Pleurococcus* Menegh.

1. *P. vulgaris* Menegh. Everywhere abundant.
2. *P. nimbatus* Wildem. [*Tetracoccus nimbatus* (Wildem.) Schmidle]. IV. Ks.

Genus *Trochiscia* Kütz.

1. *T. aciculifera* (Lagerh.) Hansg. VI. N.

*2. *T. aspera* (Reinsch) Hansg. III. Wi.

*3. *T. stagnalis* Hansg. III. C.

*4. *T. reticularis* (Reinsch) Hansg. IV. Ks.

Genus *Protococcus* Ag.

1. *P. viridis* Ag. II. No. III. Esher, Dorking.

Class MYXOPHYCEÆ.

Ord. *Hormogoneæ.*

Sub-ord. Heterocysteæ.

Fam. **Rivulariaceæ.**

Genus *Gloiotrichia* J. Ag.

1. *G. Pisum* (Ag.) Thur. III. Th. V. Go.

Fam. **Sirosiphoniaceæ.**

Genus *Hapalosiphon* Näg.

1. *H. hibernicus* West & G. S. West. VI. N.

*2. *H. intricatus* West. III. Pu.

Genus *Stigonema* Ag.

1. *S. ocellatum* (Dillw.) Thur. VI. N. VIII. T.

Fam. **Scytonemaceæ.**

Genus *Scytonema* Ag.

1. *S. cincinnatum* (Kütz.) Thur. VI. On stones in stream near Lyndhurst, New Forest (G. Massee).
   Crass. fil. 20–23 μ; crass. trich. 14–16 μ.
2. *S. figuratum* Ag. III. Ew.

Genus *Tolypothrix* Kütz.

1. *T. tenuis* Kütz. I. Ep. III. Fg.
2. *T. lanata* (Desv.) Wartm. III. Fg.

Fam. **Nostoceæ.**

Genus *Nostoc* Vauch.

1. *N. microscopicum* Carm. III. M., Mp. V. Go.

Genus *Anabæna* Bory.

1. *A. inæqualis* (Kütz.) Born. et Flah. I. Ep. (spores up to 5-seriate).
2. *A. oscillarioides* Bory. V. Go.

Genus *Aphanizomenon* Morren.

1. *A. flos-aquæ* (L.) Ralfs. III. M.

Genus *Cylindrospermum* Kütz.

1. *C. stagnale* (Kütz.) Born. et Flah. III. Pu.

Sub-ord. HOMOCYSTEÆ.

Fam. **Camptotricheæ.**

AMMATOIDEA gen. n.

Plantæ filamentosæ et epiphyticæ; fila longa e serie regulari singula cellularum formata, haud ramosa, prope medium subito et acute genuflexa circa ramos hospitis, extremitates ambas versus gradatim et gradatim attenuata, flexuosa et vaginata; vagina firma, arcta, et lamellosa, achroa vel luteo-fusca in partibus vetustis; trichomata ad extremitates ambas in pilum longum attenuata, ad dissepimenta constricta; cellulæ subquadratæ (vel diametro breviores) prope medium filamentorum, extremitates versus gradatim longiores (diametro usque ad 6-plo longiores); protoplasma ærugineum, granulosum; fila secundaria ubi genuflexa, in filis primariis sedentes et iis similes.

1. A. NORMANII sp. unica. (Pl. VII. figs. 25–28.)
   Character idem ac generis.
   Crass. fil. ad med. $5 \cdot 5$–$12 \cdot 5$ μ; crass. trich. $3 \cdot 5$–$5 \cdot 5$ μ.
   VII. Dartmoor (coll. T. Norman), epiphytic on *Batrachospermum moniliforme.*

The long attenuation of both extremities of the filaments readily distinguishes this genus from all others and places this plant in the Camptotricheæ. The filaments are very different from those of the only other genus (*Camptothrix*) of this order, and at first sight much resemble those of a *Calothrix*. The false ramification is most peculiar, the geniculate flexure of one filament being merely applied to the inner lamellæ of the sheath of another, and included in the outer lamellæ of the sheath. The plant is attached to its host by the medium acute flexure of the filaments around either one of the strands of the axis or one of the small lateral branches (*vide* fig. 25).

The discovery of this genus necessitates the modification of the Fam. *Camptotricheæ* as follows:—

Fam. CAMPTOTRICHEÆ. Fila epiphytica et aquatica, brevia vel longa, vaginata, haud ramosa, irregulariter flexuosa, *extremitates ambas versus attenuata*, serie singula cellularum intra vaginam unamquamque formata, vaginis delicatis vel firmis, achrois vel luteo-fuscis.

Gen. 1. *Camptothrix.* Fila brevissima, e serie singula cellularum irregularium formata, extremitates versus paullo attenuata, submoniliformia; vagina delicata et hyalina; protoplasma cellularum homogeneum.

Gen. 2. *Ammatoidea.* Fila longa, e serie singula cellularum regularium formata, subito genuflexa, in medio et extremitates versus longissime attenuata; vagina firma et sæpe luteo-fusca; protoplasma cellularum granulosum.

Fam. **Vaginarieæ.**

Genus *Schizothrix* Kütz.

1*. *S. vaginata* (Näg.) Gomont.
Articuli sæpius diametro trichomatis paullo longiores. Crass. trich. 2·5–3 μ. VI. N.

Genus *Dasyglœa* Thwaites.

1. *D. amorpha* Berkeley. III. Th. (a form with thinner trichomes). VI. N.

Fam. **Lyngbyeæ.**

Sub-fam. LYNGBYOIDEÆ.

Genus *Lyngbya* Ag.

*1. *L. putealis* Montagne. III. Rp.
2. *L. Martensiana* Menegh. III. Dj.
*3. *L. ærugineo-cœrulea* (Kütz.) Gomont. III. Kingston to Esher.
*4. *L. versicolor* (Wartm.) Gomont. III. Dorking.
5. *L. ochracea* (Kütz.) Thur. III. Cr.

Sub-fam. OSCILLATORIOIDEÆ.

Genus *Phormidium* Kütz.

*1. *P. molle* (Kütz.) Gomont. III. Rp. (on *Myriophyllum*).
*2. *P. foveolarum* (Mont.) Gomont. III. In chalk pit, Dorking.
*3. *P. tenue* (Menegh.) Gomont. II. Pi. III. Bi., Fg., Wi. IV. Hc.
4. *P. autumnale* (Ag.) Gomont. III. Wi. Esher, Thames Ditton, Kingston.

Genus *Oscillatoria* Vauch.

*1. *O. prolifica* (Grev.) Gomont. III. Ra.
2. *O. princeps* Vauch. III. Th. IV. Ks. VIII. H.
3. *O. limosa* Ag. (*Frœlichii* Kütz.) Frequent.
4. *O. irrigua* Kütz. III. Ew., Th. IV. Ks.
*5. *O. simplicissima* Gomont. III. Wi.
6. *O. tenuis* Ag. II. Wh. VI. N.
7. *O. amphibia* Ag. (*O. tenerrima* Kütz.) II. Wh. III. E., Th., Wi.
*8. *O. angustissima* West and G. S. West. III. Wi.
9. *O. splendida* Grev. IV. Ks.
   Var. *attenuata* West and G. S. West. II. No.
*10. *O. formosa* Bory. IV. Ks.

Genus *Spirulina* Turp.

1. *S. major* (Kütz. (*S. oscillarioides* Kütz.). I. Ep. II. Ru. III. Pu. VIII. H., W.

Ord. *Chroococcoideæ.*

Fam. **Chroococcaceæ.**

Genus *Glœothece* Näg.

1. *G. confluens* Näg. III. Th.
2. *G. linearis* Näg. III. Th. VI. N. VII. D. VIII. T.
3. *G. cystifera* (Hass.) Rabenh. III. Mp.

Genus *Aphanothece* Näg.

1. *A. microscopica* Näg. III. Fg., Th. IV. Ks. VII. D. VIII. W.
2. *A. saxicola* Näg. III. Fg., Th. VII. S. VIII. W.
   Var. *violacea* West. VI. N.
3. *A. prasina* A. Br. III. Fg., Th., Wt.

Genus *Synechococcus* Näg.

1. *S. major* Schroet. (*S. crassus* Arch.). I. Ep. IV. Ks.
2. *S. æruginosus* Näg. VI. N. VII. D. VIII. T.

Genus *Glaucocystis* Itzigsh.

1. *G. Nostochinearum* Itzigsh. I. Ep. III. Fg., Th. IV. Ks. VII. D. VIII. L.

Genus *Merismopedia* Meyen.

1. *M. glauca* (Ehrenb.) Näg. III. C., E., Ra., Rp., Th., Wt. VII. D., Tq. VIII. H., L., T., W.
2. *M. violacea* (Bréb.) Kütz. II. U. III. F. VIII. K.
3. *M. æruginea* Bréb. V. Go.

Genus *Tetrapedia* Reinsch.

1. *T. Reinschiana* Arch. I. Ep. II. Wh. III. M., Mp., Rp., Th. V. Go.

Genus *Gomphosphæria* Kütz.

1. *G. aponina* Kütz. III. Fg., Th. IV. Ks. V. Go.

Genus *Clathrocystis* Henfrey.

1. *C. æruginosa* (Kütz.) Henfrey. III. Fg.

Genus *Polycystis* Kütz.

1. *P. marginata* (Menegh.) Richter. II. U. III. Mp.
*2. *P. elabens* (Bréb.) Kütz. VI. N.
*3. *P. flos-aquæ* Wittr. III. Th. VI. N.

Genus *Aphanocapsa* Näg.

1. *A. pulchra* (Kütz.) Rabenh. III. Th.

Genus *Porphyridium* Näg.

1. *P. cruentum* (Ag.) Näg. III. Clapham, Esher.

Genus *Chroococcus* Näg.

1. *C. minor* (Kütz.) Näg. III. C., Th. IV. Ks. VII. D. VIII. L., W.
2. *C. cohærens* (Bréb.) Näg. III. Dj. VI. N. VIII. H.
3. *C. turgidus* (Kütz.) Näg. I. Ep. III. C., Ew., Th. IV. Ks. VIII. K., T.
4. *C. pallidus* Näg. III. Th.
5. *C. rufescens* (Bréb.) Näg. VIII. W.

SUMMARY.

	Genera.	Species.*
Class FLORIDEÆ.		
Fam. *Batrachospermeæ*	1	2
Class CHLOROPHYCEÆ.		
Ord. **Confervoideæ Heterogamæ.**		
Fam. *Coleochætaceæ*	1	3
Fam. *Œdogoniaceæ*	2	21
Ord. **Siphoneæ.**		
Fam. *Vaucheriaceæ*	1	6
Fam. *Hydrogastraceæ*	1	1

* Excluding varieties and forms.

	Genera.	Species.
Ord. **Confervaceæ Isogamæ.**		
Fam. *Ulvaceæ* . . .	2	2
Fam. *Ulotrichaceæ.*		
Sub-fam. Ulotricheæ .	3	8
Sub-fam. Chætophoreæ	5	11
Sub-fam. Conferveæ .	2	6
Fam. *Chroolepidaceæ* .	1	2
Fam. *Cladophoraceæ* . .	1	3
Ord. **Conjugatæ.**		
Fam. *Zygnemaceæ.*		
Sub-fam. Mesocarpeæ .	2	10
Sub-fam. Zygnemeæ .	3	22
Fam. *Desmidiaceæ* . .	23	333
Ord. **Protococcoideæ.**		
Fam. *Volvocineæ* . .	6	6
Fam. *Palmellaceæ.*		
Sub-fam. Cœnobieæ .	5	16
Sub-fam. Pseudocœnobieæ	3	4
Sub-fam. Rhaphidieæ .	6	22
Sub-fam. Characieæ .	1	6
Sub-fam. Tetrasporeæ .	5	9
Sub-fam. Dictyosphærieæ	5	6
Sub-fam. Glœocystideæ	6	17
Sub-fam. Protococcaceæ	5	11
Class MYXOPHYCEÆ.		
Ord. **Hormogoneæ.**		
Sub-ord. Heterocysteæ.		
Fam. *Rivulariaceæ* . .	1	1
Fam. *Sirosiphoniaceæ* . .	2	3
Fam. *Scytonemaceæ* . .	2	4
Fam. *Nostoceæ* . . .	4	5
Sub-ord. Homocysteæ.		
Fam. *Camptotricheæ* . .	1	1
Fam. *Vaginarieæ* . .	2	2
Fam. *Lyngbyeæ.*		
Sub-fam. Lyngbyoideæ	1	5
Sub-fam. Oscillatorioideæ	3	15
Ord. **Chroococcoideæ.**		
Fam. *Chroococcaceæ* . .	12	25
Total . .	118	588

APPENDIX.

The following notes of localities for Freshwater Algæ in Middlesex (M.) and Surrey (S.) were made with the idea of preparing an 'Algologia Metropolitana,' a scheme which circumstances have compelled me to abandon. This short list may, however, be of use in stimulating others to note the forms of life which may be found close to their own doors. It is, as far as I am aware, almost the first record of Freshwater Algæ gathered within the limits of London itself.

ALFRED W. BENNETT.

Coleochæte scutata Bréb. S. Kew Gardens.
Vaucheria sessilis DC. M. Botanic Gardens, Regent's Park; S. Kew Gardens.
Var. cæspitosa Vauch. S. Brown's Millpond, Waddon.
Sphæroplea annulina Ag. S. Kew Gardens, occasional.
Microspora vulgaris Rabh. M. Regent's Canal, Camden Town.
Cladophora flavescens Ag. M. Botanic Gardens, Regent's Park.
„ fracta Ktz. M. Regent's Canal, Camden Town.
Spirogyra nitida Lk. M. Regent's Canal, Camden Town. S. Brown's Millpond, Waddon.
Penium digitus Bréb. S. Brown's Millpond, Waddon.
Closterium lunula Nitzsch. M. Regent's Canal, Camden Town.
„ Leibleinii Ktz. S. Kew Gardens.
Docidium clavatum Ktz. S. Kew Gardens.
Euastrum didelta Rlfs. S. Brown's Millpond, Waddon.
Tetmemorus granulatus Rlfs. S. Brown's Millpond, Waddon.
Micrasterias denticulata Bréb. S. Brown's Millpond, Waddon.
Arthrodesmus Incus Hass. M. Regent's Canal, Camden Town.
Eudorina elegans Ehrb. S. Brown's Millpond, Waddon.
Hydrodictyon reticulatum Lag. S. Tank, Kew Gardens; abundant in some years.
Pediastrum Boryanum Men. M. Regent's Canal, Camden Town. S. In the Wandle, Beddington.
„ tetras Rlfs. M. Regent's Canal, Camden Town.
„ sp. Cœnobe quite compact; cells deep green, about the size of those of *P. tetras*, each with a single central conspicuous pyrenoid; marginal cells very variable in shape, each with two colourless horns proceeding from the margin, or from an angle very near the margin; tips of horns slightly thickened, but not bidentate. M. Regent's Canal, Camden Town.
Scenedesmus obliquus Ktz. M. Regent's Park.
„ quadricauda Bréb. M. Regent's Canal, Camden Town.
Tetraëdron longispinum Perty. S. Kew Gardens.
Protococcus viridis Ag. M. Regent's Canal, Camden Town.
Anabæna oscillarioides Bor. *var.* elongata. M. Regent's Park.
Oscillatoria limosa Ag. M. Botanic Gardens, Regent's Park. S. Wandle, Beddington.
„ tenuis Ag. M. Botanic Gardens, Regent's Park. S. Wandle, Beddington.
Chroöcoccus cohærens Näg. M. Botanic Gardens, Regent's Park.
Microcystis protogenita Rbh. M. Regent's Canal, Camden Town.

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.†

Darwin, and after Darwin.‡—The third volume of the late Mr. Romanes' valuable work, edited by Prof. Lloyd Morgan, deals with isolation and physiological selection. It may be a fitting tribute to the author to print his twelve general conclusions, viz.:—

"(1) Natural Selection is primarily a theory of the cumulative development of adaptations wherever these occur; and therefore is only incidentally, or likewise, a theory of the origin of species in cases where allied species differ from one another in respect of peculiar characters, which are also adaptive characters.

(2) Hence it does not follow from the theory of Natural Selection that all species—much less all specific characters—must necessarily have owed their origin to Natural Selection; since it cannot be proved deductively from the theory that no 'means of modification' other than Natural Selection is competent to produce such slight degrees of modification as go to constitute diagnostic distinctions between closely allied species; while, on the other hand, there is an overwhelming mass of evidence to prove the origin of 'a large proportional number of specific characters' by causes of modification other than Natural Selection.

(3) Therefore, and upon the whole, as Darwin so emphatically held,

* 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.

‡ 'Darwin, and after Darwin. An Exposition of the Darwinian Theory and a Discussion of Post-Darwinian Questions.' By the late George John Romanes. Vol. iii. London, 1897, viii. and 181 pp.

'Natural Selection has been the main, but not the exclusive, means of modification.'

(4) Even if it were true that all species and all specific characters must necessarily owe their origin to Natural Selection, it would still remain illogical to define the theory of Natural Selection as indifferently a theory of species or a theory of adaptations; for, even upon this erroneous supposition, specific characters and adaptive characters would remain very far indeed from being conterminous—most of the more important adaptations which occur in Nature being the common property of many species.

(5) In no case can Natural Selection have been the cause of mutual infertility between allied, or any other species—i.e. of the most general of all 'specific characters.'

(6) Without Isolation, or the prevention of free intercrossing, organic evolution is in no case possible. Therefore it is Isolation that *has* been 'the exclusive means of modification,' or more correctly, the universal condition to it. Therefore, also, heredity and variability being given, the whole theory of organic evolution becomes a theory of the causes and conditions which lead to isolation.

(7) Isolation may be either discriminate or indiscriminate. When discriminate, it has reference to resemblances between individuals constituting the isolated colony or group; when indiscriminate, it has no such reference. In the former case there arises Homogamy, and in the latter case there arises Apogamy.

(8) Except where very large populations are concerned, indiscriminate isolation always tends to become increasingly discriminate; and, in the measure that it does so, Apogamy passes into Homogamy, by virtue of independent variability.

(9) Natural Selection is one among many other forms of discriminate isolation, and presents in this relation the following peculiarities:—(*a*) The isolation is with reference to superiority of fitness; (*b*) is effected by death of the excluded individuals; and (*c*) unless assisted by some other form of isolation, can only effect monotypic, as distinguished from polytypic, evolution.

(10) It is a general law of organic evolution that the number of possible directions in which divergence may occur can never be more than equal to the number of cases of efficient isolation; but, excepting Natural Selection, any one form of isolation need not necessarily require the co-operation of another form in order to create an additional form of isolation, or to cause polytypic, as distinguished from monotypic, evolution.

(11) Where common areas and polytypic evolution are concerned, the most general and most efficient form of isolation has been the physiological, and this whether the mutual infertility has been the antecedent or the consequent of morphological changes on the part of the organisms concerned, and whether or not these changes are of an adaptive character.

(12) This form of isolation—which, in regard to incipient species, I have called physiological selection—may act either alone or in conjunction with other forms of isolation on common areas; in the former case its agency is of most importance among plants and the lower

classes of animals; in the latter case, its importance consists in its greatly intensifying the segregative power of whatever other form of isolation it may be with which it is associated."

Law of Heredity.*—Mr. Francis Galton has investigated in regard to Basset blood-hounds the average contribution of each several ancestor to the total heritage of the offspring. The result is to verify in this instance the statistical law of heredity which was stated in 'Natural Inheritance' (1889). The law is that the two parents contribute between them on the average one-half $(0 \cdot 5)$ of the total heritage of the offspring; the four grandparents, one-quarter $(0 \cdot 5)^2$; the eight great-grandparents, one-eighth $(0 \cdot 5)^3$, and so on. Thus the sum of the ancestral contributions is expressed by the series $\{(0 \cdot 5) + (0 \cdot 5)^2 + (0 \cdot 5)^3$, &c.$\}$, which, being equal to one, accounts for the whole heritage. The same statement may be put in another form:—that 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.

Influence of a Previous Sire.†—Dr. A. S. Bell reviews some of the old cases of supposed Telegony, and criticises the two explanatory theories—(*a*) that the sperm of the first sire affects unripe ova in the ovary, and (*b*) that an influence saturates from the fœtus to the mother, and through her affects future progeny. Dr. Bell also gives the results of various experiments and observations he has made as to dogs, horses, and pigeons. None of these in any way suggested the occurrence of Telegony. He also narrates the case of a woman who bore a male child, an ordinary mulatto, to a pure negro, and two years and nine months later bore a female child to a white man. This second offspring, now a woman, shows no trace of negro blood.

Regeneration of Tail in Lizards.‡—Dr. F. Werner has made a study of this interesting phenomenon in a large number of lizards, including representatives of twelve families. He begins by noting that very many reptiles are without the power of regenerating the tail, e.g. crocodiles, tortoises, snakes, chamæleons, Varanidæ, *Heloderma*, and Amphisbænidæ. In some cases of lizards, the regenerated tail has the same scaling as the original tail, viz., Lacertidæ, Gerrhosauridæ, Tejidæ, Zonuridæ, Uroplatidæ, Anniellidæ, and finally, *Sphenodon*, in which the regeneration is remarkably exact. In other cases, with which the author is chiefly concerned, the scaling of the regenerated tail is different from that of the original. His general conclusions as to the last set of cases are as follow. The more primitive characters are regenerated, the presumably newer differentiations tend to be suppressed. The original segmentation of the scaling, the occurrence of preformed rupture-lines, and the differentiation of a vertebral column, are suppressed in regeneration. Where the scaling of the primary tail-end is different from that of the rest of the tail, the secondary tail resembles the primary tail-end. Those differentiations which are not regenerated are late in appearing in the embryos. The regeneration of the tail is most exceptional, or is at least limited, when the tail has an adaptive differentiation as a

* Proc. Roy. Soc., lxi. (1897) pp. 401–13.
† Journ. Anat. Physiol., xxx. (1896) pp. 258–84.
‡ SB. K. Akad. Wiss. Wien, cv. (1897) pp. 123–46 (2 pls.).

weapon or organ of attachment. In a second regeneration the tertiary tail agrees completely with the secondary tail. Within the same family the regenerated tails generally agree as regards the scaling.

Hypotypic Regeneration.*—Prof. A. Giard finds in the phenomena of regeneration a tendency to reproduce ancestral conditions. The pentamerous tarsi of Blattidæ and Phasmidæ may be replaced by tetramerous tarsi, which are believed to be more primitive. The same tendency is seen in the scaling of lizards' tails (Boulenger, Werner), in the dorsal appendages of *Tethys leporina* (Parona), in the polydactylism of Axolotl and *Pleurodeles*, in the ringing of the stalk in *Obelia* (Davenport). To this kind of regeneration the author applies the term "hypotypic," i.e. returning to a lower type.

Critical Period in Development of Horse.†—Prof. J. Cossar Ewart begins an interesting paper with a brief description of the fœtal appendages in the horse, which he contrasts with those of bird and opossum. During the first seven weeks the embryo is fixed by the cells of the embryonic sac or trophoblast, and a special absorbing area is formed by a fusion between part of the yolk-sac and the outer sac. This acts as a sort of filter, through which the nutriment enters, and is absorbed by the vitelline blood-vessels. "At the end of the third week of gestation, when the reproductive system passes through one of its periods of general excitement, about one-fourth of the embryonic sac probably adheres to the uterus; but at the end of the sixth week, when another wave of disturbance arrives, all the grappling structures are at one pole. Hence there is probably more chance of the embryo 'slipping' at the end of the sixth than at the end of the third week. About the end of the seventh week the supply of nourishment by means of the yolk-sac is coming to an end, and there is perhaps still about this time an hereditary tendency for the embryo to escape." This is the most critical period; its difficulties are overcome by the rapid sprouting of allantoic villi, which procure fresh supplies of food and oxygen, and effect firmer fixing of the embryo to the wall of the uterus. The paper concludes with some practical hints as to the precautions which may be taken to counteract the risks of the critical period.

Origin of the Cleavage Centrosomes.‡—Miss K. Foot discusses this difficult question with immediate reference to the egg of *Allolobophora fœtida*. During the past two years the weight of authority has greatly increased in favour of the conclusion that the cleavage centrosomes are of spermatic origin. They are said to be the daughter centrosomes of the so-called male centrosome, which is believed to originate from the middle piece of the spermatozoon. But the phenomena of fertilisation in the egg of *Allolobophora fœtida* do not sustain this view; they suggest that this centrosome has the same origin as the so-called egg-centrosome, and that both are cytoplasmic elements, of like origin and constitution. The sperm attraction-sphere and the fertilisation-cone have several points in common; both structures appear to be dependent, not only upon the entrance of the spermatozoon, but also upon a definite

* C.R. Soc. Biol., 1897, 3 pp.; Zool. Centralbl., iv. (1897) p. 680.
† London, 8vo, 27 pp. and 2 pls.
‡ Journ. Morphol., xii. (1897) pp. 809-14 (1 pl.).

stage of maturation reached by the egg. Miss Foot's observations suggest that both the cone and the attraction-sphere are expressions of a definite effect produced upon the cytoplasm by the entrance of the sperm, the phenomena differing in that the anterior end of the head of the spermatozoon produces a cone, whereas the middle piece produces the attraction-sphere.

Directive Influence of Gravity on Development.* — Prof. O. Schultze furnishes some new evidence of this. By three methods he eliminated the normal action of gravity on developing frog ova, and all came to nothing. He therefore reaffirms with confidence his previous conclusion that the directive action of gravity on the egg of the frog is an essential condition of normal development.

Historical Note as to Polar Bodies.†—Prof. E. van Beneden recently stated that the theory of polar bodies as morphologically equivalent to ova was first formulated by Mark in 1881, and soon afterwards by Bütschli. He based his statement, which was quite an *obiter dictum*, on E. B. Wilson's book on the Cell (p. 175). Prof. A. Giard ‡ points out, however, that the theory was advanced by himself in 1876. Van Beneden makes the correction, but he does not in the least agree with a further statement made by Giard, that the polar bodies are formed by a true typical mitosis. As is well known, van Beneden has always insisted upon the differences between typical mitosis and the divisions which give rise to polar bodies.

Lateral Sensory Rudiment in Salmon.§—Messrs. H. V. Wilson and J. E. Mattocks have added the salmon to the list of forms in which a common lateral *Anlage* occurs. It divides, as in *Serranus* (where Wilson first discovered it), into three parts, the middle becoming the auditory sac, the posterior the rudiment of the lateral line, and the anterior remaining as a very noticeable thickening situated above the anterior gill-clefts. The original *Anlage* is in the salmon, as in Selachians, a thickening, and not an invagination.

Development of Selachii.‖—Prof. C. K. Hoffmann continues his studies on the development of Selachians, discussing the fourth and fifth palingenetic somites of the head, the sixth palingenetic somite and the four cænogenetic protovertebræ or occipital somites, the ventral nerve-roots of the head-somites, and the development of the trochlear nerve.

Early Development of Cestracion.¶—Prof. W. A. Haswell describes the early history of the blastoderm in *Heterodontus* (*Cestracion*) *Phillipi* up to the time of the enclosure of the archenteron. As this Elasmobranch was represented by near relatives as far back as the Carboniferous period, it was hoped that the embryonic development might exhibit some important primitive features. So far, however, this expectation has not been fulfilled. "What impresses one most in the results is the extraordinary persistency of certain characteristics which are not known to

* Verh. Anat. Ges. Anat. Anzeig., Bd. xiii. Ergänz.-Heft, pp. 109-16.
† Bull. Acad. Roy. Belg., xxxiv. (1897) pp. 21-4.
‡ C.R. Soc. Biol., iv. (1897) p. 549.
§ Anat. Anzeig., xiii. (1897) pp. 658-60 (2 figs.).
‖ Morph. Jahrb., xxv. (1897) pp. 250-304 (2 pls. and 9 figs.).
¶ Proc. Linn. Soc. N.S.W., xxii. (1897) pp. 96-103 (2 pls.).

have any vital significance. There can be little doubt, for example, that the 'orange spot' which forms such a striking feature of the egg of an Elasmobranch in its early stages, has been handed down with little change from Palæozoic times." The author does not confirm Hoffmann's discovery (in *Acanthias*) of an invagination cavity and open blastopore; at the corresponding stage in *Heterodontus* there was only the segmentation-cavity, which in one case had been opened by an artificial rupture.

Passage of the Eye in a Flat-Fish.*—Mr. T. Nishikawa has made an interesting observation on the young form of an undetermined species of flat-fish. The dorsal fin had grown forward before the rotation of the right eye, but the anterior extension had not united with the head, and had left a distinct hole. Through this hole the right eye passed, travelling dorsally and to the left. "If we compare this mode of passage of the eye with the first mode described by Agassiz, which is undergone by the majority of flat-fishes, we find little difference between them, beyond the fact that before the rotation of the eye takes place, the dorsal fin grows forward to the snout and lies in apposition with the head, leaving a hole for passage. If the hole had been obliterated before the rotation of the eye, a hole would have had to be pierced, as observed in *Arnoglossus* by Ehrenbaum and in *Plagusia* by Agassiz." In every case the passage of the eye from one side to the other is morphologically along the dorsal surface of the head; but the case described is, as to mode of passage, intermediate between what occurs in the majority and what occurs in the two genera named above.

Ovum in Testis of Lamprey.†—Dr. R. H. Ward describes the occurrence of a characteristic ovum in an actively functioning testis of the lamprey. In the lobule occupied by the ovum the mother-sperm-cells had apparently suffered an arrest of development; in other parts they had formed spermatozoa and had almost entirely disappeared. They persisted in this lobule, which was otherwise comparatively empty of male products. "Was the nourishment just here unsuited to them, or was it so appropriated by the ovum that enough was not left for them?"

Liver and Pancreas in Ammocœtes.‡—Dr. A. Brachet discusses the various views which have been expressed in regard to the development of liver and pancreas in *Ammocœtes*, and gives an account of his own observations. From these it results that *Ammocœtes*, and probably all the Cyclostomata, should be placed between the lancelet on the one hand and the Selachians and higher Vertebrates on the other. In *Ammocœtes* the hepatic cæcum of *Amphioxus* has become a true liver, but the pancreas, though indicated by an *Anlage* or rudiment-zone on the intestine, is not yet isolated as a special gland.

Development of Heart in Petromyzon.§—S. Hatta has observed that the heart, which is always found, independent of age, in the same section of the body as the pronephros, arises as a single endothelial tube formed from mesenchymatous cells between the two primary layers at the point on the ventral median line where the head-fold joins the larger

* Annot. Zool. Japon., i. (1897) pp. 73–6 (2 figs.).
† Amer. Mon. Micr. Journ., xviii. (1897) pp. 213–7.
‡ Anat. Anzeig., xiii. (1897) pp. 621–36 (6 figs.).
§ Journ. Coll. Sci. Imp. Univ. Japan, x. (1897) pp. 225–37 (1 pl.).

posterior yolk-mass. As to the origin of the mass of cells which form the endothelium of the heart, the author is unable to say anything definite, but he is inclined to regard it as derived from the mesoblast.

Development of Teeth in Bottle-Nose Whale.*—Herr Axel Ohlin gives an account of the development of the teeth in *Hyperoodon rostratus.* A lip-groove was well developed in the upper jaw of all the embryos; in the lower jaw in the oldest only. No *Zahnwall* nor *Zahnfurche* was discernible. The youngest fœtus showed a continuous dental ridge, with a few incipient rudiments. The ridge is divided by connective tissue into isolated epithelial masses. To its labial side appear on each side $\frac{40}{36}$ cap-shaped tooth-rudiments, which are subsequently reduced in number, only 6–7 attaining development. All the enamel germs arise on the lateral wall of the dental ridge; pigment is everywhere distributed; no rudiments of replacement teeth were seen. The first two pairs of rudiments, especially the foremost in the lower jaw, develop more rapidly than the others. There is no production of enamel, nor differentiation into enamel pulp and enamel epithelium. Besides the lateral dental ridges, there are two median epithelial folds in the lower jaw, which extend backwards to the most anterior tooth-rudiments, and may possibly hint at another generation of teeth.

Double Gastrula in Lizard.†—Dr. Fr. Kopsch describes the abnormal occurrence of a double gastrular invagination on the blastoderm of *Lacerta agilis*, and discusses the theoretical interpretation of the case. There were two distinct embryonic rudiments converging posteriorly, a convergence which the author regards as due to the medianward cell-movements associated with invagination.

b. Histology.

Structure of Striped Muscular Fibre.‡—Prof. W. Rutherford returns to a subject to which he has previously made important contributions. After a brief historical introduction, he gives an account of his methods, and then considers in detail the muscle of the crab in its uncontracted and contracted state. He distinguishes (*a*) the broad dim stripe, consisting of Bowman's elements and including Hensen's line; (*b*) the clear stripe proper, consisting of the clear segments proper; and (*c*) the intermediate stripe, including Dobie's line and Flögel's lines. A useful synonymy of the complex nomenclature is given. The author discusses the theory of contraction, but leaves it an open question.

"The appearances of striped muscle that have proved so puzzling to the microscopist depend (1) on the fact that the segments of the fibrils are not of uniform calibre; (2) their highly refractile chromatin is not equally distributed in the relaxed, and still less so in the contracted fibrils; (3) when the light is transmitted through the mass of fibrils that constitute a fibre, the effects of curvature and of unequally distributed chromatin are still more complicated by the superposition of many bundles of fibrils; it is easy to understand why observers

* Bihang K. Svenska Vetensk.-Akad. Handlingar, xxii. (1897) No. 4, 31 pp. and 1 pl.
† SB. Preuss. Akad. Wiss., 1897, pp. 646–50 (1 pl.).
‡ Journ. Anat. Physiol., xxxi. (1897) pp. 309–42 (3 pls. and 2 figs.).

have arrived at conclusions that have differed so widely from each other." At the end of the section on the effect of curvature, the author dismisses Haycraft's theory that the optical striping is due to the varicosities of the fibrils. The next part of the paper deals with the appearances of muscle in polarised light. We are not able to do more than refer to the general contents of Prof. Rutherford's paper, which is very beautifully illustrated. The author supports the fibrillar theory, and is in harmony with Kölliker, Merkel, Fredericq, and Rollett. He entirely disagrees from the opinions of Krause, Engelmann, Klein, Marshall, Melland, van Gehuchten, and others who have advocated the doctrine originally started by Bowman, that the fibrils result from post-mortem cleavage of the sarcous substance.

Cells and Energids.*—Prof. A. von Kölliker says that muscle-fibres must be looked at in two ways;—on the one hand as a sum of energids, in so far as their nuclei and the sarcolemma are direct products of the original uninucleate muscle-energids; and on the other hand as alloplasmatic structures as regards their muscle-fibrils. Similarly, but with less certainty, the axis-fibrils and their continuations into the cell-body of the neurodendrites may be regarded as *alloplasmatic*, while the neuroplasma in the cell-processes and cell-body are remains of the energid. Nissl's bodies and the medulla may be regarded as passive energid products or "*ergastic*" structures in Meyer's sense. The author will not, however, admit the generality of the statement that passive energid products are unorganised, and grow only by apposition (Sachs and Meyer).

Centrosomes in Ganglion and Cartilage Cells.†—Prof. J. Schaffer describes the occurrence of centrosomes in the peculiar cells of the lingual cartilage in *Myxine glutinosa*, and in the cerebral ganglion-cells of *Petromyzon Planeri*.

Conditions of Cell-Division.‡—Prof. Th. Boveri brings together the general results of his detailed work in a discussion as to the physiology of cell-division. His general conclusion is stated as follows:—"To bring the protoplasm into the disposition requisite for cell-division, it is not enough that nuclear substance should be present, nor that the nucleus should be in a certain state; it is necessary that the nuclear substance enter into definite relations with the poles, which must be regarded as the centres of the division-process."

Formation of Skin-Pigment.§—Herr B. Rosenstadt begins his paper by discussing the two opposed views:—(1) That melanotic pigment is derived from the blood; and (2) that the pigment is due to the metabolism of the skin-cells. In 1893, he gave some arguments in support of the view that pigment might be formed in the epidermic cells themselves; and distinguished cases of this as *pigment-degeneration* from other cases of apparent *pigment-infiltration*. A prior question, however, is as to the nature of the melanotic pigment; and, although we

* Verh. Anat. Ges. in Anat. Anzeig., xii. (1897) Ergänz.-Heft, pp. 21–5.
† SB. Akad. Wiss. Wien, cv. (1896) pp. 21–8 (1 pl.).
‡ SB. Phys.-med. Ges. Würzburg, 1896, pp. 133–51 (5 figs.).
§ Arch. Mikr. Anat., l. (1897) pp. 350–84.

remain very ignorant on the subject, the author shows at least that the term is made to include substances which are certainly not identical.

The pigment in the epidermis and hair of mammals, in the frog's skin, and in nævi and melanosarcomata, is indifferent to concentrated hydrochloric acid; it is dissolved but not changed by boiling; it disappears in nitric acid; but is unchanged in sulphuric acid, caustic potash, &c., even when heated; it is not dissolved or changed by water, alcohol, chloroform, &c. If an indubitable hæmatogenic pigment, e.g. that of sarcomatosis cutis, be subjected to similar tests, the results are altogether different. The pigment of plasmodium malariæ is also different from any hitherto investigated melanotic pigment of Vertebrates; and the black pigment of Crustacea, &c., agrees rather with that of the plasmodium than with that of Vertebrates.

By a study of skin-sections, Rosenstadt has convinced himself that epidermic cells, like connective-tissue cells, are able to form pigment independently. This was corroborated by an investigation of chick embryos, and of the retina cells in *Lucifer regnaudii*, &c. He goes on to discuss the various modes in which the pigment occurs in the skin,—in pigment-cells beneath the epidermis (Invertebrates); in melanoblasts occurring as fixed connective-tissue-cells in the cutis, and partially giving off pigment to the epidermis-cells (lower Vertebrates); in the epidermic cells themselves with or without the simultaneous occurrence of pigment-cells in the cutis (Mammals).

Periostal Ossification.* — Dr. G. Kapsammer discusses the much-debated question as to the relation between periostal and endochondral ossification. Making an exception for the epiphyses and partially for the vertebræ, he sums up the results of his studies in the following conclusions :—

(1) The periostal ossification appears before the endochondral;

(2) Periostal ossification consists in the metaplasis of a connective tissue rich in cells;

(3) The skeletal system of the adult is in greater part formed in a periostal manner;

(4) Endochondral ossification has for the most part a provisional character.

Dorsal Cells of Spinal Medulla.† — Prof. A. Van Gehuchten discusses the occurrence of the peculiar elements known as dorsal cells or *Hinterzellen* in various Vertebrates. In Cyclostomes they persist throughout life, and are in connection with the posterior roots; they may be considered as homologues of the cells of the spinal ganglia. In flat-fishes the dorsal cells persist throughout life (Dahlgren), but the course of their axis-cylinder processes is not known. In *Raja*, *Acipenser*, *Lepidosteus*, *Salmo*, *Trutta*, *Rhodeus*, *Labrax*, the dorsal cells occur in the embryo, and are in connection with the posterior roots; but their subsequent history is uncertain.

What the author particularly emphasises is that this term "dorsal cells" is at present applied to two quite different groups of nerve-elements. (1) There are the cells of Kutschin-Freud or of Reissner-

* Arch. Mikr. Anat., l. (1897) pp. 315–50 (1 pl.).

† Bull. Acad. Roy. Belg., xxxiv. (1897) pp. 24–38.

Freud in the spinal medulla of the lamprey, and the cells of Rohon in the trout—cells whose axis-cylinder process enters by one branch at least into the posterior root. These are the true "radicular dorsal cells." (2) There are the dorsal cells of the spinal medulla in *Tropidonotus natrix* and *Salamandra maculosa*, cells completely independent of the posterior roots, whose axis-cylinder process becomes a constituent fibre of the white matter of the cord. These are the true "medullary dorsal cells."

Tubular Enamel.*—Mr. C. S. Tomes discusses the peculiarity of the enamel in Marsupials. Except in the wombat, it is, as Sir John Tomes pointed out, freely penetrated by tubes, which enter it from the dentine, and are continuous with the dentinal tubes at the junction of the two tissues. The same condition occurs sporadically in other mammals, e.g. jerboa, shrew, and *Hyrax*.

The author concludes that the special cells of the enamel organ (ameloblasts) do not themselves calcify; that they each furnish from their free ends outgrowths or processes which are continuous with their own plasm, and which may be traced through the entire thickness of young enamel; that one ameloblast furnishes the whole length of an enamel prism; that the fibrillar outgrowths, previously more or less correctly described in other enamels, but not adequately appreciated, do calcify from without inwards in such a manner that an axial canal is left uncalcified; that the canals of marsupial enamel are in the centres of the prisms, and not, as supposed by Von Ebner, in the interstices of the prisms; and that towards the completion of the full thickness of the enamel, the central axis is no longer left soft, but the whole calcifies into a solid prism. Briefly stated, the author's belief is that "all enamels alike are formed by the centripetal calcification of fibres furnished by the ameloblasts, and that tubular enamels are nothing more than the perpetuation of a stage which is passed through, though only for a brief period, by every solid enamel prism."

Nervous System of Ammocœtes.†—Herr F. Mayer distinguishes in the cerebrum of *Ammocœtes* the olfactory lobe, the main ganglion (corpus striatum), and the cortex, each with typical fibre connections. In the thalamencephalon and mesencephalon most of the typical tracts are also demonstrable. The olfactory tracts may be followed to the cortex, and (as tænia thalami) to the superior commissure. They are thus related to the thalamus and hypothalamus, and through the ganglion habenulæ and Meynert's bundle to the cerebellum. Müller's fibres are neurites of colossal ganglion cells which place the optic region and that of the nerves following in connection with the spinal cord. The epiphysis is a functioning organ in nervous connection with the mesencephalon. Most of the ganglion cells, and with particular distinctness those of the corpus striatum and the hypothalamus, have an "epithelial process" which extends to the central cavity. Even in late stages of development some of the neurites in the central nervous system end freely in a point. In most of the fibre-tracts and commissures there are dendrites as well as the neurites running in the opposite direction.

* Proc. Roy. Soc. London, lxii. (1897) pp. 28–30.
† Anat. Anzeig., xiii. (1897) pp. 649–57 (1 pl.).

Intercellular Connections in Notochord Tissue.* — Herr F. K. Studnička finds considerable variety in the notochord-cells of Vertebrates, and directs attention to the very marked occurrence of intercellular bridges in *Esox lucius*, *Belone acus*, *Syngnathus*, &c. The intercellular spaces are crossed by a large number of plasmic bridges, producing an appearance like that of a layer of small vacuoles round the margins of the cells. In the middle of each of the delicate connections there is a node which stains intensely with hæmatoxylin. Similar nodes have been observed in the intercellular connections in plants.

c. General.

Measure of Variability.†—Mr. E. T. Brewster has followed Quetelet, Stieda, Galton, Weldon, and others in applying the statistical method of estimating probable error as a measure of variability. His subject-matter (taken at random) relates to body-measurements in man, skull-measurements of two species of *Lepus*, body-measurements of *Zapus insignis*, *Z. hudsonius*, and *Sitomys americanus*, and skull-measurements of cat, fox, and lynx. His thesis is stated in the following words :—" While it is generally agreed that *specific* characters are more subject to striking variations in individuals than are the characters *common to allied species*, it is not clear how far this relation extends. I wish to show that what is true of obvious variations and sports is also true of those minute differences between individuals which only careful measurements can detect ; or, in other words, that measurable quality is, in general, variable in individuals in proportion as it is a distinguishing character of the group to which the individuals belong. . . . The conclusion is, that there is so intimate a causal connection between the characters of individuals and those of the allied groups into which they are combined, that, in proportion as any character is variable in the individuals of one group, it is different in the allied groups."

Variations in Spinal Nerves of Hyla.—Miss G. Sweet‡ has made an elaborate study of the variations in the spinal nerves of *Hyla aurea*, the common green frog of Victoria. She finds a forward homœosis in the sacral plexus, and a backward homœosis in the brachial plexus. There is a tendency in this form, as in some other Anura, towards a concentration of the origin and functions of the spinal nerves towards the central region of the body.

Dr. H. Adolphi § has already reached the same general conclusion, and confirms it in a third contribution dealing with *Bufo cinereus* Schneid.

Muscular Variations in Primates.‖—Dr. J. H. F. Kohlbrugge has devoted seven years to a study of the musculature and peripheral nerves of Primates, especially of the Semnopithecini. This study has its importance for the comparative anatomist and the anthropologist; but we notice it here because the author directs particular attention to the

* Zool. Anzeig., xx. (1897) pp. 286-8 (1 fig.) (to be continued).
† Proc. Amer. Acad., xxxii. (1897) pp. 269–80.
‡ Proc. Roy. Soc. Victoria, ix. (1897) pp. 264–96 (many tables).
§ Morph. Jahrb., xxv. (1896) pp. 115-42 (1 pl.).
‖ Verh. K. Akad. Amsterdam, v. (1897) No. 6, 246 pp.

variations or anomalies which occur. These are of interest in themselves, but particularly in relation to the similar variations in man.

Inheritance of Acquired Characters in Camels.*—Prof. G. Cattaneo does not lack courage in his Lamarckian convictions. He regards the camel's hump as a morbid growth—"a professional tumour" in Lombroso's phrase—induced during the domestication period by the pressure and irritation of the saddle, &c. He seeks to show that it is not an ancient character; that it is not the result of selection; that it is a pathological character become almost stable in species, though still increasing with use, and decreasing with disuse. "If we do not admit the inheritance of acquired characters, it is difficult to explain the case of the camel according to the theory of evolution." The author interprets the callosities in the same way.

Origin of European Fauna.†—Dr. R. F. Scharff discusses this question in an essay, partly inductive and partly speculative, and dealing especially with the fauna of Ireland. A few of his conclusions may be summarised. The fauna and flora of Ireland consist mainly of two elements, from the north and from the south; in Great Britain an eastern Siberian element is added. Certainly the bulk of the migrants came by land. Unlike most authorities, the author maintains that the Irish fauna is partly pre-glacial. The Siberian fauna probably began to pour into Europe immediately after the deposition of the lower Continental boulder clay (a Pliocene marine formation). The migration took place along the tract of "black earth"; it was arrested in France by the Garonne; it reached Great Britain, but not Ireland nor Scandinavia. The northern or Arctic element in the Irish flora and terrestrial fauna came direct from the north by a land connection between Scandinavia and the British Islands; and the migration took place chiefly during the deposition of the newer English Crags and of the Continental lower boulder clay; that is to say, before the Siberian mammals arrived in Britain. The southern migration began before either the Arctic or the Siberian. This southern fauna is composed of species of south-western and of southern and central European, as well as of Asiatic origin. Ireland was separated from England at the time during which the migration from southern and central Europe was in progress. The British Pleistocene fauna does not indicate the prevalence of Arctic conditions; neither does the flora.

Temperatures of Reptiles, Monotremes, and Marsupials.‡—Mr. A. Sutherland has experimented with specimens of *Cyclodus gigas* placed in water, which was slowly heated. The lizards followed the temperature of the water very closely. For a time they are able to maintain themselves a few degrees above surrounding temperature; but even then they vary with it, their temperature rising and falling so as to keep always the same number of degrees in excess. When at rest and in good temper, the animals have a temperature almost the same as that of the air, but just a little less.

The average temperature for many specimens of *Echidna* was 29°·4; but one cold morning one was measured as low as 22°, while another in

* Rend. R. Ist. Lombardo, xxix. (1896) pp. 851–61.
† Proc. Roy. Irish Acad., iv. (1897) pp. 427–514.
‡ Proc. Roy. Soc. Victoria, ix. (1897) pp. 57–67 (1 pl.).

fierce heat (and carried in a sack) registered 36°·6—an extraordinary range of temperature for a Mammal. The average of sixteen species of Marsupials was 36°, i.e. 3° below the average of other Mammals. The wombat registered 34°·1, *Petaurus* 35°·7, the koala 36°, *Phalangista* 36°·6, the tree kangaroo 37° (the human standard). Variations from 34°·9 to 38°·4 were observed in a healthy koala.

The average for emus was 39°·5, for fowls 41°, for ducks 42°·1; but in most orders the temperature ranges about 42°. The author concludes: "The Monotremes and Marsupials form a gentle gradation between the Reptile and the Carnivore or Ungulate; while, so far as indications point, there is reason to believe that the lower birds are still reminiscent of a once existent chain of links which equally joined the cold-blooded lizards to those warmest-blooded of all creatures, the Passeriformes and Fringilliformes."

Distribution of Terrestrial and Freshwater Vertebrates in Victoria.*—Mr. A. H. S. Lucas shows, by means of lists, the marked distinctness, frequently extending to genera, of the faunas of the north-west plains of Victoria, and of the well-watered south-east hill and coast country. This points to the long persistence and ancient origin of the Dividing Range. From zoological evidence, "it seems clear that the Bass Straits were formed sufficiently to serve as an effective barrier *before* the dingo and the most highly differentiated tree-forms had reached southern Victoria, and *after* the forest had been established and the streams stocked with the existing fish, *long after* the separation or evolution of the two Victorian faunas had taken place. During the process of widening and deepening the straits, the dingo invaded Victoria, the Thylacine and Tasmanian Devil disappeared, while the koala and the beautiful flying opossums came in from the north along the eastern strip of Australia, and took possession of the Gippsland forests, along with a less desirable immigration of the fruit-eating bats, and, speaking generally, the present distribution of Vertebrates in Victoria has been effected."

Monograph of European Amphibians.†—Dr. J. von Bedriaga's monograph may be noted here on account of the abundant material which it contains in regard to secondary sex-characters, coloration and marking, larval forms, geographical distribution, and mode of life generally.

Fauna of Baikal Lake.‡—Prof. R. Hoernes takes account of the conclusion of Credner and Czerski that the Lake of Baikal is not geologically a relict sea. As Penck has pointed out, a distinction must be drawn between a relict fauna and a relict sea. The Lake of Baikal may not be a relict sea,—the geological history is against this interpretation; but there can hardly be any doubt as to the relict character of the fauna, both Invertebrate and Vertebrate. The animals are most probably in greater part migrants from the large early Tertiary inland sea.

Number of White Corpuscles.§—Dr. E. G. M. Bruhn-Fåhræus concludes an elaborate investigation, which has considerable biological

* Proc. Roy. Soc. Victoria, ix. (1897) pp. 34–53.
† Bull. Soc. Nat. Moscow, 1896 (1897) pp. 575–760.
‡ Biol. Centralbl., xvii. (1897) pp. 657–64.
§ Nordiskt Med. Arkiv, vii. (1897) No. 20, 106 pp.

interest, as to the number of white blood-corpuscles in the human blood in twenty morbid states, such as perityphlitis, acute rheumatism of joints, typhoid fever, and anæmia.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

Notes on Nautilus.*—Dr. A. Willey figures a living nautilus, showing the way in which the ordinary tentacles adhere to a foreign body, while the pre-orbital and post-orbital tentacles have no such adhesive power, but remain erect beside the ocular bulb. The spermatophore sac is figured *in situ* at the dorsal base of the buccal cone. The author notes that Graham Kerr and Bela Haller seem to have overlooked Huxley's description of the delimitations of the cœlome, and the position and features of the three openings leading from the pericardium into the visceral portion of the cœlome. Of these openings Willey gives a figure.

γ. Gastropoda.

Movements of Freshwater Gasteropods.†—Dr. L. Car has corroborated Simroth's account of the gliding movements of *Limnæa* and similar forms. The important motor factor lies in the muscular undulations of the foot. To explain the peculiarities of this "wave-play," Simroth suggested a special *Gerinnungshypothese*, which Car cannot accept. The extension and forward movement of the longitudinal muscle-fibres, and thereby of the whole sole, is brought about by a peculiar combination of the postero-anterior contraction and relaxation of the longitudinal and dorso-ventral muscle-fibres. The result can be accounted for only by the *combined* action of the two sets of fibres.

Spermatogenesis of Snail.‡—Mr. A. Bolles Lee finds in *Helix pomatia* that the basal cells ("*ovules mâles*" of Duval, "blastophoral cells" of Blomfield) are merely supporting and nutritive elements. Apart from the primordial cells and the spermatides, there are three categories of spermatogenetic cells, the spermatogonia and two generations of spermatocytes.

The division of the spermatogonia is first distinguished by a phase when the nuclear elements form a group of segmented loops, like the corolla of a flower. Between this and the equatorial crown stage, there is a remarkable phase in which the secondary segments are scattered without order in the nucleus. Perhaps there is some qualitative reduction in this phase.

The division of the first spermatocytes recalls Carnoy's division with straight rods (*à batonnets droits*) and Flemming's heterotypic division. Its essential feature is the fusion into a single chromosome of the segments produced by the longitudinal splitting of a primary nuclear segment. During this process there appear figures in rings, in ellipses, in balls grouped in fours (*Vierergruppen* doubtless). But these tetrads

* Quart. Journ. Micr. Sci., xl. (1897) pp. 207–9 (1 pl.).
† Biol. Centralbl., xvii. (1897) pp. 426–38 (14 figs.).
‡ La Cellule, xiii. (1897) pp. 199–278 (3 pls.).

are not quadripartite, only bipartite; and, like the rings and ellipses, they are merely transitional forms. The single chromosome formed by the fusion undergoes in the equatorial crown a segmentation transverse to the axis of its figure, probably the completion of the longitudinal splitting of the primary nuclear segment.

Between the division of spermatocytes I. and spermatocytes II. there is a phase of partial rest, but the chromosomes retain their independence. The division of spermatocytes II. is especially distinguished by the structure and mode of dislocation of the equatorial crown. This crown is composed of 24 recurved rods, the chromosomes of the last division, which have undergone no longitudinal splitting during the prophases. These rods are placed in the crown with their axes parallel to the axis of the spindle, and in this position they undergo a transverse segmentation. The resulting halves are distributed to the two poles. In this case the division is a qualitative and quantitative reducing division in Weismann's sense, but the reduction is not numerical. Indeed, there is no numerical reduction of chromosomes in the spermatogenesis of the snail.

The karyokinetic spindle contains a homogeneous axial portion, not differentiated into filaments, and bearing no chromosomes. It has perhaps some relation to the central spindle of Hermann. It arises, not from the cytoplasm, but from the nucleus, and seems to be formed anew at the beginning of each kinesis.

Both nucleus and cytoplasm contain a variable number of "siderophilous corpuscles," which appear to be produced by the nucleus, and to be expelled therefrom during the resting period, and before kinesis. These represent the centrosomes of other authors, but they do not form centres or play any mechanical part either in kinesis or in the cell-economy at any time. Both karyoplasm and cytoplasm have a reticular structure, but there are no "organic rays" nor "attraction-spheres."

Mesoderm of Physa fontinalis.*—Herr A. Wierzejski finds that the mesoderm in this Gasteropod arises from two sources, from a primitive mesoderm-cell and from two ectoderm-cells. The former gives rise to the posterior, the latter to the anterior portion of the mesoderm streak. The primitive mesoderm-cell contains, even at the 24-cell stage, elements of the endoderm; at the 32-cell stage it produces a small endoderm-cell, and becomes for the first time exclusively mesodermic. The two ectodermic cells referred to become mesoderm-cells only after the end of segmentation. Wierzejski briefly compares these results with those reached in regard to other Gasteropods, and is forced to conclude that the mesoderm of *Physa fontinalis* is only in part homologous to that of many others.

Terrestrial and Freshwater Molluscs of Kameroon.†—Adolf D'Ailly describes a collection of 100 species, chiefly Gasteropods, from Kameroon. Of these no fewer than 35 are new, and the author notes that almost the only memoir dealing with Kameroon Molluscs is one by E. von Martens in 1876. In describing the collection the author has

* Biol. Centralbl., xvii. (1897) pp. 388–94.
† Bihang K. Svenska Vetensk. Akad. Handlingar, xxii. (1897) No. 2, 137 pp. and 5 pls.

become convinced that too much importance has been attached to the form of the shell, the number of turns, the proportion of the last turn to the others, and so on; for these characters are very variable. He has found a more secure basis in the minute sculpturing of the shell. A frequent peculiarity is the enormous variability in the size of the adults, notably in the genus *Ennea*.

Two Australian Solenogastres.*—Dr. J. Thiele describes *Notomenia clavigera* g. et sp. n., found by Prof. A. C. Haddon in the Torres Straits. The generic diagnosis reads:—Solenogastres with moderately strong cuticle, club-shaped calcareous spicules, ventral ciliated groove, fore-gut without radula and with lobed salivary glands, mid-gut with lateral constrictions, efferent ducts of gonads with quite separate and independent openings, and with receptacula seminis. The other form is *Proneomenia australis* sp. n., which differs from *P. Sluiteri* mainly in having a biserial radula and numerous receptacula seminis.

δ. Lamellibranchiata.

Green Leucocytosis in Oysters.†—Profs. R. Boyce and W. A. Herdman have demonstrated the presence of copper in comparatively large quantity in the green leucocytes, chiefly of American oysters, but also in "natives" from Falmouth and elsewhere. The green colour was in proportion to the amount of copper present, and the colourless leucocytes contained only traces of the metal. The deposition of the copper in large quantity points to a degenerative change, comparable to the presence of iron in some of the leucocytes in man in cases of old hæmorrhages, pernicious anæmia, &c. It was accompanied by a most striking increase of leucocytes, which tended to distend the vessels and to collect in clumps. The authors are not prepared to state whether copper in the food can bring about the abnormal condition, but they have abundant evidence that it may occur where no copper mines or other evident sources of copper are present. They are inclined to suggest that the increase of copper may be due to a disturbed metabolism, whereby the normal copper of the hæmocyanin, which is probably passing through the body in minute amounts, ceases to be removed, and so becomes stored up in certain cells.

"Septibranchial" Bivalves.‡—Herr L. Plate has shown, by a study of the septum and its innervation in *Cuspidaria obsesa*, that this structure is pallial, not ctenidial. Thus the term septipalliate should replace septibranchiate.

Plankton Lamellibranchs.§—Prof. H. Simroth has described *Planktomya henseni* g. et sp. n., a eupelagic bivalve from the warm regions of the Atlantic. The foot is degenerate, and the shell uncalcified; the mantle contained numerous fat-globules. Various larval forms were obtained, all hemipelagic and eurythermal, with closed shells, no siphons, and two pallial muscles.

* Zool. Anzeig., xx. (1897) pp. 398–400.
† Proc. Roy. Soc. London, lxii. (1897) pp. 30–8.
‡ SB. Ges. Nat. Freunde Berlin, 1897, pp. 24–8.
§ 'Die Acephalen der Planktonexpedition, 1896,' 44 pp. and 3 pls. See Zool. Centralbl., iv. (1897) p. 563.

Lamellibranch with an Internal Shell.*—M. Félix Bernard describes *Chlamydoconcha Orcutti*, found by Orcutt in 1882 near San Diego (California), and first described by Dall in 1884. It has an extremely reduced internal shell and no trace of adductor muscles. The shell is lodged in the thickness of a delicate pallial lobe, which is itself covered by a thicker fold with abundant sensitive papillæ and glands. An anterior dorsal aperture allows the water to enter between the lobes. The mantle shows an anterior projecting lobe, a ventral gap for the foot, and a short anal siphon. Internally the animal is not at all divergent. Apart from mantle and shell, it seems like a Eulamellibranch of median specialisation, near the Carditidæ, especially those of the group Erycinacea, such as *Bornia*. The author also compares *Chlamydoconcha* with the yet more divergent *Scioberetia*.

Siphonal Papillæ of Cockle.†—Dr. W. A. Nagel describes peculiar structures sunk in the epithelial folds of the siphon of *Cardium oblongum*. They are externally like other siphonal papillæ, but show a weakly developed epithelium and no internal nuclei, only a coarsely fibrous substance, composed of coiled threads apparently non-contractile. There is no evidence of sense-cells nor secretory elements. A study of fresh specimens is desirable.

Arthropoda.

a. Insecta.

Autotomy in Phasmidæ.‡—M. Edmond Bordage describes autotomy in the larvæ, nymphs, and adults of *Monandroptera inuncans* and *Rhaphiderus scabrosus*. In the larvæ it occurs very readily; in the nymphs it becomes increasingly difficult in proportion as they draw nearer the final metamorphosis; in the adults it is capricious, and never so easily produced as in the saltatory Orthoptera. The anterior limbs are usually those which are most readily detached. While in the grasshoppers it is the contraction of a single muscle or of a small number of muscles that causes the rupture; this requires in the Phasmidæ very vigorous muscular contractions affecting the entire body, and is associated with serious hæmorrhage.

Life-History of Halictus.§—Dr. C. Verhoeff has made an interesting study of the life and habits of *Halictus* (*Anthophila*), especially of *H. quadristrigatus*. The vault or dome made by this species over the comb is constructed when the first batch of 1–5 cells has been formed. From 4–19 cells are made, and the number is in every case determined by the space afforded by the vault. The comb is freely surrounded by air. After laying the last egg and closing the last cell the mother bee does not die; she lives on until the larvæ are full-grown. But although she may come to know the first of her progeny, their appearance is a sign for her death. She broods on the comb from the dorsal side, to which the larvæ are turned, and where the cell-walls are thinner than elsewhere. The vault serves to protect the newly hatched young, and

* Ann. Sci. Nat. (Zool.), iv. 1896 (1897) pp. 221–52 (2 pls.).
† Zool. Anzeig., xx. (1897) pp. 406–9 (2 figs.).
‡ Ann. Nat. Hist., xx. (1897) pp. 473–8; Comptes Rendus, cxxiv. (1897) pp. 210–2, 378–81.
§ Zool. Anzeig., xx. (1897) pp. 369–93 (21 figs.).

also secures the better ventilation of the cells. Verhoeff also discusses *Halictus sexcinctus* F., which makes no vault, and dies after laying the last egg, and *H. albipes* F. (= *obovatus*), which makes a simple burrow with crowded lateral cells, but no vault.

Mouth-Parts of Insects.* — Herr Fr. Meinert maintains that in insects with complete metamorphosis, the order of development of the mouth-parts is *at first* in the succession recognised by Savigny :—(1) mandible, (2) first maxillæ, (3) second maxilla or labium; but that in later stages the order of developmental succession is :—(1) labium with (secondary) palps, (2) mandibles, (3) first maxillæ; or, if one considers position only,—(1) labium, (2) first maxillæ, (3) mandibles. In insects with incomplete metamorphosis, the fourth or most posterior post-oral metamerid—the primary metamerid of the labium with its primary labial palps—retains its position and continues its development, while the most anterior metamerid, corresponding to the secondary labial metamerid of other insects, does not develop till later, and rarely acquires appendages.

Taste-Organ in Lepidoptera.†—Dr. W. A. Nagel describes what appear to be taste-organs in the form of a dozen papillæ on the ventral hypopharynx wall of *Smerinthus populi* and other Lepidoptera. Apart from a brief note by Kirbach (1883), as to similar papillæ, the internal taste-organs of Lepidoptera have hitherto eluded observation. In general features, they resemble those in other insects. As to external taste-organs, Nagel believes that these are represented by papillæ at the end of the proboscis.

Mouth-Parts of Microlepidoptera.‡—Dr. K. W. Genthe begins his memoir with a general account of the structure of these parts. He then proceeds to a description of their peculiarities in the various families—a most laborious piece of work. In connection with theories of relationship, the mouth-parts of Phryganidæ and Tenthredinidæ are then discussed; and the author comes to the conclusion, unfortunately a somewhat negative one, that the presumed affinities between Lepidoptera and other groups of insects, especially Phryganidæ and Tenthredinidæ, are not rendered more probable by the comparative study of the mouth-parts.

Revision of European Culicidæ.§—Sig. E. Ficalbi completes his systematic account and revision of the European species of Culicidæ. He gives a history of classifications, a diagnosis of the family, and a description of the species. There are three European genera :—*Anopheles*, in which the palps of both sexes are about as long as the proboscis; *Culex*, in which the palps of the male are about as long as the proboscis, while those of the female are much shorter; and *Aëdes*, in which the palps of both sexes are much shorter than the proboscis. The memoir ends with a brief account of the life-history, habits, and distribution of gnats.

Male of Prestwichia aquatica.‖—Mr. F. Enock has discovered in Epping Forest the hitherto almost unknown male of this aquatic

* Oversigt K. Danske Vidensk. Selsk. i Forhandlingar, 1897, pp. 299–324 (14 figs.).
† Zool. Anzeig., xx. (1897) pp. 405–6 (2 figs.).
‡ Zool. Jahrb. (Abth. Syst.), x. (1897) pp. 373–471 (3 pls.).
§ Bull. Soc. Ent. Ital., xxviii. 1896 (1897) pp. 197–313 (3 pls.).
‖ Essex Naturalist, x. (1897) pp. 10–11.

Hymenopteron. It is almost apterous, and much resembles a very lean flea, both in gait and colour.

Mimicry in Oak-Galls.*—Herr F. Thomas regards the coloured spots on the small galls of *Cynips ostreus* Hrtg. as a mimicry of Coccinelleæ, and the curved or circular stripes on those of *Dryophanta longiventris* Hrtg. as a mimicry of a *Helix*, to protect them against the attacks of birds.

Larch-Galls.†—Dr. C. v. Tubeuf adopts *Dichelomyia laricis* Fr. L. as a substitute for Henschel's "nomen nudum" *Cecidomyia Kellneri*, for the name of the gall-producing insect on the larch (chiefly in the Alps), and describes the remarkable production of axillary buds round the gall, which bear very broad leaves, the result of lateral cohesion. Under the name *Phytoptus laricis* sp. n., the same author describes a new gall-producing species on the larch.

Centrosomes in Spermatocytes of Lepidoptera.‡—Dr. F. Meves notes that in certain stages of spermatogenesis in Lepidoptera there are vesicles filled with fluid and lined by a single layer of large cells called spermatocytes by Platner. In these cells the centrosomes are readily demonstrable by Heidenhain's iron-hæmatoxylin method. They lie directly on the cell-wall at the side turned towards the centre of the vesicle. Even in the resting stage there are two, and they are often separated by a minute interspace. There is no sphere nor "centrodesmosis." The bodies in question are more or less sharply curved hooks, with the loop turned towards the cell and the ends outwards. Meves compares this case with other observations on centrosomes in male sex-cells.

New Dipterous Parasite.§—Dr. Th. Adensamer found a peculiar parasite almost buried in the wing of a Javanese bat (*Phyllorhina*), and has been able to work out its structure. It seems to be a pupiparous Dipteron, but it is not referable to any known form. Among the pupiparous Diptera the Nycteribidæ and Streblidæ are known as parasites of bats, and representatives of both occur on *Phyllorhina*; but it is not easy to refer this new form to either of these families. It will be necessary to find the male before any decision is made. The author names his discovery *Ascodipteron phyllorhinæ* g. et sp. n.

β. Myriopoda.

Rheno-Prussian Diplopoda.||—Dr. C. Verhoeff begins by noting that the old belief in the unity of the Myriopoda is almost given up; the Diplopoda cannot be profitably slumped in the same series as the Chilopoda. Some time ago the number of known Myriopods was estimated at about 1000 species; now it is recognised that 10,000 would be nearer the mark. After a discussion of the geographical distribution

* SB. Gesell. Naturf. Freunde Berlin, 1897, pp. 45–7. See Bot. Centralbl., lxxi. (1897) p. 377.

† Forstl.-naturw. Zeitschr., vi. (1897) pp. 120–4, 224–9 (5 figs.) See Bot. Centralbl., lxxi. (1897) pp. 377, 378.

‡ Anat. Anzeig., xiv. (1897) pp. 1–6 (2 figs.).

§ SB. Akad. Wiss. Wien, cv. (1896) pp. 400–16 (2 pls.).

|| Ver. Nat. Ver. Rheinld., liii. (1896) pp. 186–280.

and bionomics of Diplopoda, the author gives diagnoses of the families (Polyxenidæ, Glomeridæ, Polydesmidæ, Chordeumidæ, and Iulidæ), of the genera, and of the species in Rhenish Prussia. A chapter is devoted to the numerical relations of the sexes, and another to the physiological grouping of the species as they occur in soil, under stones, under bark, and so on, ten groups being recognised. The author then discusses the *Schaltstadium* in the life-history of male Iulidæ, and ends with a bibliography.

Bohemian Diplopoda.*—Dr. B. Němec describes a new variety of *Craspedosoma Rawlinsii*, *Iulus* (*Leptoiulus*) *proximus* sp. n., *Iulus* (*Micropodoiulus*) *ligulifer* Latz., *Iulus* (*Leucoiulus*) *cœrulans* sp. n., and a new minute form of *Polyzonium germanicum*.

New Indo- and Austro-Malayan Diplopoda.†—Mr. R. I. Pocock describes 7 new genera and 26 new species of Platyrrhachidæ,—millipedes of large or medium size, in which the body is composed of 20 segments, each segment (except the first and the last) being furnished on each side with a large more or less square and horizontal plate which bears the pore.

Algerian Iulidæ.‡—H. W. Brölemann describes the five species collected by Lucas in 1846:—*Schizophyllum* (*Bothroiulus*) *fusco-unilineatum*, *S.* (*Apareiulus*) *lapidarium*, *Iulus* (*Phalloiulus*) *distinctus*, *I.* (*Phalloiulus*) *algerinus* sp. n., *I.* (*Anoploiulus*) *africanus* sp. n. He concludes that the Algerian Iulidæ, though distinct, exhibit incontestable bonds of relationship to palæarctic forms.

δ. Arachnida.

African Solifugæ.§—Mr. R. I. Pocock distinguishes three families:—Hexisopodidæ nov., Galeodidæ s.s., and Solpugidæ s.s., the last including two sub-families—Solpuginæ nov. and Rhagodinæ nov. He describes seven new species from tropical Africa. From reports by Mr. G. A. K. Marshall, some interesting notes on habits have been compiled. The noise attributed to stridulation seems more probably due to trituration. The terminal organ on the palp is, as Hutton observed, a sucker. It seems to be used in grasping the prey and conveying it to the mandibles. Termites form an important part of the food-supply of some species. The very rapid pace, e.g. of *Solpuga sericea*, like blown thistledown, is rarely kept up for more than a minute.

Development of Pedipalpi.‖—Mdlle. Sophie Pereyaslawzewa describes the state of the embryos of *Phrynus medius* Herbst just before hatching. Among the points noted are the following:—The segmentation, having attained its maximum, is beginning to disappear; while the cephalothoracic muscles are striped, those of the abdomen are all smooth; there is evidence of a local ectodermic proliferation preceding the development of the lung-books; there are hints of the formation of pulmonary structures in the adjacent segments; besides the stigmata,

* SB. K. Böh. Ges. Wiss., 1896, ii. No. 41, 8 pp. and 1 pl.
† Ann. Nat. Hist., xx. (1897) pp. 427–46.
‡ Ann. Sci. Nat. (Zool.), iv. (1896) pp. 253–76 (2 pls.).
§ Ann. Nat. Hist., xx. (1897) pp. 249–72.
‖ Comptes Rendus, cxxv. (1897) pp. 377–80.

each pulmonary segment shows a pair of stigma-like invaginations on the ventral median line; these fuse in a tube which opens into the cavity of the body and becomes connected with a group of cells evidently reproductive; in the superior pulmonary segment these invaginations give rise to the "*plaque sexuelle*" of authors, in the inferior segment to the gonads proper. In the two succeeding segments there are slight hints of similar formations. The authoress also sketches the state of the nervous, alimentary, and vascular systems.

New Spiders from Southern Asia.*—T. Thorell describes a dozen new species and three new genera,—*Eurychœra* (Lycosidæ), *Megullia* (Oxyopidæ), and *Geminia* (Heteropodidæ).

New Hydrachnids.†—Herr F. Kœnike describes six new species of the genus *Hydrachna* (O. F. Müll.) Dug. He also points out that the form described by Croneberg as *H. globosa* De Geer must be made into a new species, *H. Cronebergi*.

Wine-Mite.‡—Dr. E. L. Trouessart discusses *Carpoglyphus passularum* Robin, an Acarid which multiplies in the sweet wine of Grenache and similar kinds. It not only lives well but propagates rapidly (viviparously), in spite of the large percentage of alcohol. It probably comes from raisins used in manufacture, as it does not occur on the fresh grape. In this connection its presence may have some legal interest.

ε. Crustacea.

Peripheral Nervous System in Crayfish.§—Prof. J. Nusbaum and Herr W. Schreiber have studied, by means of the methylen-blue method, the sensory peripheral nervous system in the freshwater crayfish. Their conclusions are the following:—

(1) There are bipolar sensory nerve-cells, lying more or less deeply beneath the surface, and sending distal processes into the setæ (the Rath-Retzius type).

(2) There is a more superficial plexus of nerve-cells lying close below the epithelium (Bethe), and consisting of (*a*) roundish cells with a proximal axis-process and numerous short processes ending below the roots of the setæ; (*b*) conical cells with a long proximal process and numerous dendritic processes; and (*c*) multipolar cells with numerous ramifying processes, among which an axis-process is not usually distinguishable.

(3) The axis-processes either enter directly into the larger nerve-branches, or unite with very long fibres which form a felt-work just below the epithelium and unite in larger nerve-branches.

(4) The dendritic processes of the cells of the nerve-plexus often form very beautiful tree-like terminal ramifications, innervating setæ, or ending on a bare surface.

(5) There are three kinds of connections between the cells of the nerve-plexus—(*a*) by broad protoplasmic bridges, (*b*) by long thin unbranched processes running from cell to cell, and (*c*) by nervous ramifi-

* Bihang Svensk. Vetensk. Akad. Handlingar, xxii. (1897) No. 6, 36 pp.
† Zool. Anzeig., xx. (1897) pp. 394–8.
‡ Comptes Rendus, cxxv. (1897) pp. 363–6.
§ Biol. Centralbl., xvii. (1897) pp. 625–40 (8 figs.).

cations issuing from adjacent cells. There is no doubt that there are distinct anastomoses between individual neurons.

Between the bipolar Rath-Retzius elements, which represent isolated neurons, and the network of multipolar cells without axis-processes, there is a transition, namely, in those cells which not only share in the formation of the subepithelial plexus and the nerve network, but also have very long axis-processes.

The phylogenetic series is probably as follows:—(1) The primitive lowest stage is that of a continuous quite peripheral network of nerve-cells, as in Ctenophora. (2) A second stage is found in cases where, besides the continuity of the sub-epithelial plexus, there are some cells with axis-processes which come into contact with other neurons in the central system. (3) In a third higher stage, the cells with axis-processes lose continuity with the cells of the plexus, sink inwards from the periphery, and approach the nerve-centres. Thus arise the isolated bipolar neurons of the Rath-Retzius type in the crayfish.

Respiration of the Crab.*—M. Georges Bohn has studied the respiration of *Carcinus mænas*, which lives almost as much in air as in water. He has observed a reversal of the direction of the water current in the branchial chamber, as may be readily seen if the crab is placed in a vessel with just enough of water to cover it. It raises the front of the body to the surface, and bubbles of air are seen to pass out by the usual inspiratory orifices. The crab aërates the water in its branchial chamber by a modified action of the scaphognathite, which drives the air backwards. Bohn compares his observations with those of Garstang on *Corystes*, and notes that reversal occurs also in *Hyas*, *Maia*, *Palæmon*, *Megalopa* larvæ, crayfish, and others. In fact periodic reversal is an old-established habit, which here and there has come to be of much physiological importance.

New Terrestrial Isopod.†—Prof. Baldwin Spencer and Mr. T. S. Hall describe *Phreatoicopsis terricola* g. et sp. n., a burrowing Victorian Isopod, closely related to *Phreatoicus* described by Chilton. The generic diagnosis is as follows:—Body long, subcylindrical, laterally compressed. Upper antennæ short, lower long, with flagellum. Mandible with an appendage. First pair of legs subchelate, others simple. The legs are divided into an anterior series of four and a posterior series of three. Pleon long, of six distinct segments, but joined to telson. Uropoda biramous, short and powerful. Telson large, sharply truncate.

North American Species of Cyclops.‡—Mr. E. B. Forbes gives a descriptive account of ten North American species of *Cyclops* s. str. Claus. Of the eighteen species and three varieties which have been reported as occurring in North America, only three species, *C. ater*, *C. modestus*, and *C. edax*, and two varieties, *insectus* and *brevispinosus*, of *C. viridis*, are characteristic of America, while the remaining fifteen species and one variety are common to both Europe and America.

Copepods of Moscow.§—M. Paul Matile describes the free Copepods found in the environs of Moscow. There are four genera, *Cyclops*,

* Comptes Rendus, cxxv. (1897) pp. 441–4.
† Proc. R. Soc. Victoria, ix. (1897) pp. 12–21 (2 pls.).
‡ Bull. Illinois Lab. Nat. Hist., v. (1897) pp. 27–82 (13 pls.).
§ Bull. Soc. Imp. Nat. Moscou, 1897, pp. 113–39 (1 pl.).

Canthocamptus, *Diaptomus*, and *Heterocope*, and 19 species, nine more than have been previously recorded for this district.

Freshwater Copepods of Germany.*—Dr. O. Schmeil has issued an appendix to his monograph on the free-living freshwater Copepods of Germany. It fills up some gaps in his systematic treatment of Cyclopidæ and Centropagidæ.

Limnetic Crustacea of Green Lake.†—Prof. C. Dwight Marsh has studied the distribution of the limnetic Crustacea of this American lake by means of a closing dredge. The vertical distribution shows that there is no general movement of the whole body of crustaceans, but that there are individual peculiarities for each kind. So far as the crustaceans are concerned the horizontal distribution is not uniform, as is so often assumed.

The author agrees with Hensen that exact results in plankton work can be reached only by an enumeration of individuals. The volumetric determinations are too insecure, as indeed the discrepant results of good observers show. He further insists that only a long continued series of observations on the same body of water will furnish sufficient evidence of the uniformity or lack of uniformity in distribution.

Annulata.

Structure of Sternaspis.‡—Mr. E. S. Goodrich has shown that Vejdovsky and Rietsch were mistaken in describing *Sternaspis* as having a completely closed excretory organ, and as having the ovary or testis situated in a special cavity without communication with the cœlom. By a study of *St. thalassemoides* Otto, the author has shown that the cavity of the genital sac communicates with the body-cavity, and that the nephridium is provided with a small ciliated funnel and a lumen, and is in one region, at all events, ciliated internally. The complex granules of the nephridial cells are described; they are probably excretory, but the nephridium is not known to open to the exterior. Experiments were made as to the solubility in certain reagents of the granules, cuticle, ventral shield, and setæ. A detailed account of the muscular system is also given.

East African Polychæta.§—Prof. E. Ehlers reports on collections made by Dr. Voeltzkow and Dr. Stuhlmann. One of the results of interest is that the East African and Indo-Pacific Annelid fauna has some forms (not cosmopolitan) in common with the Mediterranean and West Indian fauna. Some important synonymies are established, and the following new species are described:—*Neottis rugosa* sp. n. (Terebellidæ), *Sabella sulcata* sp. n. (Sabellidæ).

Nephridium of Discodrilidæ.‖—Mr. J. Percy Moore has made an elaborate study of the Discodrilid nephridium in *Bdellodrilus illuminatus* and related forms. He shows that the nephridial characters, like those of many other parts, point to an alliance between Discodrilidæ

* Zoologica (formerly Bibl. Zool.), Heft 21, 1898 (published 1897) pp. 145–88 (2 pls.). † Trans. Wisconsin Acad., xi. (1897) pp. 179–224 (10 pls. and tables).
‡ Quart. Journ. Micr. Sci., xl. (1897) pp. 233–45 (2 pls.).
§ Nachrichten Ges. Göttingen, 1897, Heft 2, pp. 158–76.
‖ Journ. Morphol., xiii. (1897) pp. 327–80 (4 pls.).

and Oligochæta. Another suggestion of general interest is found in the contrast which the author draws between direct and indirect nephridial excretion. In the latter the nephridia serve simply to conduct to the exterior the products of excretion elsewhere accomplished, e.g. by the chloragogen cells. The predominance of the one or the other method is a factor influencing the arrangement of nephridial tubules.

Plasmic Processes emitted from Serpula Eggs.*—Prof. E. A. Andrews describes "spin processes" in the eggs of *Serpula* similar to those which G. F. Andrews observed in Echinoderm ova. They were first seen arising from the surface of the egg all around the polar bodies, and extending to the raised membrane. At the two-cell stage more were seen at both poles, and some were branched. They also occurred in later stages. "The occurrence of such filose activity of the surface of the eggs of an animal so widely separated from the Echinoderms supports the idea that such phenomena are universally properties of protoplasm," a view maintained in a recent work by G. F. Andrews, entitled 'The Living Substance as Such and as Organism' (1897).

Notes on Polychæta.†—Prof. W. C. M'Intosh makes four notes on Polychæta. The first records the phosphorescence of *Gattyana* (*Nychia*) *cirrosa*, a commensal Polynoid in the tubes of *Chætopterus*, and *Amphitrite debilis* Dalyell. Irritation in the dark causes the scales to gleam with a pale yellowish light, often extremely faint, and thus in contrast with *Harmothoë imbricata* and *Polynoë scolopendrina*, in which the phosphorescence is more vivid. A second note describes *Evarne atlantica* from Rockall. In the third note the author maintains that *Pholoë inornata* and *P. eximia* should be regarded merely as varieties of the typical *P. minuta*. The fourth note discusses a collection of Annelids made by Canon Norman in Norwegian fjords, and records three new species, *Evarne Normani*, *Sthenelais Sarsi*, and *Sth. heterochæta*.

Growth of Ovum in Sagitta.‡—T. Aida has made an interesting observation in regard to the cells of the stalk which connects an ovarian ovum with the germinal epithelium. These stalk-cells are produced from the cells of the germinal epithelium by a succession of amitotic divisions, and they fuse one after another with the ovum until the latter becomes mature. Unlike the nutritive cells, the ova themselves arise by mitotic divisions.

Nematohelminthes.

Excretory Cells of Ascaridæ.—Mr. A. E. Shipley § comments on Prof. Spengel's remarks on Nassonow's interesting discovery that certain large cells in the body of *Ascaris megalocephala* take up granules of carmine and Indian ink, when these substances are injected into the body-cavity. Spengel reproached Nassonow for neglecting the records of previous work, and noted that the cells in question are not always lateral, but also occur medianly, on and under the gut. But Shipley points out that this very fact, which Spengel declares to have been over-

* Amer. Nat., xxxi. (1897) pp. 818–20.
† Ann. Nat. Hist., xx. (1897) pp. 167–78 (1 pl.).
‡ Annot. Zool. Japon., i. (1897) pp. 77–81 (1 pl.).
§ Zool. Anzeig., xx. (1897) p. 342.

looked by all previous observers, was noted and figured by Hesse * in 1892, and by himself (Shipley) † in 1894.

Chromatin Reduction in Oogenesis of Ascaris.‡—Herr M. Sabaschnikoff has studied this much investigated subject in *Ascaris megalocephala bivalens*, and has reached the following conclusions:—

(1) The chromatin thread of one piece, which is left by the last division of the oogonia (from the stage of the "daughter-coil"), divides in the oocytes of the first order into several threads, which subsequently fall into separate chromo-microsomes.

(2) The chromo-microsomes begin to arrange themselves in groups of four.

(3) These groups, apposed to one another, form in the nucleus a tetrapartite chromatin fibre, which may be called a provisional "*Vierergruppe.*"

(4) This divides transversely and forms two typical "*Vierergruppen.*"

(5) In the maturation processes two reducing divisions remove from the ovum three parts of each "*Vierergruppe*," i.e. three-fourths of the total number of microsomes.

If these conclusions be correct, they corroborate Weismann's version of the maturation process.

Ascariasis. § — Dr. L. Valentini describes the case of a tramway horse in Rome which contained in its stomach and intestine 1142 specimens of *Ascaris megalocephala*, over a score of which had penetrated the intestinal wall into the peritoneal cavity, causing fatal peritonitis.

Platyhelminthes.

Helminthological Notes.‖—Dr. M. C. Francaviglia describes *Distomum hians* Rud., *Echinostomum spinulosum* Rud., and *Tænia dodecantha* Krabbe, which he found as parasites in *Hydrocolæus minutus* Pallas.

Cysticercoids of Freshwater Crustacea.¶—Dr. A. Mrázek discusses some of the thirteen Cysticercoids which he has found in freshwater Crustaceans, devoting particular attention to those of *Tænia integra* Ham. (in *Gamarus*), and of *T. lanceolata* Bl. (in Cyclopidæ).

Budding Cysticercus from Mole.**—Dr. A. Bott describes a remarkable form of bladder-worm found in a mole. It showed asexual multiplication by means of external buds. The budding area lay posteriorly at the opposite end from the scolex, but in some of the bladders buds occurred all over. In most there were three to five buds, but in some cases as many as eighty spherical protrusions were counted. The various stages seem to show clearly that separation is effected by simple constriction. The author describes the minute structure and discusses other cases of asexually-multiplying Cysticerci. He regards his discovery as most probably a variety of *Cysticercus longicollis* Rud. Since the paper was completed Braun †† has described a closely similar case.

* Zeitschr. f. wiss. Zool., liv. p. 548. † Proc. Zool. Soc. London, 1894, p. 531.
‡ Bull. Soc. Imp. Nat. Moscou, 1897, pp. 82–112 (1 pl.).
§ Boll. Soc. Rom. Zool., vi. (1897) p. 177. ‖ Tom. cit., pp. 118–24.
¶ SB. K. Böhm. Ges. Wiss., 1896, ii. No. 38, 16 pp. and 1 pl.
** Zeitschr. f. wiss. Zool., lxiii. (1897) pp. 115–40 (2 pls.).
†† Zool. Anzeig., xix. No. 514, and xx. No. 521.

New Species of Malacobdella.* — Mr. U. Takakura describes *M. japonica* sp. n., which lives in the mantle cavity of *Mactra sachalinensis*. It is interesting to notice that out of 56 shells examined, 54 were found to be infected. As Kennel found in *Cyprina islandica*, the adults always occur singly. The Japanese species differs from *M. grossa* mainly in its short rhynchocœlom, in possessing an acetabular instead of an anal commissure, and in some peculiarities of the vascular system.

New Land Planarians.†—Mr. T. Steel describes seven new species of *Geoplana* from Australia, and *G. trifasciata* sp. n. and *Rhynchodemus scriptus* sp. n. from Fiji. The author has some interesting notes on preserving. The worms are best killed with very weak spirit. After a short dehydration with strong spirit, they may be put into chloroform or kerosene or carbolised oil, if a retention of the colours is particularly desired.

Incertæ Sedis.

Structure of Actinotrocha.‡—Mr. A. T. Masterman gives a short account of the history of research and opinion in regard to this fascinating larva, and states in detail the results of his own investigation. Passing over his description of external form and the like, we may notice first his very full account of the nervous system. It consists of the following parts:—

(1) A central ganglion lying in the front collar region and between this and the pre-oral lobe, with the epiblast immediately in front depressed to form a neuropore.

(2) A ring round the posterior part of the collar, continued from the ganglion dorsally and ventrally, giving off fine double groups of nerve-tracts to the anal end of the body.

(3) Groups of fine nerve-tracts continued dorsally along the trunk from the hind end of the collar to the anal end of the body.

(4) A ring round the anal end of the trunk, into which the dorsal and ventral tracts lead.

(5) A ring round the edge of the pre-oral lobe, joined at each side to the ganglion, and in the median front region by three main tracts running in the mid-dorsal line forwards from the ganglion.

(6) A diffuse plexus of fibres at the base of nearly all the epiblastic layer, conspicuous among which are the fibres of the ventral collar area, which pass forwards and dorsally to meet the ganglion.

Mr. Masterman gives a circumstantial account of the development of the "sub-neural gland." During development the epiblast becomes tucked in at the mouth; and on the mid-ventral line of the hood, anterior to the mouth, there is formed a small depression, which deepens, increases in size, and is carried further inside the buccal cavity.

The development of the two "notochords" is described at length. The organs themselves arise from a pair of evaginations of the anterolateral walls of the pharynx, which gradually become longer and deeper till they extend forward in close contiguity with the mesentery between the collar and the pre-oral lobe. They have no connection whatever

* Annot. Zool. Japon., i. (1897) pp. 105–12 (1 pl.).
† Proc. Linn. Soc. N.S.W., xxii. (1897) pp. 104–22 (2 pls.).
‡ Quart. Journ. Micr. Sci., xl. (1897) pp. 281–339 (5 pls. and 14 figs.).

with the epiblast. At the same time as this growth in length takes place, the cells undergo a remarkable modification into vacuolated tissue.

After comparing *Actinotrocha* with *Balanoglossus* and with *Tornaria*, the author sums up his views in this classification :—

CHORDATA.

I. Archichordata.

Archimeric segmentation into protomere, paired mesomeres, and metamere ; little or no metameric segmentation. Notochord in primitive continuity with the walls of the gut throughout life. More or less connected with the protomere, the main animal organ of the body. Nerve-ganglion between protomere and mesomere, or dorsal to mesomere. Main nerves are protomeric ring, mesomeric ring, and dorsal and ventral trunks. A mesoblastic chondroid skeleton and an ectodermal chitinoid tube or skeleton.

(1) Hemichorda. Notochord fused in middle line and protruding far into the protomere. Commencing metameric segmentation in gill-slits and gonads.

(2) Diplochorda. Notochord in primitive paired condition. In close connection with the two posterior protomeric mesenteries. Mesomeres produced into numerous tentacles. Metameres with dorsal flexure.

Phoronidea (loss of pre-oral lobe and notochord in adult; no gill-slits). Cephalodiscida (one pair of gill-slits with chordoid walls; persistent notochords). Rhabdopleurida.

II. Eu-chorda.

Archimeric replaced by metameric segmentation. Single dorsal notochord loses connection with gut-wall, and dorsal nervous system with the ectoderm. Protomere and mesomeres reduced. Notochord extends into metamere (Urochorda, Holochorda), and also into protomere (Cephalochorda).

(1) Urochorda (?) (2) Cephalochorda. (3) Holochorda.

Structure of Cephalodiscus.*—Mr. A. T. Masterman has had the privilege of re-investigating this rare animal. His preconceived view that Harmer's "notochord" is the homologue of the subneural gland, and that *Cephalodiscus* has a paired notochord, has been confirmed to a remarkable degree. He proposes to include *Balanoglossus*, *Cephalodiscus*, and *Phoronis* in one group (Archichorda), the first being hemichordate, the two others diplochordate. His definition of the Diplochorda (the name expresses one of the author's main positions) reads as follows:—Mesomeres produced laterally into a number of ciliated branchial tentacles, which in the adult point upwards in front of the mouth, are supported by a chondroid skeleton, and subserve ingestion of food. Metameres reduplicated by a dorsal flexure. Stomodæum with subneural gland still opening to the exterior, and extending into the subneural sinus. Paired proboscis-pores near median dorsal line, arising internally along the wall of the subneural sinus. Paired notochords in pharynx not displaced forwards. A short œsophagus, stomach, and intestine. One pair of pharyngeal clefts may (*Cephalodiscus*) or may not (*Rhabdo-*

* Quart. Journ. Micr. Sci., xx. (1897) pp. 340–66 (4 pls.).

pleura, *Phoronis*) be present with chordoid walls. Ventral sucker forming the organ of attachment throughout life.

(1) Cephalodiscida. Protomere persistent throughout life as adhesive organ. Twelve pinnate plumes with eyes. Notochords and chordoid gill-slits persistent. Ventral sucker forms budding organ. Habitat, creeping, sedentary, and cœnœcial.

(2) Phoronida. Loss of protomere, atrial grooves, subneural gland, and notochords in adult. Great development of lophophoral tentacles (unbranched) and of chondroid tissue. Paired nephridial apertures in metameres. Metamere elongated, with circular and longitudinal muscles (as in *Balanoglossus*). Permanent fixation by ventral sucker. Habitat sedentary and tubicolous.

(3) Rhabdopleurida. Protomere persistent. No notochord (?) nor pharyngeal clefts (?) in adult. Two pinnate plumes. Attached by hypertrophied ventral sucker. Habitat creeping, tubicolous.

New or Rare British Marine Polyzoa.* — Mr. S. F. Harmer has notes on *Hypophorella expansa* Ehlers from the tubes of *Chætopterus*; *Escharoides quincuncialis* Norman, dredged off Plymouth; *Micropora complanata* Norman, common on the shore-rocks of the Scilly Isles; and *Schizoporella cristata* Hincks on a scallop-shell dredged off Plymouth.

Echinoderma.

New Echinothurid.†—Dr. R. Koehler describes *Sperosoma Grimaldii* as type of a new genus of Echinothuridæ. Several specimens of large size (22 cm. in diameter) were obtained by the 'Hirondelle' and 'Princess Alice' off the Azores. The generic characteristics are as follow:—The ambulacral zones of the ventral surface are considerably enlarged by the exaggerated development of the poriferous plates, which attain a size approaching that of the principal ambulacral plates. The latter form, in each ambulacral zone, two median rows accompanied on each side by three distinct rows of poriferous plates, of which each bears a pair of pores. The interambulacral zones of the ventral surface are, on the contrary, restricted in size, at least in the proximal half. On the dorsal surface the ambulacral and interambulacral zones have the same dimensions and triangular form; the aquiferous pores form a single regular row in the middle of each ambulacral area. The test is very flexible, and the general cavity does not contain the vertical muscles which form partitions in *Asthenosoma*. Koehler also notes that he has recognised Stewart's organs in the above form and in *Phormosoma atlanticum* and *Asthenosoma hystrix*. As Jeffrey Bell has pointed out, Stewart's organs are absent in other species of *Phormosoma*. An intestinal siphon, which seems to have escaped attention, is present in four species.

Abnormalities in Echinoid Ova after Fertilisation.‡— Prof. S. L. Schenk has studied artificially fertilised ova of *Toxopneustes* and *Echinus* with reference to abnormalities in early stages of development. He describes in particular the divergent phenomena exhibited by ova which have not attained complete maturation, whose nucleus, in other words, is

* Journ. Mar. Biol. Ass., v. (1897) pp. 51–3.
† Zool. Anzeig., xx. (1897) pp. 302–7 (1 fig.).
‡ SB. K. Akad. Wiss. Wien, cv. (1896) pp. 168–85 (4 figs.).

not prepared for fertilisation. Premature fertilisation of immature ova brings about abortive development, which soon comes to an end in the death of the egg.

Mediterranean Asteroids.*—Prof. H. Ludwig has published a useful hand-list compiled from his 'Naples Monograph' (1897), giving diagnoses of the 14 genera and 24 known species of Mediterranean Asteroids.

Cœlentera.

Tubularia crocea in Plymouth Sound.†—Mr. E. T. Browne notes the occurrence of *Tubularia crocea* (= *Parypha crocea* Agassiz) on the stern of a sailing ship from Peru which stayed for a few days in Plymouth Sound. Actinulæ were being liberated in large quantities when the colonies were taken from the ship; so it is possible that this hydroid may become an interesting addition to the fauna of the Sound. The developing ova showed a remarkable similarity to those from the medusa of *Hybocodon prolifer*. The female gonophores showed eight apical ridges, the male gonophore had none; in the European species of *Tubularia* the gonophores are either without ridges or the number does not exceed four. Variations were noticed in the annulations on the stems, in the colour of the colonies, and in the clusters or racemes of gonophores.

Taxonomy of Hydroids.‡—Dr. K. C. Schneider gives a description of 49 species of Hydroids from Rovigno, and appends thereto a systematic revision of the genera and a discussion of their relationships.

New Alcyonaria.§ — Herr J. A. Z. Brundin describes a number of new forms. A new genus, *Suensonia*, represented by *S. mollis*, from the Strait of Corea, is thus characterised:—Treelike colony of soft consistence; polyps almost free from spicules, cylindrical and non-retractile; tentacles bearing on each side a single row of pinnules; spicules very sparse, mostly twin-structures of hour-glass form without tubercles. The following new species are described,—*Bellonella rubra*, *B. cinerea*, *Solenocaulon simplex*, *Psilacabaria frondosa*, *Plexauroides verrucosa*, and *Euplexaura anastomosans*.

New Family of Hydromedusæ.‖—Seitaro Goto describes a remarkable genus *Dendrocoryne*, established in 1892 by Inaba, whose paper in the 'Zoological Magazine,' Tokyo, was, unfortunately, written in Japanese. The stock is strongly built and richly branched; the chitinous skeleton forms a lattice-work covered by the ectoderm; the polyps are sessile, cylindrical or spindle-shaped; the tentacles, up to 20 in number, are spherically thickened at their tips, and irregularly distributed on the body; the male gonophore, so far as known, is medusoid, spherical, closed, without radial or circular canals; the female gonophore is a spherical or ellipsoid medusoid, with ostium and circular canal, and sometimes with velum and rudimentary tentacles. Two species, *D. misakensis* and *D. secunda*, both from Misaki, are described. Inaba has

* Verh. Nat. Ver. Rheinld., liii. (1896) pp. 281–309.
† Journ. Marine Biol. Ass., v. (1887) pp. 54–5.
‡ Zool. Jahrb. (Abth. Syst.), x. (1897) pp. 472–555 (2 figs.).
§ Bihang K. Svenska Vetensk. Akad. Handlingar, xxii. (1897) No. 3, 22 pp. and 2 pls.
‖ Annot. Zool. Japon., i. (1897) pp. 93–104 (1 pl. and 8 figs.).

suggested that this new type may be related to that described by J. E. Gray (1868) as a sponge, and referred by von Lendenfeld (1885) to the Hydractinidæ, near *Dehitella* and *Ceratella*. The author inquires whether the structure of the skeletal lattice-work may not be of interest in connection with Graptolites.

Interrelationships of Madreporidæ.*—Mr. H. M. Bernard gives reasons for believing that the ancestral parent polyp of the Madreporidæ possessed the following leading characteristics:—(1) a porous wall, with laminate radial structures; (2) a well-developed saucer-shaped epitheca; (3) the habit of very early budding while the parent polyp was still very small; (4) the production of true buds, starting from the smallest beginnings out of the sides of the polyp, and forming their skeletons, at least in the first stages, upon and with some slight modification of the radial symmetry of the porous wall of the parent polyp. From such a form the five genera studied by the author may be deduced, along lines of specialisation which he goes on to describe. He suggests the following arrangement of the family:—

Madreporidæ { Madreporinæ:—*Madrepora, Turbinaria, Astræopora.*
Montiporinæ:—*Montipora, Anacropora.*

Porifera.

Non-Calcareous Sponges of Victoria.†—Prof. A. Dendy continues his catalogue of non-calcareous sponges collected by the late Mr. J. Bracebridge Wilson in the neighbourhood of Port Phillip Heads. The present instalment deals with the families Axinellidæ, Suberitidæ, and Spirastrellidæ, and with some forms whose systematic position is difficult to determine. Forty species are included in this part, and of these twelve are new. It has been found necessary to erect two new genera, *Sigmaxinella* and *Pseudoclathria*.

Revision of Asconematidæ and Rossellidæ.‡—Prof. F. E. Schulze recognises in the family Asconematidæ the following six genera,—*Asconema, Hyalascus, Caulophacus, Aulascus, Sympagella,* and *Saccocalyx.* He divides the family Rossellidæ into three sub-families:—(A) Rossellinæ (*Bathydorus, Rossella, Crateromorpha, Aulosaccus, Aulocalyx, Placoplegma, Euryplegma*); (B) Lanuginellæ (*Lophocalyx, Mellonympha, Lanuginella, Caulocalyx*); and (C) Acanthascinæ (*Acanthascus, Rhabdocalyptus*).

Protozoa.

A Swimming Heliozoon.§—M. Eugène Penard describes a single specimen of a remarkable Heliozoon which he found near Geneva. In most respects its characters are typical—small skeletal elements, probably siliceous, vacuolated plasma, radiating pseudopodia, and so on; but the remarkable feature is the occurrence of an investment of cilia or flagella. These were active even when the animal was fixed by the pseudopodia; they also served to drive it through the water. The author names the animal *Myriophrys paradoxa* g. et sp. n.

* Ann. Nat. Hist., xx. (1897) pp. 117–35 (1 pl.).
† Proc. Roy. Soc. Victoria, ix. (1897) pp. 230–59.
‡ SB. Preuss. Akad. Wiss., 1897, pp. 520–58.
§ Arch. Phys. Nat., iv. (1897) pp. 285–9 (1 pl.).

Revivification of Infusoria.* — Prof. M. Nussbaum has previously shown (1889) that Infusorian cysts may survive two or even three years' desiccation. Maupas has proved the same for 22 months. Weismann found that eggs of *Artemia salina* were capable of development after lying nine years in dry mud. But precise data of this sort do not seem to be numerous. Nussbaum has therefore made careful experiments with the cysts of the Infusorian *Gastrostyla vorax* dried in September 1885. None revived in 1897. The cytoplasm examined microscopically showed a complete loss of its usual structure.

Euglena sanguinea.†—Herr F. Thomas records the occurrence in a small lake in the Alps, at a height of about 2120 m., of enormous quantities of this organism, giving a blood-red tinge to the water. It displayed positive heliotaxis; the pigment was hæmatochrome.

Stichospira paradoxa.‡—Dr. V. Sterki describes this new genus and species of ciliated Infusorians. The body when extended is very long, consisting of a bulbous posterior part, a long and slender neck, and an anterior part with the peristome and a long corkscrew-like anterior extension curved dorsalwards and to the right, bearing the prolonged adoral zone of cilia. When contracted it is obovoid with the anterior end rather pointed. The substance of the body is slightly yellow. One contractile vacuole is situated in front of the peristome, somewhat to the left and dorsalward, another lies near the posterior end. Two almost globular endoplasts were seen, but not very distinctly. In the posterior region there are usually numerous food-granules and minute strongly refracting particles. On the right margin of the rather deeply excavated peristome is a broad thin hyaline membrane, standing out perpendicularly ventralward; it is rather stiff and slightly undulating. The anus is anterior, to the left of the peristome, and constant. Twelve sets of cilia are described. The food consists of very small particles, and the animal usually lives in the cavity of some plant. Very often there is also a tube made by the animal out of some mucous secretion usually plus foreign particles. It has much in common on the one hand with *Freya* and *Amphileptus*, and on the other hand with *Stichotricha acuminata* Pty., but it is very distinct.

Guide to Sporozoa.§—Von Wasielewski has compiled a guide to help physicians, veterinarians, and even zoologists in the study of this difficult and important class. He gives diagnoses of the known species of the five orders—Gregarinida, Hæmosporidia, Coccidia, Acystosporidia, and Myxosporidia, and appendices on Sarcosporidia, Amœbosporidia, and Serosporidia, which are less definitely characterised groups. The general life of these parasites is briefly discussed, the hosts are classified, and the student is introduced to the special literature and technique. The utility of this work is obvious.

Malaria in Senegal.‖—Dr. E. Marchoux records observations made on the hæmatozoon of malaria, which go to support the view maintained

* Zool. Anzeig., xx. (1897) pp. 354–6.

† Mitth. Thüring. Bot. Ver., x. (1897) pp. 28–39. See Bot. Centralbl., lxxi. (1897) p. 364.

‡ Amer. Nat., xxxi. (1897) pp. 535–41 (1 pl.).

§ 'Sporozoenkunde, ein Leitfaden für Aerzte, Tierärzte, und Zoologen,' Jena, 1896, 8vo, 159 pp. and 111 figs. See Biol. Centralbl., xvii. (1897) p. 688.

‖ Ann. Inst. Pasteur, xi. (1897) pp. 640–61 (1 pl.).

by Laveran. According to the author, the *Plasmodium malariæ* is, though highly pleomorphous, a single organism, which may pass through the whole developmental cycle without producing pigment, and only forms rosettes in the finer capillaries. The crescents are developed within red corpuscles. The communication is illustrated by 42 coloured figures, showing the different stages of development of the parasites and their presence in spleen, kidney, and brain.

Nature of the Parasite of Rabies.*—Dr. A. Grigorjew expresses the opinion that the exciting cause of hydrophobia is to be sought for among the Protozoa. To this view he is led, partly because no bacterium has yet been isolated capable of giving rise to the typical phenomena of rabies, but chiefly because appearances resembling those characteristic of Protozoa are discernible in the fixed virus. These bodies are about 2–4 μ in size, of irregular shape and contour, and appear to be composed of protoplasm, which at the central parts is reticular, and at the peripheral homogeneous. In some of these corpuscles a nucleus is visible. Examined on the hot stage, changes of shape, slow amœboid movements, and the extension of pseudopodia, are seen. These corpuscles were cultivated in the anterior chamber of the eye of dogs and rabbits. The author remarks that the course of this disease, rabies, is modified by the presence of accidental impurities, such as bacteria.

Pebrine.†—Prof. Sasaki communicated to the Zoological Society of Tokyo the results of his investigations on this disease of the silkworm. He finds that the minute corpuscles which occur in the blood represent only a stage in the life-history of an amœba-like organism. In other words, the corpuscles are spores, a view which confirms Balbiani's rather than Pasteur's results.

* Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 397–402.
† Annot. Zool. Japon., i. (1897) p. 123.

BOTANY.

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

α. Anatomy.

(1) Cell-structure and Protoplasm.

Influence of the Nucleus on the Formation of Cell-Wall.*—Mr. C. O. Townsend has investigated in a great number of instances the mode of formation of the cell-wall, and finds it to be invariably dependent on the presence of a nucleus. The influence of the nucleus may, however, be transmitted from one cell to another in which there is no nucleus by connecting strands of protoplasm; these must be destroyed in order to prevent the formation of a cell-wall. The influence may be conveyed from cell to cell through the cell-wall. Simple contact without continuity of protoplasm does not suffice to produce the result. A cell-wall is also formed round the strands of protoplasm. The power of cell-wall formation can certainly be transmitted by the protoplasmic strands to a distance of several millimetres. Both the nuclei of pollen-tubes have the faculty of inciting the formation of cell-wall.

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

"Encapsuling" of Starch-grains.†—Referring to Buscalioni's statement on this subject, Prof. L. Macchiati maintains that it rests on erroneous observation, careful photographs showing that the alleged "encapsuled" starch-grains do not belong to the tissue of the testa of the seed in question.

Localisation of the Alkaloids in Cinchona.‡—According to Dr. J. R. Lotsy, in *Cinchona calisaya*, *Ledgeriana*, and *succirubra*, the alkaloids occur in the parenchyme, but not in the sieve-tubes. Normally they are found only in living cells. Cells which contain calcium oxalate do not also contain alkaloid. As a rule, in young organs the alkaloid is dissolved in the cell-sap, while in older organs it occurs as a solid amorphous mass within the cells. Very active organs, such as the cambium or the extreme tip of the growing point, do not usually contain alkaloid; while it occurs in large quantities at a short distance from these centres. In both leaves and petals the amount of alkaloid decreases with age.

(3) Structure of Tissues.

Membranes of Vessels.§—Herr W. Rothert calls attention to the fact that in annular, spiral, and reticulated vessels, the thickening bands are not, as a rule, attached to the thin membrane of the vessel by their greatest breadth, but only by a narrow base. The purpose of this

* Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) pp. 484–510 (2 pls.). Cf. this Journal, *ante*, p. 302.

† Bull. Soc. Bot. Ital., 1897, pp. 178–83. Cf. this Journal, *ante*, p. 135.

‡ Bot. Centralbl., lxxi. (1897) pp. 395–400.

§ Anzeig. Acad. Wiss. Krakau, Jan. 1897, 18 pp. See Bot. Centralbl., lxxi. (1897) p. 131.

arrangement appears to be to combine the power of resistance against bending with the greatest possible permeability of the membrane for water. The so-called unrolling of the thickening-bands of spiral vessels does not depend on the rupture of the unthickened portions of the membrane, but on the detachment of the bands from the thin membrane. The only exception observed to this structure was in the case of *Equisetum*, where the thickening-bands are fixed to the wall of the vessel by their greatest breadth.

Transfusion Tissue.* — Mr. W. C. Worsdell discusses the origin of this tissue, especially characteristic of the leaves of Gymnosperms. It appears to serve as a secondary conducting tissue, and is usually found in direct connection with a vascular bundle, extending to the cells of the surrounding parenchyme, and consisting of tracheids often accompanied by bast-cells. It is universal in the leaves of Coniferæ, and nearly so in those of Cycadeæ. From a study of this tissue in the leaves of *Salisburia adiantifolia*, *Cycas revoluta*, and some other Gymnosperms, the author comes to the conclusion that this tissue is a direct derivative of the centripetal xylem which normally occurred as an important part of the vascular bundle in the ancestors of these plants, but which subsequently disappeared.

Origin and Distribution of Phelloderm.† — Out of 60 species of woody plants examined, Herr F. Kuhla finds phelloderm present in all but three. There is no essential difference in this respect between stem and root; but the extent of the tissue varies greatly, not only in different species, but even in the same stem. It is independent of the formation of periderm, so that abundant cork is by no means necessarily accompanied by abundant phelloderm. With secondary periderm the phelloderm usually arises only in small layers.

The phellogen cells are always of a parenchymatous character, though the mature phelloderm cells may sometimes assume a prosenchymatous form, the result of a secondary development process. The walls of the phelloderm cells usually consist of pure cellulose, but lignified membranes are sometimes to be met with. As respects their contents, they are characterised by containing chlorophyll where the light is not completely absorbed by the periderm. Beneath the bark chlorophyll is wanting, and the cells contain starch, oil, or crystals.

The special characteristics of the phelloderm are then described in a number of species.

Parenchyme-Sheath in the Leaves of Dicotyledons.‡ — Herr B. Schubert has examined the parenchymatous sheath which surrounds the vascular bundle in the leaves of all Dicotyledons examined with the exception of the Crassulaceæ. He classifies them under two groups, according to their form and the amount of chlorophyll which they contain. In the first and much the most common type, the cells are elongated in the direction of the bundle, and are distinguished from the rest of the mesophyll by the absence of intercellular spaces. As a rule

* Journ. Linn. Soc. (Bot.), xxxiii. (1897) pp. 118–22 (3 figs.).
† Bot. Centralbl., lxxi. (1897) pp. 81–7, 113–21, 161–70, 193–200, 225–30 (1 pl.).
‡ Bot. Centralbl., lxxi. (1897) pp. 337–47, 385–95, 435–45, 465–76; lxxii. (1897) pp. 13–21, 61–9 (1 pl.).

they contain much less chlorophyll. In the stronger bundles the cells of the sheath may be found on both sides of the bundle, or they may be replaced on both sides or on the under side only by the parenchyme of the bundle. In the second type, which occurs in the Chenopodiaceæ, Amaranthaceæ, and Portulacaceæ, the cells of the sheath are of a cubical or bluntly pyramidal form, and are arranged in a distinctly wreath-like manner. They are never separated by intercellular spaces. Their walls are very thick, and they contain a considerable number of large chlorophyll grains.

Staminal Vascular Bundles.*—M. P. Grélot points out that it is not at all an uncommon phenomenon for the vascular bundles to undergo great degradation or even to disappear entirely in the stamens, even in orders which are considered high in the scale of development. This degradation is first manifested by a reduction in the number of spiral and annular vessels in the xylem; while in other cases the thickening-bands have entirely disappeared. The phloem-portion of the bundle is always much more fully developed than the xylem-portion. This degradation is strikingly exhibited in *Myosotis*. The principal function of the vascular bundles in the floral organs appears to be the transport of dissolved nutrient substances, and this takes place chiefly through the phloem. Where the organ is but temporary, as is the case with many stamens, there is no need for xylem.

Polystelic Roots of Palms.†—Mr. B. G. Cormack calls attention to the general sameness in the form and structure of the root in vascular plants. But in *Areca Catechu*, instead of the normal central stele of small diameter, four other types may be recognised, passing into one another by insensible gradations; and a similar variation was observed also in other species of palm. Aerial roots are not infrequently polystelic in their thicker older parts; and this difference in structure is due to a continuous change in the mode of differentiation of the apical meristem. The whole structure of the older aerial parts is such as to fit them for withstanding both pressure as props and tension as stays; while the thinner subterranean parts are normal in conformity with the normality of their functions and environment. In correlation with the bulk of these roots and the absence from them of pneumatodes, there is a conspicuous formation of pneumatophores.

Wood of Pomeæ and Amygdaleæ.‡—Dr. A. Burgerstein continues his observations on the structure of the wood of the Pomeæ. On histological grounds he advocates the retaining of *Cotoneaster* as a distinct genus, with which *Pyracantha* should not be associated. *Mespilus* also should not be united with *Cratægus*. He enters into further details with respect to the structure of the wood of the Amygdaleæ (*Prunus*), which differs from that of the Pomeæ in no essential respect, though there are minor points, especially in the size of the vessels.

Stem of the Sugar-Cane.§—Herr A. Wieler has examined the structure of the stem in a number of different varieties of the sugar-cane,

* Rev. Gén. de Bot. (Bonnier), ix. (1897) pp. 273–81.
† Trans. Linn. Soc., v. (1896) pp. 275–86 (2 pls.).
‡ SB. K. Akad. Wiss. Wien, cv. (1897) pp. 552–82. Cf. this Journal, 1896, p. 642.
§ Beitr. z. wiss. Bot. (Fünfstück), ii. (1897) pp. 141–65 (2 pls.).

especially in reference to the deposition of silica. In addition to the silicification of the walls of the epidermal cells, there occur in the epiderm special "silica-cells," the contents of which consist of a white mass of amorphous silica. Similar structures are found also in other grasses. The arrangement of the vascular bundles is the normal arrangement of Monocotyledons.

Changes produced by Mycorhiza in the Cells of the Host-Plant.*— MM. P. A. Dangeard and L. Armand have studied the effects produced on the tissues of the root of *Ophrys aranifera* by its endotrophic mycorhiza. The filaments of the fungus penetrate the outer layers of cells, forming a ball in the cortical layers. They produce hypertrophy not only in the nucleus of the cells invaded, but in those also of adjoining cells. The cytoplasm of the cells attacked is gradually for the greater part consumed, while the nucleus remains active and intact. In the meantime the hyphæ of the invading fungus become more or less disorganised, the small nuclei disappear, and a gummy exudation of an unknown character takes place. The nucleus of the host-cell, when attacked by the parasite, breaks up by fragmentation, the fragments pressing towards the surface of the ball by rhizopod-like prolongations. In the cells attacked there are two kinds of nucleus, some with ordinary reticulate structure and numerous vacuoles, others whose substance is finely punctated and without vacuoles. The nuclei of the invaded cells maintain their activity after the parasite has become completely disorganised.

"Sereh-"Disease of the Sugar-Cane.† — From a very exhaustive examination of a great number of varieties of the sugar-cane grown under many different conditions, Herr A. Wieler contests Janse's theory that this wide-spread disease is due to stoppages in the conducting tissue caused by a parasitic schizomycete, *Bacillus Sacchari*. The gummy stoppages are of the same nature as those frequently found in other plants under healthy conditions, the gum being exuded into the vessels and intercellular spaces from living cells. Schizomycetes are frequently present, but they are saprophytic, not parasitic, the result rather than the cause of disease.

(4) Structure of Organs.

Inflorescence of Compositæ.‡ — Herr A. Weisse finds the number of ray-flowers in the capitule of Compositæ to be subject to similar laws to those of the phyllotaxis of leaves. It is to a certain extent dependent on nutrition.

Cohesion and Chorisis of Foliar Leaves.§—According to observations made by Herr G. W. Maly (chiefly on *Weigelia rosea*, which varies greatly in the number of parts of the flower), the normal number and arrangement of the vascular bundles is not departed from when either cohesion or chorisis takes place of members of the same whorl. A primary vascular bundle enters into each member of the calycine, corolline, and staminal whorls; those belonging to the sepals and stamens being

* Le Botaniste (Dangeard), v. (1897) pp. 289–313 (8 figs.).
† Beitr. z. wiss. Bot. (Fünfstück), ii. (1897) pp. 29–140 (1 pl. and 23 figs.).
‡ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) pp. 453–83 (1 pl.).
§ SB. K. Akad. Wiss. Wien, cv. (1896) pp. 269–80 (2 pls.).

united for a considerable distance. The normal course of the bundles is maintained also in those flowers in which the number of parts of the flower is changed by cohesion or chorisis.

Underground Fruits.*—Sig. L. Pampaloni distinguishes two classes of plants which mature their fruits underground, *amphicarpogenous* and *hypocarpogenous*. In the former the flower is produced above-ground, and by some mechanical contrivance, the seed-vessel is buried in the soil before ripening; in the latter the flowers as well as the seed-vessels are produced underground. To the former class belong *Vicia amphicarpa*, *Lathyrus amphicarpus*, *Cardamine chenopodifolia*, *Polygala polygama*, and *Scrophularia arguta*. Under the latter class he names thirteen species, belonging to seven different natural orders, viz.:—*Amphicarpæa monoica*, *Arachis hypogæa*, *Astragalus hypogæus*, *Trifolium subterraneum*, *Trigonella Aschersoniana*, *Voandzeia subterranea* (Leguminosæ), *Geococcus pusillus*, *Morisia hypogæa* (Cruciferæ), *Cyclamen europæum* (Primulaceæ), *Okenia hypogæa* (Nyctagineæ), *Nephrophyllum abyssinicum* (Convolvulaceæ), *Amphicarpum Purshii* (Gramineæ), and *Ceratanthera Beaumetzii* (Zingiberaceæ).

Fruit and Seed of Viscum.†—Herr G. Gjokic states that the threads of viscin which are formed when mistletoe berries are opened, are the membranes of cells which have been artificially drawn out. They give all the staining reactions of cellulose. The mucilage which surrounds the hypocotyl of the seedling is not identical with viscin; it is stained yellow by chlor-zinc-iodide, and a beautiful red by ruthenium sesquichloride. The lignified elements of the endocarp of *Viscum album* are reticulated cells and spiral vessels. The cells of the endocarp of tropical species of *Viscum* (*articulatum* and *orientale*) are neither lignified nor reticulately thickened. The exceptionally strong protection of the seeds of the mistletoe against evaporation, which enables them to germinate even in the exsiccator, depends on the development of a thick-walled cuticularised epiderm to the endosperm, covered by a thick coat of wax. The tropical species have no such contrivance.

Fruit of Argania Sideroxylon.‡—According to M. M. Cornu, the seed and fruit of this species differ in several respects from those of typical Sapotaceæ, both in the structure of the seed itself, and in the placentation. The seed contains a number of laticiferous cells, some of which branch in an arborescent manner, while some become sclerified. The mature seed is enclosed in a thick hard testa, resulting from a special layer of the ovary itself.

Ovule and Seed of Hydnoraceæ.§—According to M. P. van Tieghem, the ovules of *Prosopanche* are not, as stated by de Bary, reduced to an embryo-sac imbedded directly in the parenchyme of the placenta, but resemble those of typical Hydnoraceæ in being orthotropous and integumented. The embryo-sac, or mother-cell of the endosperm, contains an oosphere, two synergids, and three antipodals. The ovules are imbedded in, but not completely surrounded by, the placental parenchyme. The

* Bull. Soc. Bot. Ital., 1897, pp. 190–3.
† SB. K. Akad. Wiss. Wien, cv. (1896) pp. 447–64 (1 pl.).
‡ Bull. Soc. Bot. France, xliv. (1897) pp. 181–7 (5 figs.).
§ Journ. de Bot. (Morot), xi. (1897) pp. 233–8 (1 fig.).

integument of the seed is differentiated into two layers. The development of the ovule into the seed presents this peculiarity in *Prosopanche*, that there is no absorption or digestion of any part of the ovule; with the exception of the synergids and the antipodals, every constituent portion of the ovule is found in the mature seed.

Seeds of the Utricularieæ.*—Herr M. Merz has studied the development of the seed in a number of tropical species of *Utricularia*. No rudiment of a root could be detected in the embryo. The vascular bundles end in the placenta, not passing into the seed. The ordinary endosperm cell-division takes place in the central portion of the embryo-sac, while the two extremities swell up into haustoria, in which lie the enormously large endosperm-nuclei. The suspensor disappears after the abstriction of the haustorial portions of the embryo-sac. In the ripe seed the endosperm has entirely disappeared. There is only one integument. In the place of the chalaza are a number of cells which supply the upper swelling of the embryo-sac with nutritive material. The nucellus is completely absorbed during the development of the embryo-sac.

The embryo of *Pinguicula vulgaris* differs from that of *Utricularia* in the absence of the constriction of the endosperm.

Seed of Ceratonia siliqua.†—Dr. H. Marlière has studied the structure and development of the remarkably thick membranes of the cells of the endosperm of the carob. He states that, at an early stage, the cell-wall is composed entirely of cellulose, with the exception of a very small quantity of pectic substance; but that, after the secondary thickening has commenced, there are an outer and an inner layer of cellulose, and, between the two, a mucilaginous product of transformation still permeated by unchanged cellulose. When the seed is mature, this secondary membrane has become completely transformed into mucilage; the cellulose can be detected only in the outermost tertiary layer. The mucilage is a product of the reduction of cellulose, the reticulate structure characteristic of cell-walls being at least partially retained. In the cotyledons the cell-walls are composed of cellulose, without any admixture of amyloid. The chemical reactions of the mucilage are given in detail.

Pericarp of the Rye.‡—Herr A. Gregory states that the well-known thickening of the transverse walls in the "transverse cells" of the pericarp of the rye takes place only in the very last stage of ripening, and affords a practical test to distinguish ripe from unripe grains. In wheat and other cereals this thickening does not place.

Assimilating Organs of Leguminosæ.§—Herr J. Reinke has undertaken an exhaustive examination of the leaves and other assimilating organs in a large number of species belonging to the different tribes of Leguminosæ. The ancestral type of leaf in the order was probably trifoliolate, as in *Trifolium*; but this became modified in a very large number

* Flora, lxxxiv. (1897) Ergänzbd., pp. 69–87 (34 figs.).
† La Cellule, xiii. (1897) pp. 1–60 (2 pls.).
‡ Beitr. z. wiss. Bot. (Fünfstück), ii. (1897) pp. 165–8.
§ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) pp. 1–70, 528–614 (96 figs.).

of cases, as a means of adaptation to changed conditions, especially to a drier climate. From this are derived the unifoliolate forms through the disappearance of the lateral leaflets, the imparipinnate by multiplication of the lateral leaflets.

Special attention is paid to the structure of the leaves in Mimoseæ, and especially in the genus *Acacia*, with its very large number of species in which the leaves are replaced by phyllodes. All the phyllodineous species of Acacieæ are heterophyllous; but the heterophylly is usually limited to the youngest stages of the seedlings, and the appearance of pinnate leaves must be regarded as a phenomenon of reversion. The reduction of the leaves is commonly accompanied by the appearance of wings on the stem, which may be metamorphosed lower leaflets or metamorphosed stipules. They serve, like the leaves, as organs of assimilation.

Spotted Leaves.*—Prof. G. Arcangeli refers to a number of other instances (in addition to *Arum italicum*) of plants with spotted leaves, and suggests that the variegation may serve different purposes in different cases, viz.:—in promoting the functions of transpiration and respiration; in protecting the assimilating tissue from too intense radiation; in defending the parts affected from the injurious effects of cold; in promoting the visits of pollinating insects; in contributing to the beauty and elegance of the leaf, and thus promoting the dissemination and diffusion of the species.

Hydathodes of Tropical Plants.—Herr S. H. Koorders † describes the adaptation of the calyx for the exudation of water in 13 tropical species, of which 6 belong to the Bignoniaceæ, 3 to the Solanaceæ, 2 to the Verbenaceæ, and one each to the Scrophulariaceæ and the Zingiberaceæ. The exudation always takes place on the inner surface of the calyx, sometimes also on the outer surface of the corolla. The hydathodes are multicellular capitate hairs, the surface of which is covered by a cuticle through which the exudation takes place. The water remains in the calyx throughout the development of the flower, and in one case till the fruit is formed; during this period the floral organs are covered with a coat of mucilage like the young organs of aquatic plants. On the inner side of the calyx the stomates are very few or entirely wanting. Bacteria or fungus hyphæ were invariably found within the water-calyx, but never more than one kind in the same species. There is the closest connection between hydathodes and nectaries, these organs differing only in the nature of their secretion. The same trichome may perform different functions at different periods.

Herr H. Hallier ‡ calls attention to another example of a water-calyx in *Leea amabilis*, belonging to the Ampelideæ.

Adhesive Discs of Ercilla.§—Mr. J. H. Burrage describes the adhesive discs borne immediately above the axils of the leaves in *Ercilla volubilis*, belonging to the Phytolaccaceæ. They have several points in common with those of the Virginian creeper, attaching themselves to a

* Bull. Soc. Bot. Ital., 1897, pp. 198–203. Cf. this Journal, *ante*, p. 217.
† Ann. Jard. Bot. Buitenzorg, xiv. (1897) pp. 354–477 (7 pls.).
‡ Tom. cit., pp. 241–7.
§ Journ. Linn. Soc. (Bot.), xxxiii. (1897) pp. 95–102 (1 pl.).

support by means of a mucilaginous secretion, which exudes only at early contact from the apices of hairs which cover the whole surface of the disc. Their sole function appears to be to assist the plant in climbing. The discs are developed endogenously immediately above the axils of the leaves. Each is made up of a parenchyme with a central plate of tracheids, in connection with the bundles of the stem at the base of the disc. When growing in a moist atmosphere the discs will sometimes put out roots.

Structure of Halophytes.*—Prof. E. Warming describes the structural peculiarities of salt-loving plants from various climates, comparing them with xerophytes, between which two classes there is no well-marked division-line. Reference is made to 90 species, which are arranged under 16 classes. The leaves are usually fleshy and succulent, with thick cuticle and depressed stomates. Spongy parenchyme is rare. The mechanical tissue is, as a rule, feeble, and the plant is but seldom covered with hairs.

Morphology of Viola.—Herr H. Krämer † has undertaken a careful examination of the structure of the various organs of *Viola*, especially of *V. tricolor* and its allies. Among the more interesting of the results are the following:—Many of the epidermal cells, e.g. those which lie between the guard-cells of the stomates, are divided by a tangential wall into two cells, the outer one of which remains as an epidermal cell, while the inner one is connected into a mucilage-cell. The wall of the mucilage-cell consists of pure cellulose, and is very frequently provided with simple dots. These mucilage-cells appear to occur in all species of *Viola*, and in all the foliar organs except the stamens.

Prof. V. B. Wittrock ‡ records the results of a similar examination of the species belonging to the section Melanium of *Viola*. The flowers differ remarkably, both in size and marking, at different periods of the year; the pollen-grains are also dimorphic or trimorphic. *V. tricolor* is (in Sweden) as a rule cross-pollinated by Lepidoptera and Hymenoptera; while the nearly related *V. arvensis* is usually self-pollinated; and there are corresponding differences in the two species in the arrangement and markings of the parts of the flower.

The author enters into further details respecting the vegetative organs of the species of *Viola* in question, and then discusses their phylogenetic relationships, and the origin of the various cultivated forms.

Contractile Roots.§—Herr A. Rimpach sums up the facts known with regard to contractile roots, which he finds in 70 species belonging to 20 orders of Monocotyledons and Dicotyledons. They have been observed only in herbaceous, and especially in geophilous plants. The greatest amount of contraction was to the extent of 70 per cent. In Monocotyledons it is only the inner parenchyme of the cortex that takes

* D. K. Dansk. Vidensk., viii. (1897) pp. 173–272. See Bot. Centralbl., lxxi. (1897) p. 455.

† '*Viola tricolor* L., in morph., anatom., u. biol. Beziehung,' Marburg, 1897, 67 pp. and 5 pls. See Bot. Ztg., lv. (1897) 2te Abth., p. 177.

‡ Acta Horti Bergiani, ii. (1896, 97) Nos. 1 and 7, 78 and 142 pp., 15 pls. and 87 figs. See Bot. Centralbl., lxxi. (1897) pp. 133, 140.

§ Beitr. z. wiss. Bot. (Fünfstück), ii. (1897) pp. 1–28 (2 pls.). Cf. this Journal, *ante*, p. 307.

an active part in the contraction; in many Dicotyledons the parenchyme within the vascular system appears also to have its share in the process. The power of contraction may be confined to roots of a particular order, or to those produced at one time only of the year. They may be found in some species of a genus and not in other closely allied species. The orders in which they have at present been found most frequently are the Liliaceæ, Irideæ, Amaryllideæ, and Araceæ.

Root of Suæda and Salsola.*—M. G. Fron reports the results of an examination of the structure and development of the roots of species of these genera of Chenopodiaceæ, anomalous from the development at a more or less early period of a generative fibrovascular layer in the pericycle. He states that the root, when young, presents an asymmetry of structure, which is exhibited from the earliest formations, and is developed further in the secondary formations, especially in those which are anomalous.

Œdema in Roots of Salix.†—In the roots of *Salix nigra*, growing in water, Mr. H. v. Schrenk finds, in the winter, peculiar structures presenting a superficial resemblance to lenticels, but differing from them in structure and function. They consist of a collection of cells elongated radially, and in some cases bursting the epiderm. They appear to be formed from a very strong absorption of water in consequence of an abnormally high temperature, which was unable to escape in the ordinary way from the absence of transpiring leaves.

β. Physiology.

(1) Reproduction and Embryology.

Embryogeny and Fertilisation in Lilium.‡—Prof. J. M. Coulter, Mr. C. J. Chamberlain, and Mr. J. H. Schaffner have followed out the development of the sexual cells and the process of impregnation in several species of *Lilium*, especially *L. philadelphicum*. The following are some of the more important points noted:—

In the development of the embryo-sac, a single large hypodermal archesporial cell makes its appearance very early, and there is no evidence of the cutting off of a tapetal cell. The sequence of cell-divisions usual in Angiosperms is entirely suppressed, and the archesporial cell develops directly into the macrospore or embryo-sac. The persistence of the spindle-fibres is a common phenomenon in the embryo-sac divisions, and often helps to indicate the shifting of the freed nuclei. When the pollen-tube has reached and passed the synergids, it comes under the control of an influence powerful enough to bend it sharply towards the oosphere. The first division of the oosperm is always transverse, resulting in a small apical cell and a comparatively large and somewhat vesicular basal cell. The tissue of the suspensor is erythrophilous as compared with the embryo, showing its close relation to nutritive supplies. In the development of the endosperm, the sexual and polar pairs of nuclei were observed to fuse simultaneously; but when division begins the endosperm nuclei divide more rapidly than the cells of the embryo.

In their early spirem-stages the nuclei of the mother-cells of the

* Comptes Rendus, cxxv. (1897) pp. 366–8.
† Bot. Gazette, xxiv. (1897) pp. 52–4 (2 figs.).
‡ Op. cit., xxiii. (1897) pp. 412–52 (8 pls.).

pollen-grains (*L. tigrinum*) show a single much-twisted ribbon with a row of chromatin granules on each edge. In many cases the chromatin granules appear to be arranged in opposite pairs. Centrospheres were observed in connection with both the pollen-tube nuclei and the generative nucleus. In many cases the pollen-tube nuclei were seen to divide.

In *L. philadelphicum* the nucleus of the archesporial cell appears during the first division with 12 chromosomes. At an early stage the linin-thread of the chromatin-network begins to thicken, and the granules undergo transverse fission. After division of the granules the whole chromatin band undergoes longitudinal splitting, and the double threads thus produced begin to twist upon each other. The twisted band finally manifests itself as a single continuous spirem, which doubles up and twists into twelve loops. These break apart and give rise to the twelve chromosomes. The two linin-threads with their granules, which compose the loop, continually become more intimately associated, so that the loop appears like a single linin-thread with two irregular rows of chromatin-granules. The chromatin-loops become shorter by contraction, and receive a thick deposit of some substance which stains light at first, but later takes the same colour as the chromatin. The chromosomes arrange themselves in the equatorial plane in such a manner that the end containing the two free ends of the original chromatin-loop is untwisted and finally cut in two by a transverse division.

The nucleus has at first about three nucleoles, each with one or more large granular vacuoles. After the longitudinal splitting of the chromatin-band, there arise in the nuclei numerous small vacuolated bodies. These are successively abstricted from the mother-nucleole by a process of budding, and give rise to numerous micronucleoles, which all pass out into the cytoplasm before the formation of the mother-star; and later, at about the beginning of the close daughter-skeins, these micronucleoles all pass back into the daughter-nuclei, and by aggregation form the new nucleoles of the daughter-nuclei. This process is repeated for every division of the female gametophyte.

At about the time of the division of the chromatin-granules, there appear in the cytoplasm peculiar cytoplasmic threads which pass from one side of the cell to the other, and are mostly tangent to the nucleus. At a later stage, at about the beginning of the nuclear migration, these threads have disappeared, and numerous radiating threads pass out at right angles from the nuclear surface and extend to the cell-walls. Similar radiations appear round the daughter-nuclei; and the micronucleoles, as they are drawn into the daughter-nuclei, seem to be in contact with these cytoplasmic threads.

Two centrospheres appear beside the resting nucleus, and, in the mother-star stage, a single centrosphere appears at each pole of the spindle; while a little later, during metakinesis, a centrosphere appears at each point with a double centrosome. In the daughter-skein stage there are two centrospheres at each pole, which are often quite distinct, and can easily be differentiated from the micronucleoles.

Fertilisation and Embryogeny of Triticum.*—Herr M. Koernicke has made a detailed examination of the processes which take place before

* Verhandl. Naturhist. Ver. Preussen Rheinl., liii. (1896) pp. 149–85 (1 pl. and 3 figs.).

and after impregnation in the embryo-sac of a variety of the cultivated wheat. The following are the more important results.

The mother-cell of the embryo-sac divides into four superposed daughter-cells, separated from one another by strongly swollen septa. The terminal one of these four cells develops into the embryo-sac, while the remaining three become gradually disorganised. It is rare to find in the embryo-sac of *Triticum* only three antipodals; usually one of the three divides into a very large number, apparently by direct division. While the secondary nucleus of the embryo-sac is being formed, the membranes of the synergids and of the ovum-cell become somewhat thicker; the former differ from the latter in their more elongated form.

In the divisions which take place in the pollen-mother-cells, it appears certain that the greater part of the spindle-fibres are derived from the surrounding protoplasm.

In the vegetative portion of the inflorescence the number of chromosomes in a nucleus is usually 16, though as many as 24 have been observed. In the nucleus of the mother-cell of the embryo-sac and in the pollen-mother-cells there are only 8. In the fertilised ovum-cell the normal number of 16 is again attained.

The object of the remarkable increase in the number of antipodals appears to be to supply nutrient material to the endosperm rather than to the fertilised ovum-cell.

Antherozoids of Zamia.*—Mr. H. J. Webber announces the discovery of motile antherozoids in *Zamia integrifolia*, and describes a peculiar structure of the pollen-tube.

After the pollen-grain has germinated, there are found in the pollen-tube, near its basal end, two cells, one in front of the other. The posterior of these cells is spherical or slightly elongated. The nucleus of the original cell has divided into two, one of the daughter-nuclei forming within the parietal utricle a new and wholly distinct utricle which delimits a cell lying entirely within the mother-cell, and surrounded on all sides by a layer of protoplasm of nearly uniform thickness. The anterior is much larger than the posterior cell, and is provided with two small spherical organs, situated at the opposite ends of the nucleus, outside the nuclear wall, and somewhat resembling centrosomes.

Each of the daughter-cells formed by the division of the generative cell develops into a motile antherozoid, two being thus formed in each pollen-tube. They are encircled by a spirally arranged band of cilia developed from the centrosome-like body. The membrane formed by the wall of this body in its disintegration forms a band lying free in the cytoplasm of the cell. It becomes greatly extended in length, and forms a spiral band or ribbon with five or six coils. On the outer side of this band are very numerous protuberances which develop into the motile cilia of the mature antherozoid. The mature antherozoids pass into the archegone through a rupture in the end of the pollen-tube, the watery contents of the tube supplying a drop of water in which they can swim. They are of very large size, visible to the naked eye, 258–332 μ by 258–306 μ. There is no free tail. The nucleus is very large, and is surrounded on all sides by a thin layer of cytoplasm. The motion of the antherozoids

* Bot. Gazette, xxiii. (1897) pp. 453–9; xxiv. (1897) pp. 15–22 (1 pl. and 5 figs.).

is a rotating one, the cilia continuing to vibrate for a considerable period after the rotation has ceased.

Development of Pollen-Grains of Allium.*—M. C. Ishikawa has studied the development of the pollen-grains in *Allium fistulosum*. On the first division of the pollen-mother-cells each of the eight chromosomes splits longitudinally, and many of the chromosomes thus formed become bent into a V-shape. These gradually shorten, and unite into groups of four at the joints. When such a group of chromosomes assumes an equatorial position, the separate chromosomes of each pair are so arranged in the equatorial plate that one faces each pole. After nuclear division we have at each pole of the karyokinetic spindle eight V-shaped daughter-chromosomes. Each of these daughter-chromosomes is now broken through at the point where the two arms meet, the mode of division being transverse, not longitudinal. In the first division, therefore, each pollen-mother-cell undergoes in succession a longitudinal and a transverse division, so that we get finally eight pairs of chromosomes or 16 separate chromosomes at each pole. Then each chromosome of the daughter-nuclei breaks up into microsome grains.

The second division, which finally produces four pollen-cells, proceeds heterotypically. The chromosomes take the form of rings, and are eight in number. No longitudinal division takes place; the nucleus of each pollen-cell contains eight simple chromosomes. The formation of the vegetative and generative nuclei in the pollen-cell is usually completed by each chromosome undergoing longitudinal division.

Development of Sexual Cells in Typha.†— Mr. J. H. Schaffner has followed the development of the stamens and carpels in *Typha latifolia*. Notwithstanding the primitive type of flower, it presents a highly modified archesporial region. There is only a single archesporial cell, from which a single primary tapetal cell is cut off, this again dividing into two cells by a vertical wall.

Polyembryony in Allium odorum.‡—Herr F. Hegelmaier is able to confirm, in all the main points, the account given by Tretjakow §, of the occurrence of several embryos in the embryo-sac of *Allium odorum*. The adventitious embryos are never the result of direct impregnation by a pollen-tube, and may be regarded as parthenogenetic, being apparently due to an excitation resulting from the impregnation of the ovum-cell. These adventitious embryos are of 3 kinds:—(1) Derived from the egg-apparatus, i.e. from the abnormal development of one or both of the synergids. (2) Derived from the antipodals. In only one case did two of the antipodals develop into embryos; never more than two. The author was unable to detect any predisposition in one of the antipodals over the others. (3) Parietal adventitious embryos, springing from the inner surface of the ovule at different, apparently arbitrary, spots, but usually at some distance from the egg-apparatus. The author was not successful in tracing these adventitious embryos back to the unicellular condition. Two may occur in the same ovule, or one accompanied by one of either of the other kinds.

* Journ. Coll. Sci. Tokyo, x. (1897) 31 pp. and 2 pls. See Bot. Centralbl., lxxi. (1897) p. 211.
† Bot. Gazette, xxiv. (1897) pp. 93–102 (3 pls.).
‡ Bot. Ztg., lv. (1897) pp. 133–40 (1 pl.).
§ Cf. this Journal, 1895, p. 450.

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

Influence of the Dark Heat-Rays on the Growth of Plants.*—By growing plants beneath a concentrated solution of alum, Herr N. H. Nilsson has tested the effect on their growth of the dark heat-rays as compared with that of ordinary sunlight. Among the more important uniform results are the following:—The epidermal cells are larger, and have more wavy walls, the outer and radial walls being thinner; the quantity of hairs is reduced; the palisade-cells are shorter radially; and the intercellular spaces in the palisade-parenchyme are larger. Different species showed different results as respects the size of the leaves and of the stomates, and the absolute size of the spongy parenchyme.

Germination of Parasitic Phanerogams.†—Herr E. Heinricher states, as the result of experiments on various species of Rhinantheæ, that the germination of the seeds takes place independently of any chemical irritation from a host-plant; but that the haustoria are produced only as the result of the chemical irritation exercised by a second living root.

New Mode of Grafting.‡—M. L. Daniel advocates a new process of grafting which he terms the *greffe en flûte-approche*, and which he claims to combine the advantages of the "flute-method" (*greffe en flûte*) and the "shield-method" (*greffe en écusson*). It is described as being certain in its results, but it takes more time than the methods already in use, and is applicable rather to the perpetuation of special varieties than to use for ordinary purposes of cultivation.

Role of Water in Growth.§—Mr. C. B. Davenport compares the developmental processes occurring at the tip of a twig and those in the animal embryo. In both there is first a period of rapid cell-division with slow growth; next a grand period of growth in which the general form of the embryo is acquired, the rudiments of the organs are established, and the organism increases rapidly in size by the imbibition of water; and lastly, a period in which histological differentiation is carried on, while the absolute growth increments cease to increase.

Transpiration in the Tropics.‖—From series of observations made in Java and at Wageningen (Holland), Herr E. Giltay doubts the accuracy of Haberlandt's statement ¶ that transpiration is much less energetic in the Tropics than in the temperate climate of Central Europe. He does not, however, consider that any of the experiments as yet made are on a sufficiently extended scale to settle the question.

Currents of Pigments and Saline Solutions in Dicotyledons.**—Herr E. Tschermak finds a remarkable difference between the paths taken by coloured solutions and by solutions of salts in the ascending current in dicotyledonous, woody, and herbaceous plants. The pigments employed were aqueous solutions of sodium-indigo sulphate, fuchsin, saffranin,

* SB. Bot. Verein Lund, Nov. 14, 1896. See Bot. Centralbl., lxxii. (1897) p. 21.
† Ber. Naturw.-med. Ver. Innsbruck, xxii. (1896). See Bot. Centralbl., lxxi. (1897) p. 318.
‡ Rev. Gén. de Bot. (Bonnier), ix. (1897) pp. 213–9 (12 figs.).
§ Proc. Boston Soc. Nat. Hist., xxviii. (1897) pp. 73–84.
‖ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) pp. 615–44.
¶ Cf. this Journal, 1893, p. 208.
** SB. K. Akad. Wiss. Wien, cv. (1896) pp. 41–70.

gentian-violet, and eosin; the saline solutions, lithium chloride, barium chloride, strontium nitrate, calcium nitrate, sodium chloride, and ferric chloride; the first-named in each group giving the best results. In both herbaceous and woody dicotyledons the vascular bundles acted, in all the cases examined, as the sole conductors of soluble pigments, which never spread beyond them into the adjacent tissues. In woody species particular branches or parts of the plant appeared to be in connection, as far as the absorption of pigments is concerned, only with definite portions of the root. The saline solutions, on the other hand, after ascending through the vascular bundles, diffused themselves after a time through the adjacent tissues and finally through the whole plant. In the absorption of nutrient substances any particular part of the plant is not dependent on the activity of any special portion of the root, but rather on the entire accumulation of salts in the stem, which again is derived from the activity of the entire root.

Excretion of Drops of Water from Leaves.*—Dr. A. Nestler states that, while the excretion of drops of water from the leaves of plants is often effected by special organs (hydathodes), this is not always the case. In *Agapanthus umbellatus*, which has neither epitheme nor water-pores, it takes place partly on the upper side of the leaf, partly on the under side of the apex. In grasses it may be brought about in various parts of the leaf. In *Tradescantia viridis* the exudation is effected through water-clefts placed in a row on the margin of the upper side, the only stomates on this side of the leaf. In *Phaseolus multiflorus* the club-shaped hairs do not appear to have this function.

Aeration of the Stem of Mikania.†—Mr. W. W. Rowlee finds that the primary root of *Mikania scandens* gives rise to a great number of slender lateral roots, especially on the upper side, which grow towards the surface of the water of the marshes in which the plant flourishes. He regards these as aerotropic organs. When planted in dry soil, these roots appear as small erect knees, containing a large number of schizogenous air-passages, which appear every year.

(3) Irritability.

Sleep of Plants.‡—Pursuing his investigation on the advantages afforded to plants by the nocturnal position of the leaf or leaflets, Herr E. Stahl finds, in a large number of plants examined, that it acts as a protection against the deposition of dew. The effect is to promote transpiration, and thus increase the amount of nutriment conveyed to the assimilating organs. He does not favour the view that the main object is a protection against excessive radiation.

The nocturnal position of leaves or leaflets may be classed under two heads:—(1) They are directed downwards, so that the under side is better protected than the upper side against the deposition of dew (*Biophytum sensitivum*, *Oxalis Acetosella*, *Robinia pseudacacia*, *Hedysarum gyrans*, *Impatiens noli-tangere*, &c.). (2) They are so placed that the

* SB. K. Akad. Wiss. Wien, cv. (1896) pp. 521–50 (2 pls.).

† Proc. Amer. Micr. Soc., xv. pp. 143–56 (6 pls.). See Bot. Centralbl., 1897, Beih., p. 95.

‡ Bot. Ztg., lv. (1897) 1te Abth., pp. 71–109. Cf. this Journal, 1895, p. 657.

upper side is better protected than the under side against the deposition of dew (*Colutea arborescens, Trifolium repens, Impatiens glanduligera*, &c.). This difference is usually correlated with a difference in the disposition of the stomates, as is well seen in the different species of *Impatiens*; but there are exceptions to this rule. Geotropism no doubt plays some part in promoting the vertical nocturnal position.

Hydathodes are very abundant in the Oxalideæ and other nyctitropic families. It is probable that the spontaneous movements in the leaflets of *Desmodium gyrans, Trifolium pratense*, and other plants, which have no relation to nyctitropism, and the easily provoked trembling of the leaves of the aspen, have also an advantage to the plant in promoting transpiration.

Sensitive Cushions of Mimosa.*—In the primary cushions of the leaves of *Mimosa pudica*, Prof. S. Schwendener finds that the stereome-sheath which surrounds the central vascular bundle is composed of true collenchyme. The "swelling parenchyme" has on its inner side a zone, consisting of only a few layers of cells, with large intercellular spaces which are always filled with air. The larger peripheral portion has only very small intercellular spaces. The sensitive (lower) half of the cushion has always much thinner cell-walls than the other portion.

The secondary cushions of the pinnæ have essentially the same anatomical structure as the primary cushions, but the central bundle has always a ribbon-like form, and is composed of a collenchyme plate with about five vascular bundles lying side by side. On the sensitive side of the tertiary cushions are a number of stomates, which are, however, not in any way connected with their irritability. The difference between the cylindrical central bundle of the primary cushion and the ribbon-shaped bundle of the secondary cushions is connected with a difference in the mode of curvature.

The upper and lower halves of the cushions react in opposite directions towards changes in the light. The upper half loses, while the lower half gains, in expansive power with loss of light, and *vice versâ*.

The mathematical conditions of the changes in position are discussed in detail.

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

Mucilage Excreted by Seeds.†—According to M. H. Coupin nearly all seeds excrete mucilage by a process of osmose when placed in water for the purpose of swelling. In the case of peas and haricots, the loss of weight by this process may be as much as from two to three per cent. The mucilage is derived both from the nucellus and from the integument, and the excretion is promoted by a high temperature.

Secretion by the Scutellum.‡—From a series of experiments made on the scutellum of grasses (chiefly *Zea Mays*), Herr J. Grüss has come to the conclusion that when the endosperm has been removed during germination, the seeds have the power of converting starch into sugar, even without the agency of bacteria.

* SB. K. Preuss. Akad. Wiss. Berlin, xiv. (1897) pp. 228–57 (1 pl.).
† Rev. Gén. de Bot. (Bonnier), ix. (1897) pp. 241–4.
‡ Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger) xxx. (1897) pp. 645–64 (1 fig.). Cf. this Journal, 1895, p. 200.

Function of Antitoxins.*—Dr. H. A. Cummins suggests that the principal purpose served by the formation of antitoxins (alkaloids and others) in plants is to protect them against the attacks of injurious bacteria in the soil. This is confirmed by the fact that the production of poisonous principles varies in the same species with the nature of the soil. The antiseptic principles appear usually to be produced as the result of irritation of the cells by the entrance of organisms which cause fermentation of the juices of the plant, the antitoxin then killing the invading organism.

Advances in the Chemistry of Fermentation.†—In an introductory address, Prof. E. Buchner, after reviewing the history of the physiology of fermentation, alluded to Traube's idea of the existence in yeast-cells of a body capable of exciting fermentation. The ill success of numerous experimenters in isolating this fermenting substance from the yeast-cells in the same way that invertin was isolated, resulted from the difficulty in crushing the thick cell-membrane in all the cells of a large quantity of yeast, and therefore of quickly emptying the cells of their contents. The author mixed the yeast with quartz sand. After long rubbing the mash becomes moist, and the fluid portion of the cell-contents escapes. Water is then added, and the whole mass exposed to a pressure of 500 atmospheres. From the press runs out an almost clear yellow fluid, which amounts to nearly half of the whole of the cell-contents. In six hours 500 cubic cm. of juice can be obtained from one kilogram of beer yeast. This juice possesses the property of fermenting carbohydrates without the presence of organisms. Mixed with one volume of strong saccharose solution, the development of CO_2 begins in a quarter of an hour, and in a refrigerator continues for more than 14 days. In this way alcohol is formed. Cane-, grape-, fruit-, and malt-sugars are fermentable just as well as with a living ferment, but not mannite or milk-sugar. The ferment, which is designated *zymase*, has the characters of albuminous bodies. It is not living protoplasm, as chloroform does not inhibit its action. Under natural circumstances it is apparently excreted by the yeast-cells, and becomes diffused in the fluid, and in this way effects the decomposition of sugar. Zymase is diffusible through parchment paper. By precipitation with alcohol it is rendered insoluble in water. When heated to 40°–50° there is a copious deposit of albumen, and the filtrate has no fermenting power. The ferment is so inconstant that after standing for five days in the refrigerator in half full flasks, its efficiency disappears. Hence the author thinks that zymase is more closely allied to the living protoplasm of the yeast-cells than to invertin, and belongs to the genuine or native proteids.

Butylalcohol Fermentation.‡—Induced by Fitz's works, Herr O. Emmerling sought in cow-dung and in hay for the ferment which decomposes glycerin in butylalcoholic fermentation. After frequent failure he finally succeeded in obtaining this fermentation from hay grown in Alsace. The *Butyl-bacillus* thus found is identical with that described by Fitz, but not with the *Granulobacter saccharobutyricus* of Beyerinck.

* Proc. Asiatic Soc. Bengal, 1897, pp. 15–21.

† Tübingen, 1897, 23 pp. See Bot. Centralbl., lxxi. (1897) p. 38. Cf. this Journal, *ante*, p. 414.

‡ Ber. Deutsch. Chem. Gesell., 1897, No. 4. See Centralbl. f. Bakt. u. Par., 2te Abt., iii. (1897) p. 322.

γ. General.

Mechanical Effect of Rain on Plants.*—From observations made in Java, Herr J. Wiesner altogether disputes the injurious effects alleged to be produced on leaves and flowers even by tropical rain. He never observed any splitting or tearing of leaves or petals even by the heaviest rain, when not accompanied by strong wind. When flowers or leaves are bodily torn away by rain, it is because their tissues had already undergone the change which made them nearly ready to fall. The immunity from the effects of heavy rain is due to the elasticity of the flower-stalk or leaf-stalk. If these organs are fixed so as to have no power of movement, the impact of a falling body of only one-thousandth the weight of a heavy drop of rain will have a destructive effect. A moderately heavy rain has no effect on the leaves of *Mimosa pudica*.

Freezing of Plants.†—From a series of observations made on tropical plants, Herr H. Molisch states that the freezing of plants at a temperature above zero (C.), independently of their transpiration, is the result of chemical rather than of physical changes in the living substance; some chemical processes, such as the formation of chlorophyll and of etiolin, respiration, and the assimilation of carbon dioxide, being largely dependent on the temperature, while other processes are not.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Parthenogenesis in Marsilia.‡—Mr. W. R. Shaw has succeeded in cultivating embryos of *Marsilia Drummondii* from female prothallia in which the archegones were completely isolated from any possible access of antherozoids. About one-half of the megaspores thus sown germinated. The embryos were slightly smaller than those produced in the ordinary way.

Regeneration of Selaginella.§—Dr. J. Behrens describes the two modes of regeneration which occur in *Selaginella*, especially in *S. inæqualifolia*, viz. by the independent growth of fragments of the stem, and by proliferation of the sporange.

Muscineæ.

Hygroscopic Mechanism of the Peristome of Mosses.‖—Herr C. Steinbrinck compares the mechanism by which spores are thrown out of the sporange of a Moss with those which govern the bursting of a capsule or an anther in flowering plants. Like seeds, the spores of mosses are usually protected against rain by the outer teeth forming a dense covering over the mouth of the sporange, due to the hygroscopic movements of its outer teeth. But in some cases the dissemination of the spores is promoted by rain. According to the behaviour of the peristome-teeth on drying, Mosses may conveniently be classified under three groups,

* Ann. Jard. Bot. Buitenzorg, xv. (1897) pp. 277–353.
† SB. K. Akad. Wiss. Wien, cv. (1896) pp. 82–95.
‡ Bot. Gazette, xxiv. (1897) pp. 114–7.
§ Flora, lxxxiv. (1897) Ergänzbd., pp. 159–66.
‖ Tom. cit., pp. 131–58 (13 figs.).

viz.:—(1) Those in which the outer teeth mostly or exclusively bend inwards (*Ceratodon, Barbula, Pylaisia*); (2) those in which they mostly or exclusively bend outwards (*Orthotrichum, Grimmia, Dicranum, Dicranella, Funaria, Fissidens*); (3) those in which the outer teeth have an oscillating movement on contracting and swelling (*Hypnum, Amblystegium, Plagiothecium, Rhynchostegium, Brachythecium, Camptothecium, Neckera, Homalia, Bryum, Mnium*). Examples of each of these groups are described in detail. The direction of the curvature of the teeth on an alteration in the moisture is determined, as in the sporange of a fern or in an anther-lobe, by the unequal solidity of their inner and outer surfaces. This property resides especially in their radial walls, which are capable of great swelling.

Non-Sexual Propagation of Campylopus flexuosus.* — Herr J. Familler has investigated the mode of propagation of this moss, by the separation of very slender small-leaved branches, which become detached at the slightest touch. These do not develop directly into a new moss-plant, but produce a protoneme on which the leafy plant arises in the ordinary way as a lateral outgrowth. The moss grows in swampy places, and is probably partially saprophytic. It rarely produces fructification.

Biology and Physiology of Marchantiaceæ.†—Herr Z. Kamerling has studied several points in the structure and development of the Marchantiaceæ and allied families.

The rhizoids with peculiar conical outgrowths on the inner side of the cell-wall (*Zäpfchenrhizoiden*) are found in several species (*Marchantia* and *Lunularia*). Rejecting the theories of previous observers as to the function of these rhizoids, the author believes at least one purpose of the projections to be to counteract the injurious effects of bubbles of vapour in hindering the circulation of water through the rhizoids. In accordance with this view, the development of this kind of rhizoid is largely correlated with the nature of the habitat of the species. The strongest development of the conical projections was seen in the stalk of the inflorescence of *Preissia commutata*. In *Marchantia polymorpha* they frequently have a spiral arrangement. The rhizoids spring from the under side of the thallus, and are protected by scales.

The air-chambers of the Riccieæ and Marchantieæ are described. The stomates are of two kinds, according as the divisions in the mother-cell take place at right angles or parallel to the surface of the thallus, the canal-shaped stomates being the result of the latter process. The structure of the stomates differs in minor details in different genera.

In reference to their habits and biology, the author classifies the Marchantiales under six types, viz.:—The ephemeral type (*Riccia glauca, Ricciocarpus natans*, &c.); (2) the xerophytous type (*Riccia lamellosa, Oxymitra pyramidata, Targionia hypophylla*, &c.); (3) the alpine type (*Clevia, Sauteria, Peltolepis*); (4) the *Lunularia* type (*Marchantia palmata, Lunularia cruciata, Fimbriaria stahliana*, &c.); (5) the hygrophilous type (*Fegatella conica*, &c.); (6) the bog type (*Marchantia polymorpha* alone).

* Flora, lxxxiv. (1897) Ergänzsbd., pp. 174–5 (2 figs.).
† Tom. cit., pp. 1–68 (3 pls.).

Algæ.

Food-Material of Algæ and Fungi.*—Dr. T. Bokorny gives the results of a series of experiments on the limits of dilution of substances which can be taken up by the lower plants. Among the more noteworthy are the following:—In a 1:100,000 solution of fuchsin, *Mesocarpus* and *Spirogyra* became strongly coloured, and soon died; a solution of 1:1,000,000 produced no effect. In a 1:100,000 solution of potassium biniodide, starch-grains assumed a violet tint in 24 hours; with a solution of 1:500,000, the starch-grains were not coloured, but the cells (*Spirogyra*) were killed. Caffein produces the aggregation-reaction in the protoplasm with a dilution of 1:10,000; ammonia produces the same result with a dilution of 1:100,000. A proportion of 1:100,000 of a mixture of potassium phosphate, magnesium sulphate, and calcium nitrate in water is sufficient to afford a supply of the necessary mineral ingredients of the food of Algæ.

Arboreal Algæ.†—Among a collection of Algæ gathered on trees in Samoa, Herr W. Schmidle finds the following new species:—*Phycopeltis microcystis*, *Hansgirgia polymorpha*, and *H. irregulare*, all on leaves; also the following:—

Dendronema confervaceum g. et sp. n. Cellulæ minimæ, 2–3 μ latæ, 6–12 μ longæ, cylindricæ et utrinque rotundatæ, aut raro longe ellipticæ, vix se attingentes, et præcipue materia firma hyalina non v. vix visibili in filum breve conjunctæ; fila simplicia, æquicrassa, paucicellulata, foliis Muscorum Hepaticorum aut Scytonematibus basi affixa, patentia, plerumque appropinquata, raro singula; contentus chlorophyllosus (ut videtur) axialis, membrana pro ratione firma; pyrenoidibus et nucleolis adhuc ignotis; multiplicatio zoogonidiis rima e cellula effugientibus (ut videtur). Epiphytic on Hepaticæ.

Fossil Algæ.‡—Herr A. Rothpletz classifies the Fucoideæ (or probably rather the Phæophyceæ) of the Flysch under six genera, viz. *Phycopsis* (including *Chondrites*, *Chondrides*, and *Gigartinites*), *Granularia* (including *Halymenites*, *Caulerpa*, and *Münsteria*), *Keckia*, *Squamularia*, *Gryllophyllites*, *and Taonurus*. A new genus, *Siphonothallus*, is also described, belonging apparently to the Siphoneæ.

New Marine Algæ.§—Herr P. Kuckuck gives a more detailed description of the newly discovered genus *Mikrosyphar* from Kiel and Heligoland, with two new species, *M. Porphyræ* and *M. Polysiphoniæ*, growing on the respective seaweeds from which they are named. Two new species of Phæosporeæ are also described, *Ectocarpus lucifugus* and *Leptonema lucifugum*, growing in dark hollows, as well as other new species of Phæosporeæ and Florideæ, and a new genus of Chlorophyceæ, *Sporocladus*, resembling a small *Cladophora*, and developing sporanges from the terminal cells of primary and secondary branches, containing from

* Biol. Centralbl., xvii. (1897) pp. 417–23.

† Hedwigia, xxxvi. (1897) pp. 277–87 (4 pls.).

‡ Zeitschr. Deutsch. Geol. Gesell., 1896, pp. 854–914 (3 pls.). See Bot. Centralbl., lxxi. (1897) p. 71.

§ Beitr. z. Kennt. d. Meersalgen, 42 pp. and 7 pls.; also Bemerk. z. marinen Algen-vegetation v. Helgoland, ii., 28 pp. and 21 figs. See Bot. Centralbl., lxxi. (1897) pp. 96 and 311. Cf. this Journal, 1896, p. 91.

six to ten swarmspores. The swarmspores of *Codiolum Petrocelidis* have four cilia.

Antherozoids of Dictyota and Taonia.*—Mr. J. Ll. Williams has detected motility in the antherozoids or pollinoids of *Dictyota* and *Taonia*, hitherto supposed to be immotile. On escaping from the antherid, the antherozoids were seen to swarm, and to display as great activity as those of *Fucus*. The cilia were clearly displayed on staining; but it is stated that there are striking differences between the phenomena and those of the Fucaceæ.

Arrested Condition of Zygnema.†—Herr W. Schmidle describes a peculiar condition of a *Zygnema* from Australia, in which the protoplasts of the cells have undergone contraction into a spherical form, giving a torulose appearance to the filament. It appears to mark a transition between *Zygnema* and *Zygogonium*, to which latter genus it should probably be referred.

Fungi.

Influence of Nutrient Media on the Development of Fungi.—M. J. Ray ‡ has grown examples of the lower Fungi, chiefly *Sterigmatocystis alba*, in a variety of nutrient media, and finds the one character which remains constant to be the size of the spores. Almost all other characters which are relied on as specific are liable to vary, while those which are regarded as generic are for the most part constant. The size of the cells of the filaments which compose the thallus is especially variable. When cultivated in liquids in motion, the cells are liable to assume a spherical form, or the thallus itself becomes rounded. In nature the vegetative elements springing from spores of the same origin may vary greatly, according to the conditions of germination and development.

Herr A. Schmidt § gives full details of the effects of various nutrient fluids of different degrees of concentration on the development of the conids, gemmæ, and ascus-fructification of *Sterigmatocystis nidulans*.

Herr W. Schostakowitsch ‖ has investigated the changes produced in *Mucor proliferus* ¶ by external conditions. It varies exceedingly according to the temperature and the nature of the nutrient fluid. It may vary in height between 0·5 mm. and 7 cm. Swellings may appear below the sporanges, as in *Pilobolus*. The wall of the sporange may lose its deliquescent property. The spores are subject to extraordinary variation in size, viz. between 2 and 67 μ; they may become curved or lobed, hour-glass-shaped or cylindrical, and may germinate within the sporange.

As the result of experiments made on some of the lower Fungi, *Aspergillus niger*, *Penicillium glaucum*, and *Botrytis cinerea*, Mr. H. M. Richards ** finds that many nutrient substances, both organic and inor-

* Journ. of Bot., xxxv. (1897) pp. 361–2.

† Flora, lxxxiv. (1897) Ergänzbd., pp. 167–70 (11 figs.).

‡ Rev. Gén. de Bot. (Bonnier), ix. (1897) pp. 193–212, 245–59, 282–304 (6 pls. and 4 figs.); Comptes Rendus, cxx. (1897) pp. 193–4.

§ 'Ueb. d. Bedingungen d. Conidien-, Gemmen-, u. Schlauchfrucht-Production bei *Sterigmatocystis nidulans*,' Halle, 1897 (1 pl.). See Bot. Centralbl. lxxi. (1897) p. 98.

‖ Flora, lxxxiv. (1897) Ergänzbd., pp. 88–96 (1 pl.).

¶ Cf. this Journal, *ante*, p. 149.

** Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) pp. 665–88.

ganic, have a distinct influence on their growth. An increased activity of growth of the mycele is, however, frequently accompanied by a retardation in the production of conids. The colour of the conids is sensibly affected by the chemical composition of the nutrient medium.

Pleomorphism of Fungi.* — In reviewing the question of pleomorphism, Dr. O. Johan-Olsen follows the lead of Brefeld, who laid down the proposition that parasitism is to be regarded as an adaptation phenomenon; and the author's view is that, as a rule, the primary form of a fungus lives on dead matter, is a saprophyte in fact, and that if there be a parasitic form, this cannot exist for ever as a parasite, but must return to the saprophytic condition in order to regain the power of invading living tissue. A large number of examples of the variations of fungi under natural and artificial conditions are referred to, and these certainly lend colour to the view that so little is known as yet about these fungi that it would be wise not to dogmatise too strongly. Hence it would be better to regard most bacteria as adaptation forms, and not as independent species, and, after Coppen Jones, speak of *Tuberculomyces* just as we do of *Actinomyces*.

Classification of the Spores of Fungi.†—M. P. A. Dangeard suggests a classification of the spores of Fungi, from the point of view of their origin, different from any of those which now prevail. Conids (e.g. *Penicillium crustaceum*) he defines as spores which are derived from the continued division of the single nucleus of a mother-cell. These conids may, however, be of two kinds:—(1) they are the result of the budding of the mother-cell (*Aspergillus*, *Trichoderma lignorum*, and many Mucedineæ, spermogones of Uredineæ, *Saccharomyces*), and this is the most common mode of production; (2) they result from the division of the mother-cell (*Sphærotheca Castagnei*). The conid is, in its origin and structure, a nonsexual spore in every sense of the term. In the *Coremium*-stage of *Penicillium* the spores are not produced from a mother-cell, but by the breaking up into cells of multinucleated fertile branches, as in *Oidium lactis*; and for this kind he proposes the term *oidia*; they are not necessarily the result of the division of a nucleus. Chlamydospores are encysted oidia. The Ascomycetes and the Basidiomycetes produce both conids and oidia. Uredospores and æcidiospores must be regarded as conids. Both conids and oidia may be compound. Conids are altogether analogous to the spores of the Muscineæ and Filices; while oidia have more analogy to bulbs, gemmæ, and similar structures.

New Genera of Fungi. — In a collection of Fungi from South America, Herr P. Hennings ‡ finds a number of new species, and the following new genera:—

Ditella (Uredineæ). Sporæ continuæ, catenulatæ, sine cellulis interstitialibus, pseudoperidio tectæ; sori subtremelloidei, subglobosi, basi immersi. *D. verruciformis*, on leaves of *Sida macrodon*.

Hypocreodendron (Hypocreaceæ). Stroma carnosum, truncatum, fruticiformite ramosum; perithecia stromatis parte superiori disciformi tantum immersa, subglobosa; asci haud conspicui; basidia ramosa;

* Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 273–84 (1 pl.).
† Le Botaniste (Dangeard), v. (1897) pp. 313–7.
‡ Hedwigia, xxxvi. (1897) pp. 190–246 (1 pl.).

conidia bacillaria, hyalina, continua. *H. sanguineum*, in crevices of a trunk.

Phæophacidium (Phacidiaceæ). Mycelium intercellulare; ascomata superficialia, submembranacea, pulvinato-applanata, irregulariter laciniato-dehiscentia, atra; asci clavati, 8-spori, paraphysati; sporæ oblongæ, continuæ, fusco-atræ. *P. Escalloniæ*, on leaves of *Escallonia rubra*.

Septorella (Sphæropsideæ). Peritheciis superficialibus, carbonaceis, opacis, nigris; sporulis anguste fusoideis, curvulis, guttulatis, hyalinis; basidiis cæspitosis, brevibus. *S. Salaciæ* on leaves of *Salacia*.

Allescheriella (Hyphomycetes). Hyphæ repentes, septatæ, ramosæ, hyalinæ, subflavescentes; conidia apice ramulorum oriunda, singularia, continua, subglobosa, ovoidea v. oblonga, læte colorata. *A. uredinoides*, on corticolous mosses.

Negeriella (Hyphomycetes). Stromata filiformia, rigida, lateraliter ramosa, e hyphis atrofuscis septatis ramosisque composita; conidia apicibus ramorum singularia, subfuscoidea, pluriseptata, colorata. *N. chilensis*, on dead boughs of a *Eugenia*.

Didymochlamys (Ustilagineæ). Massa sporarum (?) in floribus nidulans, sacculo membranaceo inclusa; sporæ (?) continuæ, membrana duplici tectæ, coloratæ. *D. ustilaginoidea*, in the inflorescence of a *Rhynchospora*.

From *Marasmius* Herr A. Scherffel * separates those species which have coloured, especially brown, spores, constituting them into a new genus with the name *Phæomarasmius*, g. n.

Fungi inhabiting Excrement.†—Prof. E. C. Hansen describes the structure and biology of several species of *Coprinus* found on the dung of Mammalia, viz. *C. stercorarius*, *niveus*, and *Rostrupianus* sp. n. The latter species and *C. stercorarius* form types for two different modes of development, the one with obligatory, the other with facultative, formation of sclerotes. The fungus previously described by the author as *Eurotium stercorarium* he now constitutes as the type of a new genus under the name *Anixiopsis stercorarius*, distinguished from *Anixia* by the absence of paraphyses, and by the spores being united into a more or less spherical group.

Fungi Parasitic on Lichens.—In further investigation of this subject, Prof. W. Zopf ‡ describes a fungus parasitic on *Pertusaria sulphurella*, a Pyrenomycete with groups of peritheces, which he describes as a new species, *Rosellinia Groedensis*. It has the property of forming gemmæ. The fungus described as *Rhymbocarpus punctiformis*, parasitic on *Rhizocarpon geographicum*, is the type of a new genus belonging to the Arthonieæ. Another new genus is represented by *Dicothecium stigma*, parasitic on several lichens, but effecting no injury in the gonids. Many other examples of parasitism are described.

Prof. E. Kernstock § makes a number of additions to Zopf's list of Fungi parasitic or epiphytic on Lichens.

* Hedwigia, xxxvi. (1897) pp. 288–90 (3 figs.).

† Bot. Ztg., lv. (1897) 1[te] Abth., pp. 111–32 (1 pl.).

‡ Nova Acta K. Leopold.-Carol. Deutsch. Akad. Naturf., lxx. (1897) pp. 97–190, (2 pls.). See Bot. Centralbl., lxxi. (1897) p. 280. Cf. this Journal, *ante*, p. 228.

§ Oesterr. Bot. Zeitschr., xlvii. (1897) pp. 9–11.

Red Pigment in Mucor.[*]—M. P. A. Dangeard records the occurrence, in a culture of *Mucor racemosus*, of an abundant red pigment, insoluble in water and in alcohol, resembling that of *Micrococcus prodigiosus.* The pigment is in oleaginous globules, or dispersed throughout the filaments.

Syncephalastrum and Syncephalis.[†]—Mr. R. Thaxter discusses the relationship of these two little-known genera of Mucorini, and advocates the retention of the former as a distinct genus. The zygosperms of *Syncephalis nodosa* are described in detail. Diagnoses are given of the following new species:—*Syncephalis Wynneæ*, on *Wynnea macrotis*; *S. pycnosperma*, on dung of mice and sheep; *S. tenuis*, on *Sphagnum.*

Systematic Position of Protomyces.[‡]—From a study of the development of *Protomyces macrosporus*, parasitic on various Umbelliferæ, M. Sappin-Trouffy rejects all the hypotheses that have at present been proposed with regard to its systematic position, viz. among the Ustilagineæ, among the Uredineæ, and among the Exoascaceæ. The spores do not contain two nuclei which subsequently conjugate, like those of *Entyloma* and of the asci of *Exoascus*; the nuclei of the spores have a totally different origin, viz. from the thallus, and display no phenomenon of conjugation. He regards the genus as more nearly allied to the Chytridineæ, and especially to *Cladochytrium*, where propagation takes place by cysts and by sporanges.

Sexual Reproduction in the Ascomycetes.[§]—From a fresh examination of the mode of formation of the ascus in *Sphærotheca Castagnei*, M. P. A. Dangeard confirms his previous view of the inaccuracy of Harper's statement [‖] that there is an actual passage of a male reproductive nucleus from the antherid into the archegone through an opening in the wall of the latter, and a fusion with its nucleus. He finds, on the contrary, that the cell which becomes segmented off at the apex of the antheridial branch exhibits degeneration of its protoplasmic contents from the moment of its segmentation. Nor was he able in any case to detect an orifice in the wall of the ascogone. The ascogone has at first only a single nucleus, which subsequently divides into two daughter-nuclei of equal size. Usually each of these again divides, and two septa appear, dividing the ascogone into a middle binucleated and two uninucleated cells, one at each end. The ascus is always derived from the binucleated cell after fusion of the two nuclei.

Parasitic Fungi. — Under the name *Rhizopus necans* sp. n., Mr. G. Massee [¶] describes a parasitic fungus very destructive to the bulbs of lilies in Japan, but attacking them only when already injured.

Mr. J. B. S. Norton[**] describes 33 species of Ustilagineæ from Kansas, together with the results of experiments on the germination of the spores on different host-plants. There are two new species.

* Le Botaniste (Dangeard), v. (1897) pp. 318–9.
† Bot. Gazette, xxiv. (1897) pp. 1–15 (2 pls.).
‡ Le Botaniste (Dangeard), v. (1897) pp. 285–8 (1 fig.).
§ Tom. cit., pp. 245–84 (17 figs.). Cf. this Journal, 1894, p. 719.
‖ Cf. this Journal, 1896, p. 339.
¶ Bull. Misc. Inform. R. G. Kew, 1897, pp. 87–90 (1 pl.).
** Trans. Acad. Sci. St. Louis, vii. pp. 229–41 (5 pls.).

Uredo Goebeliana * is a new parasitic fungus found by Herr P. Magnus on the leaves of a species of *Parietaria* in Venezuela, the first known to attack that genus.

The "soft spot" of the rind of oranges is, according to Mr. R. E. Smith,† due to the attacks of a fungus apparently identical with *Penicillium digitatum*, rather than with *P. glaucum*.

Two little known parasitic fungi are described by Herr E. Rosen ‡: *Graphiola Phœnicis*, on *Phœnix dactylifera*, a fungus of very uncertain affinities, possibly allied to the Ustilagineæ, but differing in having a closed double peridium and a spore-distributing column; and *Botrytis longibranchiata*, on *Blechnum brasiliense* and succulent flowering plants; chiefly saprophytic, but facultatively parasitic.

Fungus Parasitic on Pellia.§—Mr. W. G. P. Ellis finds a fungus parasitic on the thallus of *Pellia epiphylla*, which proved to be the conidial form of an Ascomycete apparently identical with the *Trichoderma*-phase of *Hypocrea*. It may be regarded as a saprophytic fungus taking on a parasitic phase.

Development of Volutella.‖—On a rotten hyacinth-bulb M. E. Boulanger finds a very polymorphic species of *Volutella* to which he gives the name *V. scopula* sp. n. Under cultivation in different media it assumes three different fertile forms, viz.:—a simple filamentous form; a normal tubercular form or "sporodochium"; and a filamentous form adapted to liquid media and bearing chlamydospores.

Meliola.¶—On the ground of its basal asci collected into tufts, and of the presence of an ostiole, Herr F. Bucholtz separates *Meliola* from the Plectascineæ, where it was placed by Fischer, and relegates it to the true Pyrenomycetes, where it must probably be accompanied also by *Testudina*, *Zukalia*, and *Ceratocarpia*.

Exobasidium Vitis.**—D. V. Peglion describes the structure and development of this parasite of the grape, preferring this nomenclature, rather than *Aureobasidium Vitis*. It differs from the other genera placed by Brefeld in the Hypochnaceæ in the spores giving birth, on germinating, to numerous buddings, instead of developing directly into a mycelial tube.

Morphology and Biology of Lichens.††—Pursuing the subject of the dependence of Lichens upon light, Herr H. Zukal points out that an exceedingly thin layer of chlorophyllaceous tissue will use up almost completely all the rays of light that promote assimilation. The cortex of a lichen will absorb, on the average, about ten times as much light as the epiderm of higher organisms. The very large superficial development of Lichens in comparison to other Ascomycetes is due to the

* Flora, lxxxiv. (1897) Ergänzbd., pp. 176–7 (2 figs.).
† Bot. Gazette, xxiv. (1897) pp. 103–4 (1 pl.).
‡ JB. Schles. Gesell. Vaterl. Cult., 1896 (1897). Zool.-bot. Sect., pp. 37–8.
§ Journ. Linn. Soc. (Bot.), xxxiii. (1897) pp. 102–17 (2 pls.).
‖ Rev. Gén. de Bot. (Bonnier), ix. (1897) pp. 220–5 (1 pl.).
¶ Bull. Herb. Boissier, v. (1897) (1 pl.). See Bot. Centralbl., lxxi. (1897) p. 271.
** Atti R. Accad. Lincei, vi. (1897) pp. 35–9.
†† SB. K. Akad. Wiss. Wien, cv. (1896) pp. 196–264. Cf. this Journal, 1896, p. 658.

enclosed Algæ (gonids). With regard to the pigments of lichens, the author is unable to say whether they act in the same way as phycoerythrin in the Florideæ, in promoting assimilation. Each species is adapted for a special intensity of light and combination of the coloured rays.

The simplest form of ascus, such as that which occurs in *Endomyces*, is morphologically equivalent to the lateral chlamydospores; both are apical swellings of a lateral branch. In the asci the ascospores are formed by endogenous cell-division; while in other cases the mycelial cells are transformed *in toto* into chlamydospores or oidia.

The author discusses further the various modes of propagation of Lichens; the influence on their development of climate and substratum; and the diseases to which they are subject.

Lengthening of the Receptacle of the Phalloideæ.*—According to experiments made by Mr. E. A. Burt on *Dictyophora duplicata*, the very rapid elongation of the receptacle after the "egg," or half-developed stage of growth, is largely dependent on an abundant supply of water. During the elongation, and coincident with the disappearance of the abundant store of glycogen present in the receptacle, there is a very rapid and general growth in size of the pseudo-parenchymatous cells which constitute its walls. The bursting forth of the receptacle from the volva and the straightening of its folded walls are due to this process of growth of the pseudo-parenchyme, during which the cells at the angles of the folds grow somewhat more spherical, and so become to some extent presumably active agents in the process of elongation.

Blastomycetes in Hypertrophied Tonsils.†—Dr. A. de Simoni examined twelve cases of hypertrophy of the tonsillar glands, and in all of them bodies which were recognised as Blastomycetes were observed. In the fresh condition the bodies are described as round, homogeneous, highly refracting, and of variable size. When stained they were found to be free and also endocellular, and not unfrequently budding. The stains used were lithium carmine and Gram's method. Mostly the bodies were violet when stained, but some were surrounded by a rose-coloured halo. The bodies described are stated to be identical with the Blastomycetes isolated by Sanfelice.

Protophyta.

a. Schizophyceæ.

Pelagic Flora of the Swiss Lakes.‡—Prof. R. Chodat gives some results of a comparison of the pelagic or plankton flora of the Swiss lakes, which varies with the elevation, the composition of the water, and other conditions. The flora of the Jurassic lakes presents many features in common, independently of their altitude. Among these is the great abundance, in most of them, of *Rhizolenia* (sic) *longiseta*, and in some of them of *Stephanodiscus Astræa*, and the great rarity of desmids. *Oocystis lacustris* is one of the most abundant organisms. Of the floating Cyanophyceæ (flos aquæ) *Anabæna flos-aquæ* is the most widely distributed. *Oscillatoria rubescens* was only rarely met with. Many of the lakes pre-

* Bot. Gazette, xxiv. (1897) pp. 73–92.
† Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 120–2.
‡ Arch. Sci. Phys. et Nat., iv. (1897) pp. 166–73.

sented characteristic features in the species of the plankton-flora peculiar to themselves.

Movements of Diatoms.*—Mr. W. M. Kozlowski reviews the various theories which have been proposed to account for the movements of diatoms, and sums up in favour of the efficient cause being assimilation. The chief ground of this conclusion is the dependence of the movements on the intensity, the colour, and the direction of the light. The author doubts whether the periodicity of the movements occurs in nature; it may be the result of the artificial disposition of the light in the Microscope.

Gallionella.†—Prof. W. Migula has had the opportunity of examining the structure and development of the rare organism *Gallionella ferruginea*, found occasionally in water containing iron. He rejects the conclusions previously drawn as to its systematic position, whether among the Diatomaceæ or the Confervaceæ, and assigns it a place in the Cyanophyceæ, between *Leptothrix* and *Spirulina*. It has two distinct forms. In one the threads are extremely fine, simple, yellowish, unsegmented, and irregularly coiled, about 1 μ in diameter; the other form has threads of about twice the thickness, which are distinctly segmented. These latter are seen, under a high magnification, to be arranged in a double coil. The author does not believe in any genetic connection with *Leptothrix ochracea*.

Resting-Spores in a Calothrix.‡—In a new species of *Calothrix* from the Sandwich Islands, *C. sandwicense* sp. n., Herr W. Schmidle finds resting-spores, resembling those described by Gomont in *C. stagnalis*. They occur in the cell immediately behind the basal heterocyst, one only in each cell.

β. Schizomycetes.

Myxobacteriaceæ.§—Mr. R. Thaxter dissents from Zukal's view ‖ that the Myxobacteriaceæ (Myxobotrysaceæ) are Mycetozoa, and also throws doubt on several points in that writer's account of the development of the organisms observed by him. Thaxter adheres to his former view that the Myxobacteriaceæ are Schizomycetes. Further details are given with regard to the germination of the spores and other points in the life-history of the group, and the following new species are described:—*Chondromyces apiculatus*, on antelope-dung; *C. gracilipes*, on rabbit-dung; *Myxococcus stipitatus*, on dung of sheep, pig, &c.; *M. cirrhosus*, on grouse-dung; *M. cruentus*, on cow-dung. The author's genus *Myxobacter* is sunk in Schroeter's earlier *Cystobacter*.

Evolution of Oxygen from Coloured Bacteria.¶—The experiments made by Dr. A. J. Ewart show that "a number of coloured bacteria possess the power, under appropriate conditions, of evolving oxygen in greater or less amount. In certain of these the oxygen evolved appears to be occluded oxygen absorbed from the air by the pigment-substance

* Bot. Gazette, xxiv. (1897) pp. 39–46.
† Ber. Deutsch. Bot. Gesell., xv. (1897) pp. 321–7 (1 pl.).
‡ Flora, lxxxiv. (1897) Ergänzbd., pp. 170–3 (3 figs.).
§ Bot. Gazette, xxiii. (1897) pp. 395-411 (2 pls.). Cf. this Journal, 1893, p. 370.
‖ Cf. this Journal, *ante*, p. 154.
¶ Journ. Linn. Soc. (Bot.), xxxiii. (1897) pp. 123–55.

excreted by the bacteria. The process is not a vital one. The substances contained in an alcoholic extract appear to have, though to a less extent, the same power of occluding oxygen, though this property is soon lost. The purple and green bacteria, in which the pigment forms an integral part of the bacterial plasma, show, when exposed to radiant energy, a very weak evolution of oxygen, continuing for an indefinite length of time if conditions are favourable. In the former of these the assimilating pigment is bacterio-purpurin, in the latter chlorophyll. The process is a vital one, and the oxygen evolved is apparently derived from the assimilation of carbon dioxide."

Ferrophilous Bacteria.*—Herr G. Marpmann describes an iron bacterium, which was isolated on silk-jelly. The rodlets, which are motionless and devoid of cilia, are from 2–3 μ long and 0·8–1 μ broad. The ends are rounded, and there are polar black chromatophores with intervening grey granules. Many of the cells are black throughout. The pigment, which is insoluble in alcohol, ether, bisulphide of carbon, and benzin, contains both sulphur and iron. When cultivated on pepton-gelatin, the colonies were colourless, and did not give the iron reaction. Hence the iron must have been selected from the medium and assimilated by the bacteria.

Root-Tubercle and other Bacteria in their Relation to Vegetable Tissue.†—The chief results of the experiments made by Herr O. Zinsser to determine more closely the relation of root-tubercle and other bacteria to living vegetable tissue, were that there is no hereditary infection of the seeds of Leguminosæ; for when cultivated under sterile conditions Leguminosæ are devoid of root-tubercle. The bacteria are not to be met with in the internal parts of the rootlets, nor in the portions of the plant above the earth; and even when artificially introduced they seem neither to wander very far from the inoculation site, nor to live very long. Other kinds of bacteria seem to behave in very much the same way towards healthy plants. The root-tubercle bacilli do not appear able to form nitrogenous compounds necessary for their existence, by assimilation of free nitrogen. Besides the mere presence of rhizobes, certain associated conditions are necessary for the development of root-tubercles.

Sensitiveness of Frogs to Infection with Plague.‡—Herr D. V. Devell states that frogs (*Rana temporaria*) are sensitive to the virus of plague, both in summer and in winter. They may be infected by the introduction of cultures, or bits of organs of animals affected with plague, into the lymph-sac. Spontaneous infection of frogs may occur if the skin be wounded. From infection with bacilli of constant virulence for white mice (death in 2–2½ days), frogs die of plague in from 13–19 days. After one passage through the frog, the plague bacilli kill frogs in 12–14 days, after a second passage in 7–8 days, and after a third in 5 days.

Antivenomous and Antitoxic Qualities of the Bile of Serpents and of other Animals.§—Prof. Fraser has shown that the bile of certain

* Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 124–7.
† Jahrb. f. wiss. Bot. (Pfeffer u. Strasburger), xxx. (1897) pp. 423–52.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 382–5.
§ Brit. Med. Journ., 1897, ii. p. 595.

animals possesses the property of rendering venoms and toxins inert. The experiments were made with diphtheria toxin and rabbit's bile, and with cobra venom and ox gall.

Rise and Fall of Bacteria in Cheddar Cheese.*—Mr. H. L. Russell and Mr. J. Weinzirl thus summarise the results of their analytical study of the bacterial changes that take place in the curing of American Cheddar cheese. There is at first a marked falling off in the number of bacteria in the green cheese for a day or so; this is followed by a rapid increase, the number of bacteria being scores of millions per gram. After this the numbers sink until they become insignificant. The maximum development is hastened or retarded by external conditions, such as temperature, moisture, &c.; and this period marks the beginning of the physical change that occurs in the cheese in the earlier part of the breaking down of the casein. Though the lactic acid bacteria predominate in milk, there are always liquefying or peptonising organisms, and as a rule bacteria capable of developing gaseous by-products. In ripening cheese the peptonising or casein-digesting bacteria are quickly eliminated; the gas-producing bacteria disappear more slowly; while the lactic acid bacteria develop enormously, until the cheese is partially ripened, when they too begin to diminish in numbers. The theory that the peptonising bacteria break down the casein in the cheese, as they do in milk, is regarded as improbable, and the view promoted is that the ripening of cheese is due to lactic acid bacteria, and this is supported by the fact that cheese made from pasteurised milk in which the lactic bacteria have been destroyed, fails to ripen in the usual way, while the addition of lactic acid starters permits the changes in the casein to occur in the normal manner.

Effect of Sunlight on the Virulence of Tubercle Bacilli.†—The results of the experiments made by Dr. Migneco are confirmatory of those of Koch, who found that not only direct but diffused sunlight was harmful to tubercle bacilli. The author used linen and wool rags smeared with tuberculous sputum, and exposed these to the action of the sun. Water in which the exposed rags had been washed was also used. The presence of tubercle bacilli was demonstrated by means of injections into guinea-pigs. The author found that sunlight exerted a harmful influence on the bacilli of tubercle; that the bacilli do not resist the sunlight longer than 24–30 hours, provided that the layer of sputum be not too thick ; and that the virulence of the bacteria gradually decreased after 10–15 hours.

New Type of Tuberculosis.‡—MM. Bataillon, Dubard, and Terre examined a tumour removed from the belly-wall of a carp. The tumour, which was about the size of a pigeon's egg, showed on histological examination numerous giant cells, at the periphery of which were arranged in a radial manner a considerable number of bacteria, and these, in shape and staining reaction, resembled the bacillus of tubercle. From *Bacillus tuberculosis* they differed in their other biological characters, the most

* Centralbl. Bakt. u. Par., 2[te] Abt., iii. (1897) pp. 456–67.

† Arch. f. Hygiene, xxv. p. 361. See Bot. Centralbl., 1897, Beih., p. 213.

‡ C.R. Soc. Biol., 1897, p. 446. See Centralbl. Bakt. u. Par., 1[te] Abt., xxii. (1897) p. 61.

important difference being that they developed at a lower temperature, the optimum lying between 23° and 25°. The bacillus is aerobic, and develops freely in bouillon, forming a copious sediment, the bouillon remaining clear. On potato it forms a whitish fragile layer having about the consistence of soap. Serum or agar cultures 9–10 days old showed dichotomously branching bacteria with pointed ends. These forms were obtained only with difficulty. Gelatin was not liquefied. The bacteria were motionless.

Products of the Tuberculosis Bacillus.*—Drs. E. A. de Schweinitz and M. Dorset have isolated from liquid cultures of the tubercle bacillus, a crystalline substance having a melting point of 161°–164°, readily soluble in water, ether, and alcohol, and separating from these solutions in needle-like or prismatic crystals with a slight yellow tint. They did not give the biuret reaction. The solution is acid in reaction and taste, and optically inactive. There is no precipitate with silver nitrate, platinum chloride, or barium hydrate. Analysis gave a formula closely corresponding to $C_7H_{10}O_4$, or teraconic acid, an unsaturated acid of the fatty series. The medium contained potassium acid phosphate, ammonium phosphate, asparagin, and glycerin. Injection of these crystals into the liver of guinea-pigs produced necrotic areas, and it is therefore probably the substance responsible for the coagulation necrosis so frequent in tuberculosis. It is also a temperature-reducing principle in healthy and diseased animals. The fever-producing substance of tuberculosis was extracted by means of hot water, the extract being found to contain an albuminoid which caused the tuberculin reaction in guinea-pigs and calves upon repeated injections. The authors infer that the reason why tuberculin does not react continuously is the joint presence of these two bodies.

Saprophytic Form of Human and Avian Tuberculosis.† — MM. Bataillon and Terre, who discovered a bacillus having close affinities with that of tuberculosis, inoculated intraperitoneally carps, lizards, and frogs with young cultures; positive results were obtained from these cold-blooded animals, while guinea-pigs and pigeons were found to be refractory. Thinking that this germ, originally derived from a tumour on the belly of a carp, might be an altered form of tuberculosis, the authors, in order to test this view, fed carps on the viscera of tuberculous guinea-pigs.

After eight or nine days bacilli were found swarming in the liver, and in eleven days bacilli were isolated from the frog which were morphologically and culturally identical with those previously described. But guinea-pigs injected with an emulsion of the carp's liver remained quite healthy. Human tubercle bacilli inoculated on frogs failed to develop; but from avian bacilli excellent results were obtained after a passage of 15 days.

The authors conclude that the form described is a saprophytic variety of tuberculosis, and one which can be reproduced by passing human or avian tuberculosis through cold-blooded animals.

* Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 209–21 (1 pl.).
† Comptes Rendus, cxxiv. (1897) pp. 1399–1400.

Congenital Tuberculosis in the Calf.*—Herr Lohoff examined a three weeks old calf, and found tuberculous deposits in the portal glands, liver, bronchial, and mediastinal glands, heart-muscle, and in the right kidney. Tubercle bacilli were easily demonstrated. The case is noteworthy, inasmuch as it shows that the virus was introduced through the blood circulation, and also that the lymphatic glands were infected secondarily.

Human Tuberculosis in the Pigeon.†—M. J. Auclair made experiments to ascertain whether the pigeon, like the domestic fowl, is refractory to human tuberculosis, in what organs the tubercle bacillus is localised, and how long approximately it retains its vitality in the body of the pigeon. Three pigeons were intraperitoneally inoculated with pure cultures of human tubercle. The birds died in from 1–3½ months without any indication of tuberculosis. In a second series pigeons were intraperitoneally infected with human tubercle, and killed at intervals of of 6, 7, and 14 days. Guinea-pigs were inoculated in the peritoneal sac with the blood, liver, and lungs of these birds. Some of the guinea-pigs died without any tuberculous phenomena, but two, which were infected from the lungs and liver, died of local tuberculosis; in one, the large omentum was studded with tuberculous glands, and in the second there was tuberculosis of the testicles. The author concludes that pigeons intraperitoneally infected with human tubercle die without tuberculous changes. The bacilli are chiefly located in the liver and lungs, never in the blood. Tubercle bacilli passed through the pigeon evoke in guinea-pigs a slowly developing local tuberculosis.

Differential Diagnosis of Leprosy and Tubercle Bacilli.‡—According to Herr Spiegel, a comparison between film preparations and sections of organs of cases of leprosy and tuberculosis reveals the following differences. The leprosy bacilli are always present in much greater numbers, and they are heaped up together in little bundles, while the tubercle bacilli are less frequent, are irregularly distributed, and rarely occur in bundles. The rodlet of lepra is straighter and plumper than that of the tubercle, which is curved and thin. The lepra bend is angular, and that of the tubercle bacillus is curved. The granules of leprosy are coarse, and lie far apart; those of tubercle are fine and lie close together.

Fattiness of Lepra and Tubercle Bacilli.§—According to Unna, not only lepra, but also tubercle bacilli, contain a considerable quantity of fat, and this was determined in the following way:—Fresh glycerin-agar cultures of tubercle bacilli were immersed for a whole night in Flemming's solution, and when washed with water, the black bacillary overlay showed up on a white ground. On blood-serum the cultures did not show up so well, owing to the brownish background. If a culture be kept in cold ether or alcohol for 24 hours, it becomes almost as black as a fresh

* Zeitschr. f. Fleisch- und Milch-Hygiene, 1897, p. 163. See Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) p. 883.

† Arch. Méd. Exp. et Anat. Pathol., ix. (1897) p. 277. See Centralbl. Bakt. u. Par.. 1te Abt., xxii. (1897) pp. 16–7.

‡ Monatshefte f. Prakt. Dermatol., xxiii. (1896) p. 221. See Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 817–8.

§ Deutsche Medizinal-Zeitung, 1896, Nos. 99 and 100. See Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 938–9.

culture, showing that the fat in the tubercle bacillus cannot be entirely extracted by ether or alcohol. But if the culture, before being treated with osmic acid, is boiled in alcohol, ether, or a mixture of the two, then the culture thus treated is not black but brownish-yellow or clay-coloured. As the brownish hue is very much alike for all the extraction media, it is probably due to staining of the protoplasm, and not to un-extracted fatty residua.

Barbone Disease of Cattle and Pigs.*—Dr. F. Sanfelice, Dr. L. Loi, and Dr. V. E. Malato have discovered that the barbone disease exists in Sardinia, where cattle and pigs are affected. The disease belongs to the class of hæmorrhagic septicæmias, and was first described by Oreste and Armanni in 1886. Italian buffaloes are very liable to this disorder, which is caused by a specific micro-organism readily to be found in the inflammatory exudation in the neck and in the nasal mucus. In form and staining reaction it resembles *Bacillus choleræ gallinarum*, but is distinguishable therefrom in that it is invariably pathogenic to guinea-pigs, while the fowl-cholera microbe is only occasionally fatal. It also has certain features in common with the bacillus of the septicæmia of cattle and with *Bacillus suis septicus*.

Pseudomonas campestris (Pammel).†—Dr. E. F. Smith gives a convenient summary of his account of *Pseudomonas campestris*, a micro-organism described by Prof. L. H. Pammel in a paper entitled 'Bacteriosis of Rutabaga (*Bacillus campestris*, sp. n.).' *Pseudomonas campestris* is a yellow rod-shaped motile micro-organism, varying in size and colour according to substratum, food-supply, &c. Generally it measures $0 \cdot 7 – 3 \cdot 0\ \mu$ by $0 \cdot 4 – 0 \cdot 5\ \mu$. In colour it varies from dull wax-yellow to canary-yellow, though occasionally it is as bright as light cadmium or as pale as primrose-yellow. It has one polar flagellum, and, as far as is known, does not form spores. It is pathogenic to various cruciferous plants, entering and dwarfing or destroying the host plant through the vascular system, which becomes decidedly brown. It is aerobic, but does not produce gas or acid. It forms cavities around the bundles, but seems to be only feebly destructive to cellulose. It produces a brown pigment in the host plants and on steamed cruciferous substrata, especially the turnip. It grows very rapidly on steamed potato at room temperature, but without odour or the formation of pigment. It liquefies gelatin. It grows feebly at from 7–10°, luxuriantly at from 21–26°, feebly at 37–38°, and not at all at 40°. It is killed by ten minutes' exposure to 51°.

Report of the German Commission on the Foot and Mouth Disease.‡—Prof. Loeffler and Prof. Frosch, who formed the commission for the investigation of the foot and mouth disease, have issued a summary of their report. They find that the disease is not bacterial in origin, for bacteria-free lymph is able to produce the typical disease. In such lymph certain morphotic elements are present; though whether these are protozoic or not it would be at present premature to declare definitely. Cattle and pigs are specially sensitive to experimental infection. The most effectual method of infection is to inject some of

* Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 33–42.
† Op. cit., 2te Abt., iii. (1897) pp. 284–91, 408–15, 478–86 (1 pl.).
‡ Op. cit., 1te Abt., xxii. (1897) pp. 257–9.

the lymph taken from the vesicles into the blood circulation, while the least certain are subcutaneous and cutaneous inoculations. Intravenous injections give rise to febrile phenomena, vesicles in the mouth, on the udder, and on the hoof. When the vesicles appear the virus vanishes from the blood. For infection 0·0002 ccm. of fresh lymph suffices. The lymph virus is easily destroyed by heat, but can be kept in a refrigerator for fourteen days or longer. In the blood of immune animals, substances are present which appear to neutralise the effect of lymph. Cattle and pigs can be artificially immunised, either by means of lymph which has been heated, or by the injection of lymph-immune blood-mixture. Hence it would appear that the foot and mouth disease can be successfully treated by protective inoculation.

Gonotoxin.*—Dr. J. de Christmas has obtained positive results in his experiments with the toxin of *Gonococcus*. Subcutaneous injection of cultures into rabbits produced abscesses, apparently the result of secondary infection due to the lessened resistance of the tissues to the action of the toxin. Besides the local reaction, a general effect, marked by emaciation and anæmia, is produced. Intravenous injection induces febrile phenomena and emaciation, and if the quantity injected is large, death in a short time from collapse. Thus the general results of infection of gonotoxin in cultures are intoxication and cachexia, and the local are suppurative. The toxin isolated from liquid cultures by filtration, when injected into veins, produced quite similar results. Heating the culture was not found to impair the toxic effect, provided the coagulation point of the albumen dissolved in the liquid was not exceeded. Gonotoxin is precipitated from cultures by alcohol and a strong and stable solution by means of glycerin. The culture was evaporated in a water-bath at 50° with 10 p.c. of glycerin. Though the toxin does not produce appreciable coarse lesions when introduced into the blood circulation, marked effects follow from injection into serous sacs and into the anterior chamber of the eye of animals. No results were obtained from inoculation of the mucosal surfaces of the eye and the genito-urinary tract of animals, but a typical blenorrhagia was easily excited in the human urethra. At first the discharge contains numbers of the epithelial cells lining the urethra, but afterwards the discharge is principally composed of leucocytes. Attempts to obtain antitoxic serum from the blood of immunised goats and rabbits were, though difficult in the attainment, attended by some measure of success, though it is admitted that the antitoxic power of the serum was not strong.

Bacillus denitrificans agilis and Denitrification.†—Sig. G. Ampola and Sig. E. Garino have found that *Bacillus denitrificans agilis* exists normally in turf, but is unable to exert its influence as long as the reaction of the medium or the manure is acid. When the acidity is diminished or abolished, the organism becomes capable of exercising its normal biological functions.

Ætiology of Foot and Mouth Disease.‡—Prof. V. Babes and Dr. G. Proca, in a preliminary paper, relate their experiments and observations

* Ann. Inst. Pasteur, xi. (1897) pp. 609–39.
† Centralbl. Bakt. u. Par., 2te Abt., iii. (1897) pp. 309–10.
‡ Op. cit., 1te Abt., xxi. (1897) pp. 835–49 (6 figs.).

as to the ætiology of the foot and mouth disease. Two organisms living in close symbiosis are described. The one is a fluorescing bacillus, much resembling *Bacillus pyocyaneus*; the other is a higher fungus, possibly an Ascomycete, which showed itself to be highly polymorphic. Inoculation with small quantities of potato culture produced an eruption of vesicles, while the injection of a large quantity ended in hæmorrhagic septicæmia.

Bacteriology of Pertussis.*—Dr. H. Koplik has isolated from the sputum of hooping cough a bacillus apparently identical with that described by Afanassjew. It is motile, from $0 \cdot 8 - 1 \cdot 7\ \mu$ long, and $0 \cdot 3 - 0 \cdot 4\ \mu$ broad. When stained it has a finely dotted appearance. Old agar and hydrocele cultures show bacilli with club-shaped extremities. Though pathogenic to animals, no specific effects were observed after injection of pure culture, the animals dying of septicæmia without having exhibited any convulsive movements or lung symptoms.

The most favourable cultivation medium was hydrocele fluid. The microbe was frequent in the pellets fished out of the sputum, and grew both aerobically and anaerobically. The growth is white, and gelatin is not liquefied.

Ætiology of Beri-Beri.†—Dr. M. Glogner states that in the blood from the spleen of persons suffering from Beri-Beri he has observed, in about 65 per cent. of the cases examined, roundish motile intraglobular bodies which contain pigment-granules, and vary in size from that of 1/12 to 1/6 of a red corpuscle. The pigment is brownish-red to black, and is distributed peripherally or centrally; if the former there is no movement, but in the latter case the granules are very lively. The organism appears to divide in a manner analogous to that of the malaria parasite.

Ætiology of Yellow Fever.‡—Dr. J. Sanarelli, in a second memoir on yellow fever, presents some of the results obtained by injecting into animals some of the toxin of the *Bacillus icteroides*. The principal features of experimental amarillous intoxication are hæmolysis combined with fatty degeneration and inflammation of certain viscera, especially the liver and kidneys. Invasion of the body by the *Bacillus icteroides* not infrequently allows a secondary invasion by some other organism, the presence of which complicates the disorder and masks the presence of the primary poison. The organism is probably disseminated by the atmosphere, and its destruction is not infrequently prevented through the protection afforded by symbiosis with certain moulds.

Toxicity of Gonococcus.§—Herr L. Nicolaysen, who has been experimenting with *Gonococcus* and its toxin, states that the injection of pure culture into the knee-joint of rabbits excites a suppurative arthritis. When introduced into the peritoneal sac of mice, the animals die without the production of any local affection. The effect is the same whether living or dead cultures are used. The pathogenic effect does not depend on the multiplication of the cocci, but is due to the toxin contained in the bacterial bodies; soluble toxin is not formed in the cultures. The toxin

* Brit. Med. Journ., 1897, ii. pp. 1051–3.

† Arch. f. Schiffs- u. Tropenhyg., i. Nos. 1 and 2. See Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 410–2.

‡ Ann. Inst. Pasteur, xi. (1897) pp. 673–98 (3 pls.).

§ Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 305–9.

contained in the bacterial bodies is not destroyed by drying or by heating to 120°, and it is not extracted by means of a soda solution or of distilled water.

Dissemination of Plague Bacilli by Insects.*—The experiments made by Dr. G. H. F. Nuttall for the purpose of ascertaining if the plague were spread by insects, tend to show that flies die from feeding on plague-infected organs. But as they live sufficiently long in an infected condition, it seems highly probable that they may have some share in disseminating the disease, chiefly by contaminating food with their bodies or their evacuations. It appears that plague bacilli gradually die off within the bodies of bugs, and consequently bites of these insects are but little dangerous. Reference is afterwards made to the degrees of sensitiveness of different animals to the plague, as it occurs under natural conditions, and when artificially imparted.

Streptococcus of Enteritis.—Dr. J. L. Hirsh † isolated from the mucopurulent portions of the stools of an infant suffering from gastro-enteritis a *Streptococcus* which stains by Gram's method, and in bouillon cultures appears mostly in pairs. The only satisfactory medium was sugar-bouillon, all other nutrient subtrata being failures. The organism, which was also found in the blood and urine, gave positive results with white mice, but not with other animals.

Mr. E. Libman ‡ mentions two cases of gastro-enteritis from the dejecta of which he obtained a *Streptococcus* apparently identical with that described by Hirsh. But cultures were obtained on gelatin, potato-agar, and blood-serum; and the fact that it grows well only on the last medium seems to indicate that it is a true blood-parasite.

Streptococcus capsulatus.§—Dr. R. Binaghi describes a new capsule coccus which is pathogenic to guinea-pigs, giving rise in these animals to a chronic bronchopneumonia and multiple abscesses. In the pus of these abscesses the coccus was found in chains and in pairs. It stained with Gram's method. It was cultivable in bouillon and on agar, but not in other media. On agar and in bouillon it formed chains of 4–6 individuals. After repeated cultivation it died off.

Story of Germ Life.‖—Though a popular work, the Story of Germ Life as told by Prof. H. W. Conn is so admirable for its lucidity, terseness, and the author's grasp of the subject, that it may be recommended to anyone who is desirous of becoming acquainted with the general features of bacterial life and the baneful and beneficent results of microbic growth and development. The story of germ life is told in six chapters wherein, after dealing with their morphology, the uses of bacteria in the arts and industries, their importance for dairying and agriculture, and their relation to disease are described. Not the least interesting and important part of the work is that which touches on immunity, antitoxins, and preventive medicine.

* Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 87–97.
† Tom. cit., pp. 369–76 (2 pls.). ‡ Tom. cit., pp. 376–82.
§ Tom. cit., pp. 273–9 (1 pl.).
‖ London (George Newnes Limited), 1897, 212 pp. and 34 figs.

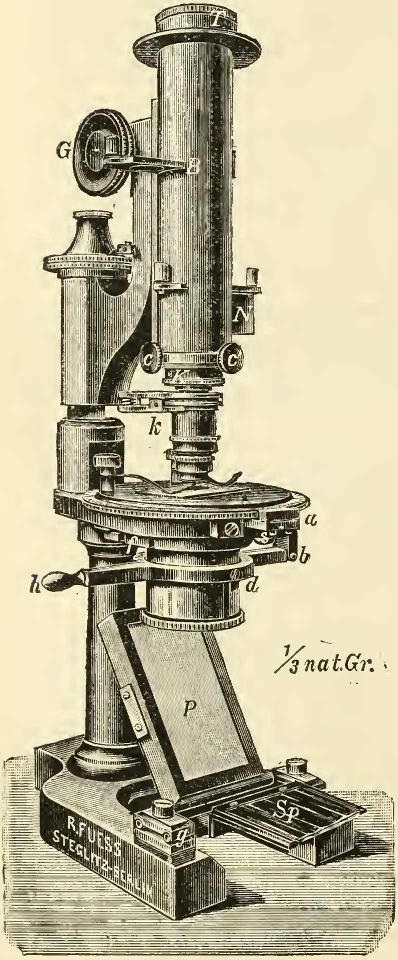
MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

New Stand, with Polariser and Large Illuminator.†—Herr C. Leiss points out that, owing to the scarcity, and the consequently high price, of Iceland spar, it is important to be able to replace the polarising Nicol prism by some other arrangement; since for convergent light it is necessary to have a Nicol with an opening large enough to correspond with that of the condensing system. It is common to see Microscopes in which the opening of the polariser is scarcely a third of that of the condenser.

Fig. 44.



In the present stand (fig. 44), made by Fuess, the polariser consists of a bundle of thin glass plates P, as in the ordinary Nörremberg polariscope. The frame holding the plates can, with the mirror *Sp*, be moved about the axis *g*, and a mark indicates the proper polarising angle. The analyser is an ordinary small Nicol N. For ordinary light a mirror may be placed above the glass plates P.

The illuminator is an Abbe's triple condenser of N.A. 1·40; it can be lowered by the lever *h*, and turned out of position about the hinge *b*, thus affording an easy change from convergent to parallel light. The front lens of the condenser has a diameter of 11–12 mm., and the lower lens one of 30 mm., those of the ordinary Fuess Microscopes being 6 mm. and 18 mm. respectively. This increase in the size of the condenser is to compensate for the loss of light by the glass plates P, and also to enable thick sections to be examined in convergent polarised light. The tube of

* 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. angew. Mikr., iii. (1897) pp. 138–41 (1 fig.).

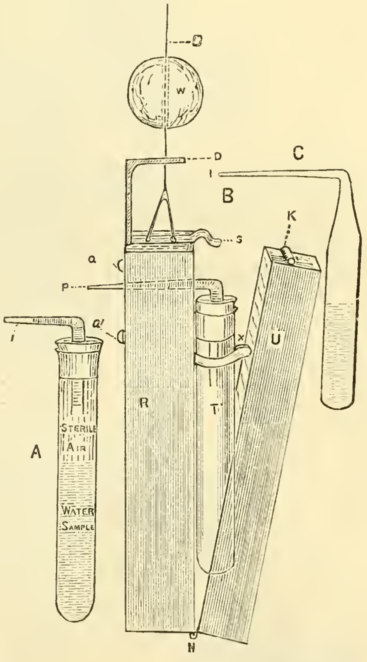
the new stand is arranged for oculars of large field. The following table gives the diameters in millimetres of the objective field with the various oculars and objectives, from which it may be seen that the second ocular almost doubles the field of view.

Objective, No.	0	1	2	3	4	5	6	7	8	9
Ordinary ocular, No. 2	3·8	3·45	2·25	1·6	1·35	0·9	0·7	0·46	0·33	0·28
Ocular No. 2 with increased field	6·0	5·5	3·31	2·5	2·0	1·5	1·15	0·7	0·55	0·4

The graduated rotating stage reads with a vernier to 5′.

Stand for the Examination of Large Sections.*—Herr E. Nebelthau describes an arrangement for facilitating the systematic examination of large sections under the Microscope. Large medical preparations can often not be conveniently handled on the ordinary stage. The stage is bridged over by a plate, on which, by means of a screw, the Microscope-tube may be moved from left to right. The stage itself may be moved backwards and forwards by a screw under the bridge. By means of these two rectangular motions, any portion of the preparation may be brought into view, and orientated by scales on the upper plate and stage. The stage and bridge are supported on a frame in which are openings for the adjustment of the mirror.

FIG. 45.



(3) Illuminating and other Apparatus.

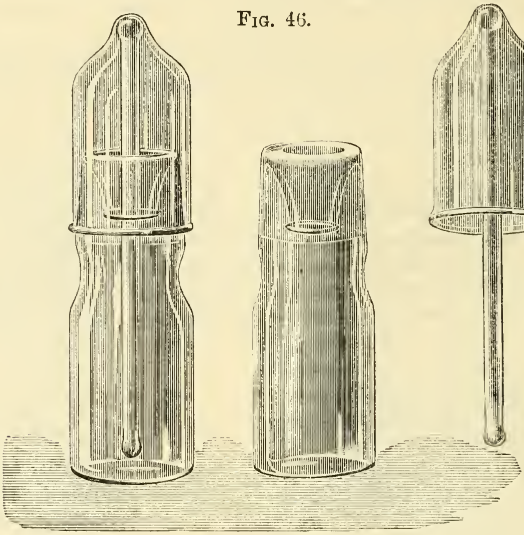
Apparatus for Bacteriological Sampling of Well Waters.†—The apparatus devised by Prof. H. L. Bolley is best explained by the accompanying sketch, and is made, except the glass and rubber parts, of brass. The body-piece R is 9 in. long by 1½ in. square. To one side of R is fitted the box U, attached by the hinge *r*, and so arranged as to close in the collecting tube T when ready for lowering into the water. The block is perforated so as to allow the passage of the tube *p* directly through the centre of the body-piece. The tube also passes through a slot in the bar

* Zeitschr. f. Instrumentk., xvii. (1897) pp. 252–3. See Zeitschr. f. wiss. Mikr., xiii. (1896) p. 417.

† Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 288–90 (1 fig.).

d, which in itself moves vertically on the body by means of two slots fitted to the screwheads *q* and *q'*. When the weight W falls, it is guided by the copper wire *o*, upon which the apparatus is lowered, and falls

Fig. 46.

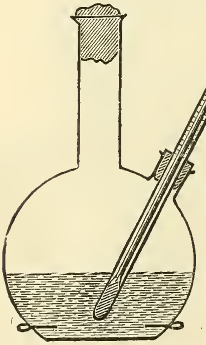


upon the bar *d*, breaking the tube *p* square across. The other parts are —*s*, a steel spring clip, and *k*, the knob which fastens R and U together.

A, fig. 45, shows the collecting tube after the water sample is properly taken; and C, another form of sampling tube. The total weight of the apparatus is about six pounds, and it is thus self-sinking.

A complete vacuum should not be made in the tube, because it is not desirable that the latter should be entirely filled with water. There is always water enough left in the small tube (A) to shut off the external air.

Fig. 47.



Bottle for Immersion-Oil and for Canada Balsam.*—Herr A. Meyer has invented a glass dropping-bottle which appears to be very suitable for immersion-oil and for Canada balsam. Its construction and appearance will be easily understood from the above illustration (fig. 46), from which may also gathered that it is dust-proof, and that if upset, the contents will not run out.

Flask for Bacteria and High Tension.—Mr. F. J. Reid sends the accompanying sketch (fig. 47) of a flask which he has found most useful with bacteria and high tension currents. Its advantage consists in its having the short neck at the side, into which a thermometer can be

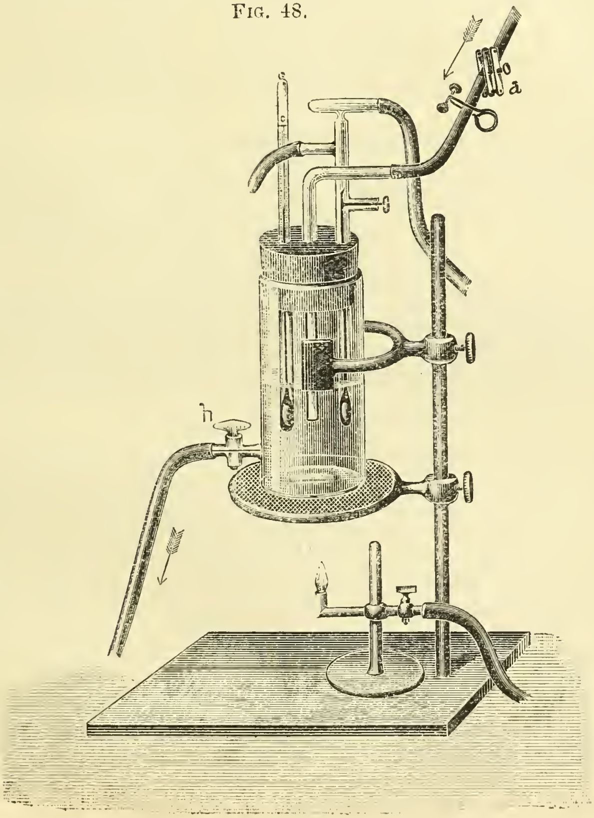
* Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 174–5 (3 figs.).

inserted. With this flask there is no danger of injury to the bacteria by heating the culture through overcharge of current; any rise of temperature is indicated by the current being cut off when this becomes excessive.

Compressorium.*—Prof. H. E. Ziegler describes his circular form of compressorium, through which a current of fresh water is made to flow, and which has already been figured in this Journal. He also describes a rectangular form constructed on the same principle, but large enough for the examination of relatively large objects, e.g. frog-larvæ and small fishes.

Heating Arrangement for Compressorium.†—Dr. R. Kantorowicz describes an arrangement for warming to a definite temperature the

FIG. 48.



water which is to be passed through Ziegler's compressorium.‡ The vessel shown in the figure (fig. 48) contains a quarter of a litre; into it

* Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 145–53 (4 figs.). Cf. this Journal, p. 759; 1895, p. 367.

† Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 154–7 (2 figs.).

‡ Cf. this Journal, 1894, p. 759; 1895, p. 367; and preceding abstract.

water flows by the tube *a* as quickly as it flows out through *h* to the compressorium. As the water does not remain long in the heating apparatus, it is not deprived of much of its dissolved air. A thermometer and thermostat also dip into the vessel.

Another form of apparatus suggested by Prof. Ziegler consists of a long glass worm contained in the heating apparatus. As the water passing through this worm does not acquire the same temperature as the bath, its temperature is taken before it enters the compressorium.

New Knife-holder for Microtomes.* — Prof. S. Apáthy gives the following requirements for a perfect knife-holder for a sliding microtome:—(1) It must hold the knife quite firmly; (2) the knife-edge may be set at any desired angle in the plane of motion; (3) the knife-edge to be parallel to the plane of motion; (4) the blade of the knife may be inclined at 0°–20°; (5) the knife may be taken out of the holder and replaced again in exactly the same position. A holder satisfying these conditions—especially (2) and (4)—is described in detail. The inclination of the knife to the plane of motion is effected by means of wedges.

Cheap Condensing Lens.† — Instructions are given for making a cheap mount for a bull's-eye condenser. A spectacle maker's cataract lens is fixed by sealing wax in a loop made from a strip of metal; this is attached by a wire passing through a cork to a vertical wire on a wooden base.

(4) Photomicrography.

Simple Apparatus for Photomicrography.‡—Mr. M. J. Golden describes a simple wooden base, consisting of a long board, to which are attached a shelf to hold the Microscope, and a sliding piece with a pair of brackets to carry the camera. A heavy cloth funnel connects the Microscope and camera.

(6) Miscellaneous.

Diamond for Cutting Glass Discs.§ — Dr. C. J. Cori describes a simple and cheap apparatus for cutting glass discs of various sizes, which are always of use in laboratories. It is constructed on the principle of the beam-compasses. The fixed centre consists of a wooden cylinder of 2 cm. diameter, held to the glass by wax; about this rotates the horizontal prismatic beam, which carries a block holding the diamond. Annuli of glass may be cut with the apparatus.

B. Technique.‖

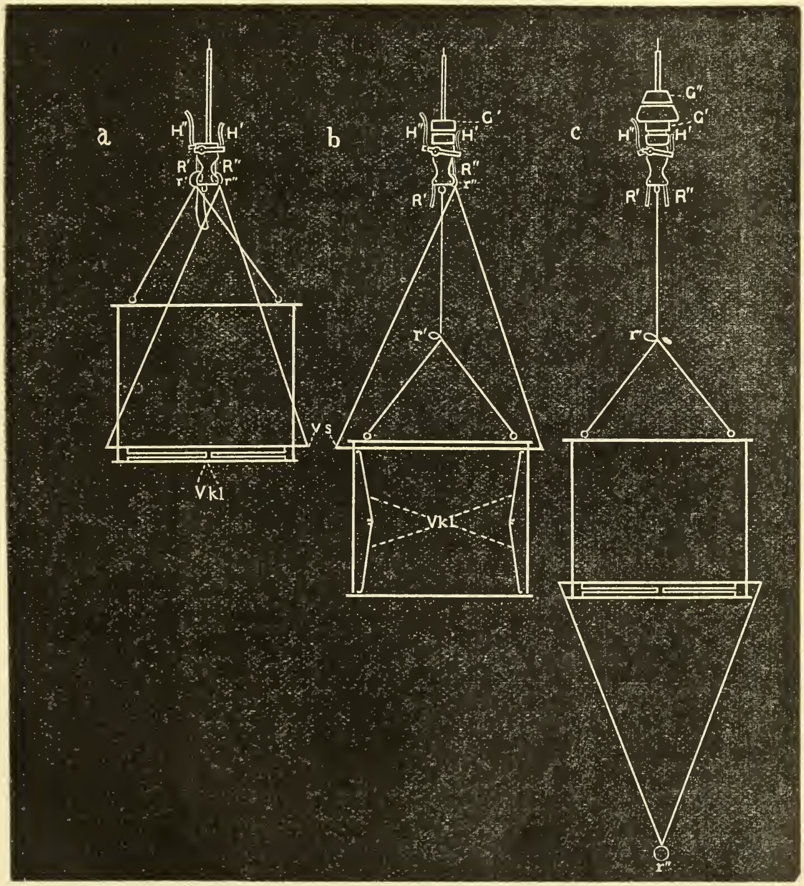
(1) Collecting Objects, including Culture Processes.

Closing Fishing Net.¶—Dr. C. J. Cori describes a form of net which may be opened at any depth, and, after being trawled for any required time, closed again, thus enabling the organisms from any depth to be

* Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 157–74 (9 figs.).
† The Microscope (Washington), v. (1897) pp. 109–11 (1 fig.).
‡ Tom. cit., pp. 103–4.
§ Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 175–7 (1 fig.).
‖ This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous. ¶ Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 178–84 (3 figs.).

collected. Fig. 49 *a* shows the mouth of the net closed. By letting fall the weight G′, the lever H′ releases the bolt R′, which in turn releases the ring *r*′, and so opens the mouth of the net as shown in fig. *b*. The mouth of the net, which has a width of 30 cm., is made of hinged metal bars V*kl*, contained in the sliding frame V*s*. To close the net again, the larger weight G″ is let fall; this, through the lever H″ and bolt R″, releases the ring *r*″, when the portion V*s* of the sliding

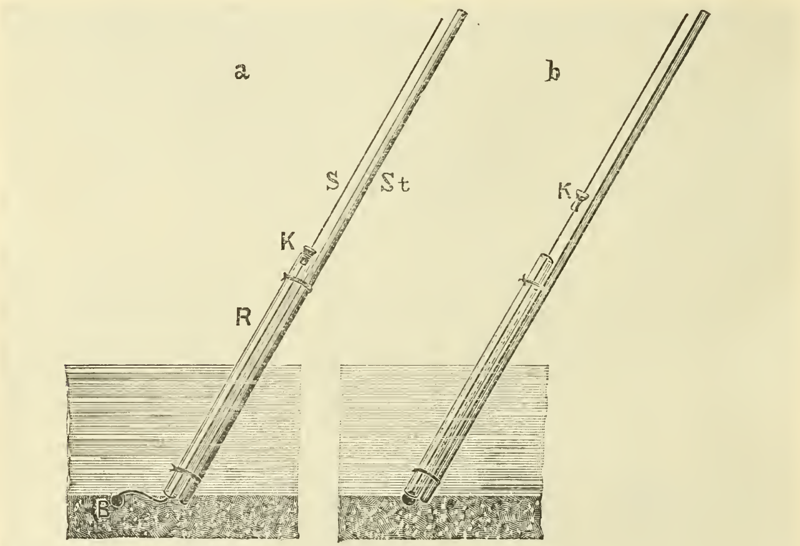
Fig. 49.



frame falls down. The weights G′ and G″ are made in two parts, so that they can be put on the cable and then bound together by wire round the grooves shown in the figure. The author has used this net in the Traun Lake in Upper Austria, and finds that the plankton is not evenly distributed in depth, but shows a distinct zoning, the depth of which varies with the time of year and day. The apparatus could be slightly modified for deep sea purposes.

Mud Collector.*—Dr. C. J. Cori describes an apparatus for collecting the fauna from the surface of mud at the bottom of ponds. The glass rod R (fig. 50) is fixed to a bamboo rod, and is provided with a tightly fitting cork K, and an indiarubber ball B. On pulling the cork out by the string S, the escape of air causes the water to rush into the tube; on further pulling the string, the mouth of the tube is closed by

Fig. 50.



the ball B. A form with a metal, in place of a glass, tube is figured. A further modification, suggested by Prof. Hatschek, for use with a cable in deep water, is described. A greater lowering of the line than shown in fig. 51 *a*, causes the projection Z on the tube to become disengaged from the weighted hook H, as seen in fig. *b*. When the line is pulled, the cork is withdrawn from the tube, and a further pull causes the tube to be closed again by the india-rubber ball, as in fig. *c*.

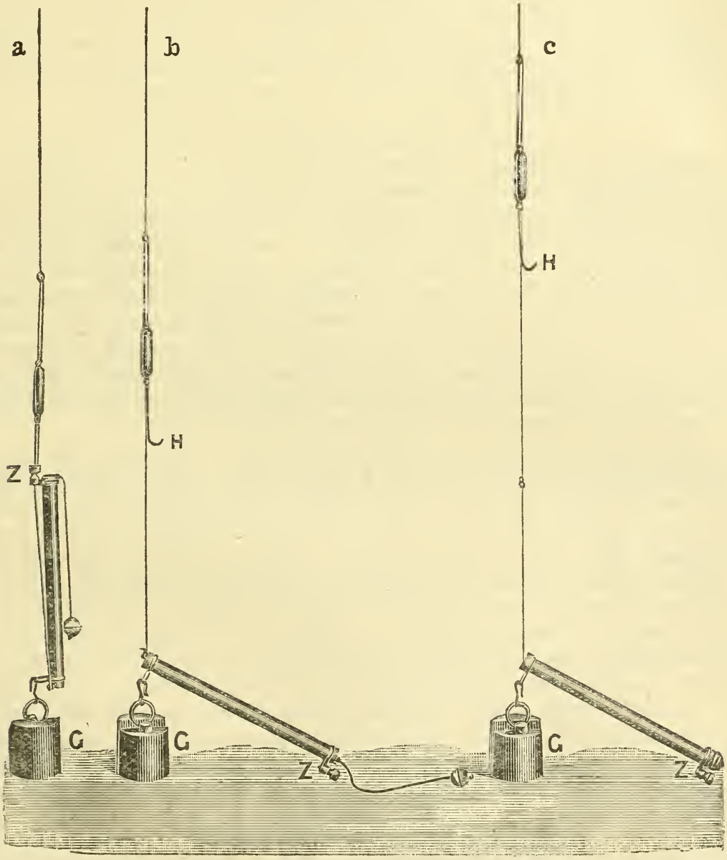
Cultivation of Amœba.†—According to Prof. P. Frosch, living bacteria are necessary for the proper growth and sustenance of Amœbæ, though certain media are more suitable than others. The one preferred is composed of 0·5 grm. agar, 90 grm. tap water, and 10 grm. alkaline bouillon. Upon this, luxuriant cultures of an Amœba derived from garden earth were constantly obtained. In these bacteria were always demonstrable, and the author's view is that successful cultivation of Amœba depends almost entirely on the bacteria supplied.

Silk-Glue as a Medium for the Cultivation of Bacteria.‡—In raw silk there exists a peculiar adhesive substance which imparts to the

* Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 184–9 (3 figs.).
† Centralbl. Bakt. u. Par., 1te Abt., xxi. (1897) pp. 926–32.
‡ Op. cit., xxii. (1897) pp. 122–4.

silk filament its firm hard character and grey colour. This "lime" is soluble in boiling water, and when cold sets to a greyish jelly, forming, according to Herr G. Marpmann, a good cultivation medium for many bacteria. Not only do air and water bacteria grow well on the silk glue, but mould fungi, and the peptonising organisms also, though the medium is but little liquefied by the latter. Owing to the fact that silk glue contains sulphur, it forms a suitable medium for the cultivation of thiophilous bacteria. The addition of salt, sugar, or pepton to the medium is not necessary.

Fig. 51.



Growth of Diphtheria Bacilli on different Media.*—Dr. G. Michel records the results of an elaborate series of experiments made for the purpose of comparing the growth of diphtheria bacilli on the following media:—Glycerin-agar, Loeffler's bullock-serum, normal bullock-serum, Loeffler's horse-serum, and normal horse-serum. Of these, Loeffler's

* Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 259–73 (5 figs.).

horse-serum proved to be the best, the second place being taken by glycerin-agar; for out of 200 cases examined, the former gave positive results in 137 instances, the latter in 122. The aspect of the growth in the five media inoculated from the same case is well shown in photographs. From these it would seem that the glycerin-agar was the best medium, though the Loeffler horse-serum runs it close.

The Loeffler's serum consists of 3 parts serum and 1 part bouillon, with 1 per cent. pepton, 0·5 per cent. salt, and 1 per cent. grape-sugar.

Egg-yolk Agar for Cultivating Gonococcus.*—Herr Steinschneider makes a nutrient medium for cultivating *Gonococcus* in the following way. An egg yolk is beaten up with thrice its bulk of sterile water. Twenty grm. of this are mixed with 10 grm. of 20 per cent. solution of biphosphate of soda and 90 grm. of 2·5–3 per cent. agar, and the mixture, having been poured into tubes, is allowed to set. On this the coccus can be cultivated directly from the purulent secretion.

(2) Preparing Objects.

Method of Preparing Anatomical Specimens.†—Dr. N. Melnikoff-Raswédenkoff places the specimens directly they are removed from the body in a solution composed of 10 formol in 100 water for 24–48 hours. Then are added 5 to 10 parts (per 100 of fluid) of sulphuretted hydrogen, or 0·5–1 part of peroxide of hydrogen. The preparation is afterwards immersed for 3 or 4 days in 60–80 per cent. of alcohol, and finally in a mixture of 20 parts glycerin, 15 acetate of potash, and 100 parts of water. To the first fixative fluid the author adds various substances, which exert some influence on the fixation of certain tissues, such as hydroxylamin, hydrochinon, pyrocatechin, and certain acetates, e.g. those of aluminium, copper, calcium, barium, and magnesium.

Preparation and Use of Klein's Fluid for Separating Minerals and Diatoms.‡—Of the solutions of high specific gravity, Klein's fluid is to be preferred, says Herr Marpmann, as its sp. gr. is 3·6, and it is not poisonous, while Thoulet's fluid and Rossbach's solution are extremely poisonous and of less specific gravity. Klein's fluid consists of boro-tungstate of cadmium, and is prepared by dissolving 1 part of tungstate of soda in 5 parts of water, adding 1·5 parts of boracic acid, and boiling until crystals of borax precipitate. The lye is inspissated until glass fragments will lie on the surface, and then 0·3 parts of a solution of barium chloride added, after which it is acidified with hydrochloric acid. In this way boro-tungstate of barium is formed, the salt separating out in tetragonal crystals, which are purified by repeated re-crystallisation. By mixing boiling solutions of the barium salt and of cadmium sulphate, cadmium boro-tungstate is obtained. This is soluble in 0·1 per cent. of water, the fluid having a specific gravity of 3·28 at 15° C. By evaporation and re-crystallisation the specific gravity is raised to 3·6 at 75°, and the salt can only be used when warm. The vessels suitable for separation of the various constituents are, a glass funnel, capable of holding 100 ccm., and having a stopcock at the lower end of the stem,

* Berlin. Klin. Wochenschr., 1897, No. 18. See Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 104–5.

† Comptes Rendus, cxxiv. (1897) p. 238. See Zeitschr. f. angew. Mikr., iii. (1897) p. 115.

‡ Zeitschr. f. angew. Mikr., iii. (1897) pp. 150–2.

or a flask of similar capacity, with a long narrow neck, which is marked off in divisions of 0·1 ccm. The powdered material and the hot solution are placed together in one of these vessels and then water added drop by drop, the vessel being carefully shaken after each drop. In this way the fluid is very slowly diluted, and the specific gravity lowered so gradually that it is possible to separate substances from one another the specific weight of which differs by 0·01 p.c., or less. As soon as the density corresponding to that of the mineral or of the organisms is reached, the particles sink slowly to the bottom of the neck of the funnel. When the supernatant fluid is perfectly clear, the tap is turned, and the sediment allowed to flow very slowly into watch-glasses. This takes from 12–24 hours, and as the fluid has cooled, more water must be added, and fresh sediments removed as they form. As diatoms consist of the same chemical substance, silicic acid, with but slight admixture of other chemical compounds, as soon as the density of silicic acid is reached, all siliceous bodies are deposited, and it might be supposed that all the diatoms will come down together. This, however, is only theoretically the case; for, as a matter of fact, the larger diatoms are deposited sooner than the smaller sorts; so that an expert manipulator has it in his power to collect the different kinds by themselves, and unmixed with other varieties. The material collected is washed with water, and further purified by sedimentation. The Klein's fluid which has been used is separated by the addition of some cadmium and by evaporation, and may be used over and over again.

Modification of Golgi's Method.*—The energetic action of aldehyds on silver salts suggested to Dr. F. Kopsch a favourable modification of Golgi's method. The fixative employed is a mixture of 40 ccm. of a 3·5 per cent. solution of potassium bichromate and 10 ccm. of formalin. After 24 hours' immersion in this fluid, the objects are removed to pure bichromate solution, and in 2–3 days transferred to 0·75 per cent. nitrate of silver solution for 3 to 6 days. Nervous tissue stains well without suffering from precipitates.

Schaper's Reconstruction Method.†—The main difference between Dr. A. Schaper's method and that of Born is that the base line of the sections is not at a distance from the section of the object, but is on the edge of the section itself. The embryo is first saturated with paraffin to prevent its drying and shrinking afterwards. It is then taken from the bath and fixed to a piece of Bristol board, after which it is sketched or photographed. It is then transferred to the bath, and a line drawn on the sketch or photo just touching the head, thus including the figure in a right angle. A similar angle is drawn on a piece of cardboard that fits into the imbedding-box. The latter is filled with melted paraffin and the embryo oriented so as to correspond with the position of the figure in the sketch. After hardening, the mass is sectioned. In sectioning, the plane of the section must be perpendicular to the median plane of the embryo. The sections should be 20 μ thick. Sketches of the magnified sections are made on paper and transferred to wax sheets; but before doing so a pencil-point is made on the dorsal side of the sketch

* Anat. Anzeig., xi. (1896) pp. 727–9.

† Zeitschr. f. wiss. Mikr., xiii. (1896) pp. 446–59 (10 figs.). See also Amer. Natural., xxxi. (1897) pp. 746–8 (2 figs.).

in the median plane, and sometimes also one in the same plane on the outline of the surface of some central organ.

The photo or sketch is then enlarged on a sheet of Bristol board, to correspond with the magnification of the sections and the enlarged figure. If only an enlarged model of the entire embryo is desired, it is merely necessary to arrange the wax sections within the Bristol board outline, and then smooth off the outer surface with a warm modelling tool. If, however, it be desired to reconstruct an internal organ, the process is more complicated, for then the second guiding-point (that on the surface of some central organ) is necessary. "In cutting out of the wax plates the outlines of the sections of the organ to be reconstructed, this point, along with that on the dorsal surface, is cut out so as each to form a point of the piece of wax that remains connected with the sections of the organs by bridges of wax." When the series of wax sections has been cut out, they are arranged in their proper places on the Bristol board, care being taken that the two guide-points fall within the plane of the Bristol board, and that the line passing through them is perpendicular to the dorsal line. When all are in place, all that remains is to smooth off the outer surface of the model.

Method of preparing Rotifers.*—M. N. de Zograf has used a modification of Rousselet's earlier method for narcotising Rotifers with cocain, and staining with osmic acid. The animals are first treated with an aqueous solution of hydrochlorate of cocain, which is added drop by drop to the specimen fluid. The methyl-alcohol used by Rousselet is continued. As soon as the animals begin to draw in their antennæ, a few cubic centimetres of dilute osmic acid are added, and in from 2–4 minutes mixed with 10 per cent. wood-vinegar (pyroligneous acid). The fluids are slowly poured off and replaced by alcohol. The animals do not lose bulk, and may be preserved in glycerin or mounted in balsam.

Demonstrating presence of Flagella of the Plague Bacillus.†—Mr. M. Gordon, working under the direction of Dr. E. Klein, began with a gelatin culture of the plague bacillus. From this a bouillon culture was made and incubated at 37°, and small doses thereof were injected subcutaneously into a guinea-pig. The animal died in two days, and characteristic organisms were found in the lymphatic glands and spleen. Plate cultivations were made from the heart-blood, and typical colonies reinoculated on oblique agar. After 20 hours' incubation at 37°, cover-glass preparations were stained by van Ermengem's method. In successful preparations rodlets are found which possess at one end a spiral flagellum about double the length of the organism. Occasionally a second spiral flagellum at the same end, but attached laterally, is present. The flagella are only stained with difficulty, apparently owing to the presence of some viscid substance by which the organisms are invested. Slight movements are visible in hanging drop preparations of agar cultures.

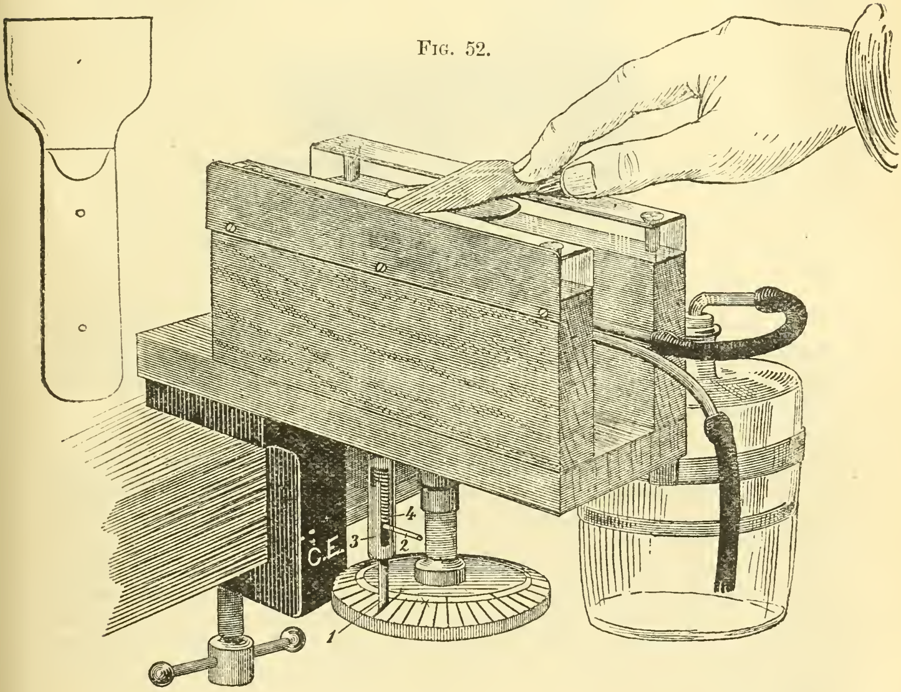
Decalcifying and Desilicating Sponges.‡—Dr. E. Rousseau decalcifies sponges which contain much lime salt, such as *Leuconia*, *Leucandra*, *Leucosolenia*, *Sycon*, &c., by first hardening pieces the sides of which are not longer than 2 cm., and then imbedding in celloidin.

* Comptes Rendus, cxxiv. (1897) p. 285. See Zeitschr. f. angew. Mikr., iii. (1897) p. 116. † Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) p. 170.
‡ Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 205–9.

The imbedded pieces are then immersed for 12–24 hours in a mixture of spirit and nitric acid (15–40 parts HNO_3 sp. gr. 1·4 and 100 parts of alcohol 85 per cent.). Each piece requires at least 20 ccm. of the fluid. The pieces are next transferred to 85 per cent. alcohol which contains some precipitated carbonate of lime, until every trace of acid is removed. They are then placed in 85 per cent. spirit, and sections made.

For desilication, sponges are treated with fluoric acid, after pieces have been imbedded in celloidin as in the previous method. Of course, all the vessels and instruments used must be made of, or covered with caoutchouc or paraffin. A piece of sponge imbedded in celloidin is placed in a caoutchouc capsule, having a lid, and containing at least

Fig. 52.



50 ccm. of alcohol. To this commercial hydrofluoric acid is added drop by drop up to 20 or 30 drops, according to the amount of silica in the sponge. The desilication takes from one to two days. The pieces are then placed in 85 per cent. alcohol containing some lithium carbonate. If there be any precipitate in the tissue, it may be subsequently removed with hydrochloric acid alcohol.

By this procedure very good sections of *Tethyx*, *Suberites*, *Thenia*, *Geodia*, *Reniera*, &c. can be obtained.

(3) Cutting, including Imbedding and Microtomes.

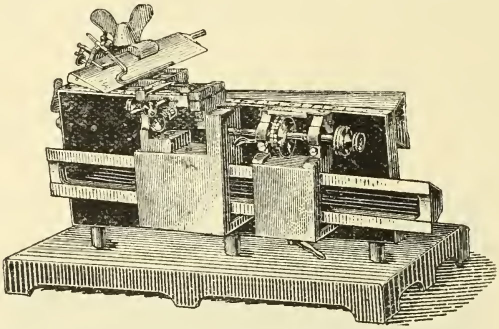
Improved Cathcart Microtome.*—Herr C. Erbe describes slight improvements in the Cathcart microtome (fig. 52). To prevent slipping

* Zeitschr. f. angew. Mikr., iii. (1897) pp. 147–9 (1 fig.).

of the knife on the strips of glass, a small metal flange projects upwards for the knife to rest against. The glass slips may be easily turned or replaced when worn. The micrometer screw gives a movement of 10 μ. The object-holder is strengthened, and a larger ether flask is provided.

Weigert's Microtome.*—Herr C. Erbe gives detailed instructions on the method of using Weigert's sliding microtome. An improvement of this instrument is introduced by making the slides double.

Fig. 53.



Microtome with Metzner's Double Support Guidance.— Herr C. Erbe, of Tübingen, has produced a microtome (fig. 53) with a double support, for which he claims increased firmness both for the object and for the knife.

(4) Staining and Injecting.

Notes on Fixation, Alcohol Method, Stains, &c.†—Herr G. Eisen highly commends the following mixture for fixing:—Platinum chloride 0·5 per cent., 50 parts; iridium chloride 0·5 per cent., 50 parts; glacial acetic acid 1 part; but has found that the iridium chloride alone is superior. The solutions are iridium chloride 0·5 per cent., 100; glacial acetic acid, 1; and iridium chloride 0·2 per cent., 100; glacial acetic acid, 1. Small objects should be kept immersed for six hours or so. A prolonged stay in the fixative is stated to be harmless. After removal from the fixative, the objects are placed for a few hours in distilled water.

According to the author the alcohol method for fixing sections to the slide is successful enough if performed in the following way. The slide is flooded with 80 per cent. alcohol. The paraffin sections are placed thereon, and removed to the shelf top or side bench of the bath, the water in which is kept at 55°. The sections at once stretch out, and then the slide must be removed to the work-table, when the alcohol is poured off, and the sections arranged. Two strips of thick blotting paper, the same size as the slide, are placed on the sections, the strip next the sections being moistened with 80 per cent. alcohol, the upper one kept dry. A roller, used with considerable force, is then passed

* Zeitschr. f. angew. Mikr., iii. (1897) pp. 169–73 (1 fig.).
† Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 195–202.

over the blotting paper, and thus the sections are firmly fixed to the slide. The sections are then brushed over with a soft large camel's hair brush, and returned to the shelf of the water-bath, on which are placed several layers of black cardboard. The sections dry in from ten minutes to an hour, and may then be manipulated with impunity, or stored away for future use.

Brasilin, says the author, is a very good stain, in many respects being superior to hæmatoxylin. It should be mixed in the same way as Böhmer's hæmatoxylin. After a few weeks the stain ripens into a deep red, with copious precipitate of blue flakes insoluble in water. The flakes are collected in a filter, and dissolved in 95 per cent. alcohol, and 15 per cent. of glycerin added. This solution is superior to the original solution, and stains nuclei a deep red.

Iron hæmatoxylin. The sections are immersed for 12 hours or more in liq. ferri sulf. oxidati diluted at least five times. Before being placed in the hæmatoxylin bath the sections should be washed for at least one minute in water. The saturated aqueous solution, which should contain 10 per cent. of alchol, is diluted for use with from ten to twenty times the amount of distilled water, and the sections immersed therein for 12 hours or more. Differentiation is then made with the same liq. ferri greatly diluted, or with 25 per cent. (or less) formic, acetic, or other acid, or with mixtures of acids and liq. ferri. In using this method it is important to remove all traces of alcohol from the sections before they are placed in the liq. ferri.

Thionin-ruthenium-red. This combination will produce opposite results according to the length of time occupied by the thionin-staining, or the age of the ruthenium mixture.

(1) Stain first for 5 minutes with aqueous 1 per cent. solution of thionin with 10 per cent. of alcohol. Rinse in distilled water, and then put on the section a few drops of ruthenium-red (made by dissolving in 80 per cent. distilled and filtered water, 10 per cent. absolute alcohol, and 10 per cent. glycerin). When the cells in mitosis exhibit a red cytoplasm and dark blue chromosomes, as observed under the Microscope, the differentiation is checked. Dehydrate with absolute alcohol, clear with pure fresh bergamot oil, and follow at once with xylol.

(2) Stain for 12–24 hours in a very weak solution of thionin (a couple of drops of 1 per cent. solution in a Naples jar of water). Rinse in distilled water, and differentiate as before with ruthenium-red. Dehydrate and clear as before. By the first procedure the chromosomes are stained blue, by the latter red, or reddish-brown, and so on.

Gum-thus. This substance is a gum from a *Pinus* indigenous to the Eastern United States; it is dissolved in xylol; it dries quicker, and gives clearer and better definition, than Canada balsam. It has the additional merit of being much cheaper than balsam.

Combined Method of Fixing and Staining Microscopic Preparations.*—Herr M. B. Wermel has combined the fixation and staining of blood and muscle by the use of the following solution:—1 methylen-formalin (saturated alkaline methylen-blue, 30 ccm.; 2·5 per cent. aque-

* Medizinskoje Obosrenje, May 1897. See Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) p. 419.

ous solution of formalin, 100 ccm.); (2) eosin-formalin (eosin 1 per cent. in 60 per cent. alcohol, 100 ccm.; formalin 10 per cent. aqueous solution, 20 ccm.); (3) methylen-blue formalin (saturated aqueous solution of methylen-blue, formalin 4 per cent. aqueous solution).

Blood preparations are first dried in the air, then stained for two minutes in solution 2, the excess of stain removed, and next stained for 2 minutes with solution No. 3, after which they are washed in water and examined. For Gram's method, gentian-violet-formalin was used, i.e. 10 ccm. of 10 per cent. alcoholic solution of gentian-violet, and 100 ccm. of 2·5 per cent. aqueous solution of formalin. For staining gonococci the film need not be fixed in the flame, but merely treated at once with eosin-formalin for 2 minutes, and afterwards with a saturated aqueous solution of methylen-blue.

Double-Staining Vegetable Tissue.*—Herr H. Pfeiffer recommends a mixture of hæmalum and naphthylamin yellow for staining vegetable tissue, as it differentiates the lignified from the non-lignified tissue. The sections fixed in alcohol are placed in a mixture of equal parts of saturated aqueous solution of hæmalum and naphthylamin yellow, for 30 to 50 minutes. On removal they are washed in water for one or two minutes, placed on a slide, dehydrated, and mounted in the usual way. The ligneous tissue is stained yellow, the non-ligneous parenchymatous tissue violet.

Triple Stain for Animal Tissues.†—Herr J. L. Graberg uses the following solution for staining sections of animal tissue:—1 per cent. aqueous solution of Bordeaux red, 400 ccm.; 0·5 per cent. aqueous solution of thionin, 200 ccm.; 1 per cent. aqueous solution of methyl-green with 25 per cent. alcohol, 300 ccm. The solution is filtered, and the sections immersed therein for 24 hours, after which they are thoroughly washed in 93 per cent. alcohol to which a few drops of acetic acid have been added, until they assume a reddish hue. The sections stain best when the material has been fixed in saturated solution of sublimate in 0·7 per cent. salt solution.

Method of Staining Nervous Tissue for Microscopic Purposes.‡—Dr. Vastarini-Cresi stains the central nervous system for microscopic purposes by immersion in formalin (13 per thousand), for 2 weeks, the meninges being removed on the second or third day. Sections from 3–5 cm. thick are placed in water, or better in 40 per cent. alcohol, for 12–24 hours, and then removed to 0·75 solution of silver nitrate, wherein they may remain for an indefinite period. The preparations are afterwards treated with water and 70 per cent. alcohol. Tissue thus prepared shows well the relations between the white and grey substances.

(6) Miscellaneous.

Demonstrating the Electric Organs of the Ray.§—Herr E. Ballowitz examined the electrical organs of the common ray, *Raja clavata* L., and found that not only the nerve-endings, but other structural elements

* Zeitschr. f. wiss. Mikr., xiv. (1897) pp. 202–5. † Op. cit., xiii. (1896) pp. 460–1.
‡ Rif. Med., Feb. 14, 1896. See Brit. Med. Journ., 1896, i. Epit., 303.
§ Zeitschr. f. wiss. Mikr., xiii. (1896) pp. 462–7.

of the electrical organs, usually only seen with great difficulty, were rendered perfectly clear by Golgi's method. The preparations were stained in chrom-osmic acid (4 : 1), and, after 3–4 days, were washed in dilute silver nitrate solution, and then immersed for 1–3 days in 0·75 silver nitrate.

Concentration of Therapeutic Sera by Freezing.*—Prof. O. Bujwid has been able to obtain strongly concentrated diphtheria and tetanus sera by means of freezing. The ice is devoid of antitoxins; these, together with other constituents of the sera, remaining in solution. On freezing a bottle containing serum, the latter separates into ice crystals and a small quantity of brownish fluid. After thawing at room temperature, the contents of the bottle are found to have separated into two layers; the upper, which is quite colourless, contains only a small quantity of solid matter, and is practically water. Its antitoxic action is almost nil. The lower layer is of a yellow colour, perfectly clear, and contains all the antitoxins. After freezing two or three times, a serum is obtained which is 2½ to 3 times more concentrated than the original, so that 1–2 ccm. contain 1000 antitoxin units.

Pastes and Cements for General Purposes.†—(1) Gum arabic, 4 parts; starch, 3 parts; sugar, 1 part. Dissolve the gum in water sufficient to take up the starch, add the sugar, and heat the whole on a water-bath until the starch is completely dissolved.

(2) *Collodine* is a paste made by treating starch with water rendered strongly alkaline.

(3) *Triticine* is a paste made by dissolving equal parts of dextrine and starch in water and then heating. A little glycerin is added to make the paste pliable and elastic when dry, and a little boric acid or thymol to prevent fermentation.

(4) Gum arabic, 70 parts; water, 200 parts; aluminium sulphate, 2 parts. Dissolve the aluminium sulphate in some of the water, the gum in the rest, and mix the two.

(5) Gelatin, or best glue, 2 parts; water, 6 parts. Soak the gelatin in the water until it is soft throughout, then melt in a water-bath. Add 1–2 parts of chloral hydrate, and continue to heat gently for some time.

(6) Cover 100 parts of gelatin with water, and let stand until the gelatin is saturated. Then melt in water-bath and add 150 parts alcohol, 500 parts water, 50 parts glycerin, and 20 parts carbolic acid. This makes a very powerful cement.

Bronzing of Copper.‡—For bronzing copper, Herr Mondil gives the following procedure:—After the surface has been thoroughly cleaned, it is brushed over with a mixture composed of 20 parts by weight of castor oil, 80 parts alcohol, 40 parts soft soap, and 40 parts water. The mordant is left on the metal until it is sufficiently stained. The surface is then dried with hot saw-dust, and afterwards covered with a thin layer of varnish.

* Centralbl. Bakt. u. Par., 1te Abt., xxii. (1897) pp. 287–8.
† Amer. Mon. Micr. Journ., xviii. (1897) pp. 296–8.
‡ Centralztg. f. Opt. u. Mech., 1897, p. 4. See Zeitschr. f. angew. Mikr., iii. (1897) p. 118.

Browning Iron or Steel.*—A correspondent gives the following method for browning iron or steel to protect them from rust:—2 parts of crystallised iron chloride, 2 parts of chloride of antimony, and 1 part of gallic acid are dissolved in 4 parts of water. The object is then smeared with the solution applied with a rag or sponge, and is allowed to dry in the air. The procedure is repeated several times until the colour is sufficiently dark. The object is then washed with water, dried, and the surface rubbed with boiled linseed oil. The antimony chloride should be quite neutral.

* Centralztg. f. Opt. u. Mech., 1897, p. 4. See Zeitschr. f. angew. Mikr., iii. (1897) p. 118.

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 20TH OF OCTOBER, 1897, AT 20 HANOVER SQUARE, W., THE PRESIDENT (E. M. NELSON, ESQ.) IN THE CHAIR.

Pursuant to notice given at the preceding meeting, June 16th, the President declared the meeting to be made special for the consideration of the following addition to the Bye-laws, to be called Bye-law No. 65: —"The Council shall, at the Annual Meeting, propose a Fellow of the Society to act as Curator of the instruments, tools, and such other objects as may from time to time be confided to his care; he shall be elected by the Society, and shall make an annual report of the condition of the objects under his charge." As this was a new bye-law, its insertion would involve the re-numbering of those which followed.

The President having moved the adoption of this proposed new bye-law from the chair, it was seconded by Mr. J. J. Vezey, and being put to the meeting, was declared to be carried unanimously, and was ordered to be added to the list of Bye-laws accordingly.

The business of the ordinary meeting was then proceeded with, and, in the absence of both the Hon. Secretaries, the minutes of the meeting of June 16th last were read by Mr. Vezey, and having been duly confirmed, were signed by the President.

The following Donation was announced:—

	From
Den Norske Nordhavs Expedition 1876–78. XXIV. Botanik, Protophyta, by H. H. Grau. 36 pp. and 4 pls. (4to, Christiania, 1897.)	*The Editorial Committee of the Norwegian North-Atlantic Expedition, on behalf of His Norwegian Majesty's Government.*

Mr. Vezey remarked that this was a valuable donation, and on the motion of the President a special vote of thanks to the donors was unanimously carried.

The President said he had great pleasure in bringing to the notice of the Fellows of the Society the most excellent and valuable work which their Treasurer, Mr. Suffolk, had been doing, namely, the compilation of a complete catalogue of about 4000 slides in the Society's cabinet. Mr. Suffolk had been for years working at these slides, putting right where possible those which were going bad from age or imperfect mounting, and having thoroughly overhauled them, he had produced the very valuable catalogue which he now had the pleasure of laying upon the table. He felt sure that when they knew what an amount of care and trouble had been expended upon the production of this catalogue, they would join with him in a very hearty vote of thanks to Mr. Suffolk for this very excellent piece of work.

Carried by acclamation.

Messrs. R. and J. Beck sent for exhibition two new Microscopes and a new form of Centrifuge, which were described by Mr. Hill. The Microscopes were in most respects similar to their well-known "National" pattern, but in place of the circular stage they were fitted with a large square stage; one had a stand of the usual form, the other was made to fold and pack away in a case of the smallest possible size to contain the instrument and its accessories, for convenience and portability. The centrifuge was a very well made instrument for separating and depositing rapidly matter held in suspension by various fluids; it had been found efficient in the separation of the red corpuscles in blood, rendering it easy in this way to determine their relative proportion in a given quantity. The separation of cream from milk in two small glass tubes was shown in the room, the proportionate quantity in a cubic centimetre being read off at once on a scale. Mr. Hill also exhibited two Hand-Magnifiers, which had been constructed on a new formula, and were said to be perfectly aplanatic.

Thanks were voted to Messrs. Beck for their exhibits.

The President said there was an exhibition on the table consisting of part of a collection of Insects' Eggs presented to the Society's cabinet some years ago by Mr. J. T. Norman. The Society were greatly indebted to Messrs. Swift and Son, who had lent the necessary Microscopes to display this exhibition, and he was sure the Fellows would join him in expressing thanks to Messrs. Swift.

The President said that the Council had felt it their duty, in common with all the other learned Societies, to forward a message of congratulation to Her Majesty the Queen on the completion of the sixtieth year of her reign. An address had therefore been prepared and forwarded, and a reply had been received thereto. The text of both address and reply were read to the meeting as follows:—

"To the Queen's Most Excellent Majesty.

May it please your Majesty,—

We, your Majesty's loyal and obedient subjects, the Fellows of the Royal Microscopical Society of London, most humbly beg to be allowed to offer to your Majesty the assurance of our sincere congratulations upon the completion by your Majesty of the sixtieth year of your Majesty's reign, and of our earnest share in that great outburst of affectionate loyalty which has sprung so unmistakably from all peoples and all lands included within the limits of your Majesty's vast Empire.

It is to the Fellows of the Royal Microscopical Society matter of gratification and pride that the origin of the Society closely corresponds in point of time with the beginning of your Majesty's reign, that the usefulness of the Society was recognised and its prestige enhanced by being incorporated by Royal Charter in the year 1866, that His Royal Highness the Prince of Wales has for years held the office of Patron, and that the labours of the Society may accordingly claim to have shared, however humbly, in that marvellous progress in Science, in Arts, and general knowledge, which has attended and adorned the successive years of your Majesty's reign.

We fervently trust and pray that the same conditions may long endure, and that long-continued health and strength may be granted to your Majesty.

Signed on behalf of the Fellows of the Royal Microscopical Society,

EDWARD MILLES NELSON.

20 Hanover Square, London, W."

"Whitehall,
20th September, 1897.

Sir,—

I have had the honour to lay before The Queen the loyal and dutiful Address of the Fellows of the Royal Microscopical Society of London on the occasion of Her Majesty attaining the sixtieth year of her reign, and I have to inform you that Her Majesty was pleased to receive the same most graciously.

I have the honour to be,
Your obedient Servant,
(Signed) M. W. RIDLEY.

The Secretary of the Royal Microscopical
Society of London.
20 Hanover Square, W."

Mr. A. W. Bennett said that a valuable paper had been contributed to the Society by Mr. William West and Mr. George S. West, who were known to be such diligent and careful workers that anything from them was sure to be of the highest interest. The paper itself was not, however, one which could be read in detail to the meeting, but it would be a most valuable addition to the literature of the subject, being a list of the Freshwater Algæ of the South of England below a line drawn across the country from Essex to Cornwall, containing a description of many new species and two new genera, and illustrated by two very beautifully drawn plates. He had asked permission to add to this some notes of his own on the freshwater Algæ found in the neighbourhood of London, including some rare species met with in the Gardens at Kew. Even in such unpromising localities as the Regent's Canal he had found some interesting freshwater Algæ.

The thanks of the meeting were unanimously voted to Mr. Bennett for his communication.

Mr. T. Comber read a paper 'On the Limits of Species in the Diatomaceæ.'

Mr. George Murray, being called upon by the President for some remarks upon the subject, said it had been a great pleasure to listen to Mr. Comber as one who had such a practical acquaintance with the subject and was also a man of such wide reading. He had hoped, therefore, to get some very welcome ideas upon the matter, for he confessed that he came to the meeting with a great deal of confusion in his mind, and he was afraid he was going away still more confused, for it was with diatoms as with some other groups of plants and with animals, an extremely difficult matter to decide what to regard as a species. For some few years past he had been working at marine diatoms, and had experienced this same difficulty in determining what was really the limit of any particular species, and he had applied to Mr. Comber and to others with only very conflicting results, and he came to the conclusion that there was hardly anything in Nature equal to what existed among diatoms as to confusion of species; they seemed to run one into the other in such numerous ways, and in lines which branched out in all directions. Numbers of them were found in fossil conditions as far back as the Cretaceous rocks, where some of the same forms were met with which were existing at the present day, and it would therefore be most natural to think that things of such determinate character would at least have well-marked forms; but they found it was not so. It was to be hoped, however, that light would some day be thrown upon it, and that by working with a strong determination they might perhaps get a little better order infused.

The President said their hearty thanks were due to Mr. Comber for his very excellent paper, which he hoped would be a means of reducing the enormous number of species, or at least of checking their increase. He had been doing a little work himself amongst diatoms, but certainly not in naming them; and it had always appeared to him that the species-namers had troubled themselves too much with outside form rather than giving their attention to the way in which the structure was built up.

The thanks of the meeting were unanimously voted to Mr. Comber for his paper.

Mr. Vezey said they had received another paper, but this was one which they would agree it would be better should be taken as read, as apart from the illustrations it would scarcely be intelligible. This was by Mr. Chapman, and was Part 10 and conclusion of his series of papers on the Foraminifera of the Gault of Folkestone, with Appendix and Summary. The paper would of course be printed in a future number of the Journal.

The thanks of the Society were given to Mr. Chapman for his communication.

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

The Society:—The following slides of Eggs of Insects from the Society's Cabinet:—Moths: *Abraxas grossulariata*, Magpie; *Acidalia aversata*, Ribband Wave; *Biston hirtarias*, Brindled Beauty; *Bombyx Mori*, Silkworm; *Cerura Vinula*, Puss; *Crocallis flinguaria*, August Oak; *Hylophila* or *Halias prasinana*, Silver Lines; *Hemerophilia abruptaria*, Waved Umbre; *Odonestis potatoria*, Drinker; *Orygia antiqua*, Vapourer; *Noctua triangulum*; *Selenia illustraria*, Purple Thorn; *Tortrix* sp.; and Willow Beauty. Butterflies: Cabbage White; *Chrysophanus Phlæas*, Copper; *Hipparchia Janira*, Meadow Brown; *Pontia Brassicæ*, Large White; *Vanessa Urticæ*, Tortoise-shell; *Anthomyia* (?); *Sialis surturalis*, Sedge-Fly; *Cimex lectularius*.

Messrs. R. and J. Beck:—Two new Microscopes; a new form of Centrifuge; and two Hand-Magnifiers.

MEETING

HELD ON THE 17TH OF NOVEMBER, 1897, AT 20 HANOVER SQUARE, W. E. M. NELSON, ESQ., PRESIDENT, IN THE CHAIR.

The Minutes of the special and ordinary meetings of 20th October last were read and confirmed, and were signed by the President.

The Secretary said that the only donation to the Society (exclusive of exchanges) which he had to report was volume iv. of Dr. de Toni's 'Sylloge Algarum.'

The thanks of the Society were voted to Dr. de Toni for this donation.

The Secretary said that a vacancy having occurred in their list of Honorary Fellows, it was proposed to elect Mr. Arthur Bolles Lee, of Nyon, to fill this vacancy; a nomination paper was accordingly read, and ordered to be suspended until the next ordinary meeting.

Mr. J. W. Measures exhibited and described a new binocular dissecting Microscope, in which a direct image was obtained by means of Porro's prisms, a further peculiarity being that the image in each eye-piece was formed by a separate objective, the two objectives being fitted together at an angle which, at the focal distance, admitted of the axis of each passing through the same point. There was an arrangement by which the distance apart of the eye-pieces could be regulated to suit the eyes of the observer, and provision was made for both dark and light ground illumination. The image seen was ortho-stereoscopic, and hand-rests were fixed on either side of the stage, as was usual in the case of dissecting Microscopes. The Microscope was made by Zeiss.

Mr. A. D. Michael inquired up to what power this arrangement was available, and whether there was not a loss of light consequent upon the use of these prisms. He fancied that the use of an instrument of this kind would be confined to dissection with low power, and he feared that the loss of light would prove a difficulty if higher powers were attempted. For large objects and under low magnifying powers it would probably be a very handy instrument, but for very delicate dissections under high powers, he doubted if it would be successful.

Mr. Measures said this Microscope was only intended for use in dissecting with low powers. He did not know how far it would be possible to work it with objectives of higher power than those on the Microscope.

Mr. Beck asked at what angle the two objectives were inclined towards the object. After inspection, he thought the angle was about equal to that of the eyes placed about 6 in. apart, and that it would consequently give undue stereoscopic effect.

The President said that some years ago he felt very much interested in this kind of thing, and in the course of his experiments he made a binocular Microscope on the Cherubin d'Orléans model, in which he used two Seibert's objectives. He wanted to see what difference there would be between the stereoscopic effect produced in this way and that obtained by Mr. Wenham's arrangement. The result was exceedingly pleasing; he never saw anything so nearly approaching the natural beauty of the object as the effect which he obtained by viewing it through two objectives in this manner. When the Porro prisms came out, he thought that they could be used for the purpose to which they were applied in this Microscope. It was, as Mr. Michael had surmised, only available for low powers, but extremely beautiful effects could be got out of it.

During the vacation he had stumbled across a delightful old book, which was partly devoted to optics, and partly to magic and philosophy. He had thought the Porro prism was a new thing, but to his surprise, he found it was described in this old book, dated 1702. He had also been under the impression that Jordan's sunshine recorder was something which belonged to the 19th century, but on looking through this book, there it was, with a number of ingenious modifications. Telescope sights for guns he also thought to be a new invention, but these were there too, and not only fitted to guns, but also to cannons.

Père Cherubin d'Orléans had in 1671 anticipated the drawing pantograph which Dr. Isaac Roberts described in the 'Monthly Microscopical Journal,' vol. viii, page 1, July 1872.

Cherubin d'Orléans (whose real name was François Lassère) was the inventor of binocular Microscopes and telescopes, and consequently of the opera and field-glasses of the present day. He was a man who was greatly in advance of the time in which he lived. In his optical book he describes the apparatus, and methods of grinding and polishing lenses.

The President made some remarks on an interesting old Microscope which had belonged to Sir David Brewster, and which Mr. C. L. Curties had brought down for exhibition. It was provided with six powers, amongst which was the original Garnet lens.

Mr. J. E. Barnard read a paper 'On the Application of the Electric Arc to Photomicrography,' in which he described the successful arrangements devised by himself and Mr. Carver. In illustration of the subject, an image of the carbon points with the arc between them was projected upon a screen, and the most effective position and distance thereby demonstrated. The difference between the action of the continuous and the alternating current was also shown in the same manner. Photographs of the lamp and its accessories, and photomicrographs taken in the manner described, were also shown upon the screen.

Mr. Vezey said he understood that Mr. Barnard did not claim a hand-fed arc lamp as a novelty, because such lamps had been in use for some time in lantern work, where it was essential for the source of light to be kept central to the condenser. He referred to Mr. Davenport's patent electric lamp and others which had been designed for this purpose.

Mr. Barnard said he was quite aware that there were many forms of hand-fed arc lamps in use, but the point to which he had endeavoured to direct attention was that hitherto no means of accurately observing the crater and measuring the length of the arc had been available, but with a pin-hole camera such as he had described this was efficiently provided.

The President inquired what light was focused upon the object in using the Microscope, also what was about the actual size of the spot of light upon the positive carbon.

Mr. Barnard said the direct light from the carbon point was used; what came through the pin-hole was merely used to indicate the position of the light. The diameter of the brightest part of the crater was about 1 mm.

Mr. C. L. Curties said that in the lamp used at Dr. Symes Woodhead's laboratory on the Thames Embankment, they had crossed lines instead of a hole, and the crater was kept central to these.

Mr. T. A. B. Carver had recently seen a large arc lamp at the Royal College of Surgeons, but was surprised to find that, although it was equipped with a lens casting an image of the arc upon a coloured screen, no reference marks were provided by which the true position and condition of the arc could be observed.

Mr. C. L. Curties said that it was originally provided with crossed wires and screen.

The President said that he had not used the electric arc for photomicrography, but only the lime light. This was, however, not the ordinary lime light, but, as he had often described, was arranged so as to produce a small bright steady source of light. He got this by using only about 1-inch pressure of gas and very hard lime, and in this way he obtained a comparatively steady light, although some of his negatives had been spoilt through some little irregularities in the lime or the pressure. One thing he liked the lime light for was with respect to the length of the exposure, as it was so much more easy to regulate a 5- or 10-second exposure than a 1/2-second one; but of course the electric arc had its advantages and was extremely clean. For this purpose he did not use the gas direct from the cylinders, because it was simply impossible to regulate it properly, but he worked with gas-holders which were filled from the cylinders.

Mr. Beck asked what optical appliance, if any, was used between the light and the substage condenser.

Mr. Barnard said he had used it both with and without a supplementary lens; an ordinary plano-convex lens answered every purpose. The slide of typhoid bacilli had been taken with the lamp, using a current of 6 amperes, giving a light of from 700 to 800 candle-power. A screen of a saturated solution of bichromate of potash was used. The image was projected 7 ft. without an ocular, and the exposure was 6 seconds. The exposure could be varied by changing the pressure, and thus varying the size of the source of light.

The President thought it was highly detrimental to the accuracy of a photomicrograph to work without the eye-piece. The greatest distance at which he had worked with an eye-piece was 6 ft. 6 in., and he thought it was hardly possible to exceed this with advantage.

The President said he was sure that the Fellows who were present had been greatly interested by the subject, and in the manner in which it had been brought before them. He had much pleasure in moving that a very hearty vote of thanks be given to Messrs. Barnard and Carver for their paper and exhibition. Carried unanimously.

The President said that Mr. Vezey had kindly brought a number of slides for exhibition upon the screen.

Mr. Vezey said that the series of slides (about 70) which were now to be shown on the screen, had been in his possession for some time, and had been painted by Mr. Underhill some years ago. It had been suggested that Fellows would like to see them, and so he had brought them up. The slides had been prepared principally to illustrate 'Pond Life.' The description would be found on each slide, but in case any further information were required he had asked Mr. Rousselet to furnish it, as the subject had been his special study,

The slides were then exhibited upon the screen.

The President proposed the thanks of the Society to Mr. Vezey for bringing down this large number of beautiful slides for them to see, and to Mr. Rousselet for his explanatory remarks.

The vote of thanks having been put to the meeting, was unanimously carried.

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

Mr. Measures:—New Binocular Dissecting Microscope by Carl Zeiss.

The President:—A Microscope which belonged to Sir David Brewster, lent for exhibition by Mrs. Brewster Fergusson.

Mr. Geo. Hind:—Spider's Web and Fly.

Messrs. Barnard and Carver:—Lantern Slides illustrating their paper.

Mr. Vezey:—70 Hand-painted Lantern Slides of Pond Life.

New Fellows.—The following were elected *Ordinary* Fellows:—Mr. G. H. Barker, Sr. Domingo de Orueta y Duarte, Mr. J. W. Flower, Mr. C. D. Soar, and Mr. W. T. Webster.

INDEX OF NEW BIOLOGICAL TERMS, OR OLD TERMS WITH NEW MEANINGS, RECORDED IN THIS VOLUME.

α. ZOOLOGY.

β. BOTANY.

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1 2

C.F. Rousselet and F.R. Dixon-Nuttall del.ad nat. West,Newman sc.

Rhinops vitrea. (*male*).

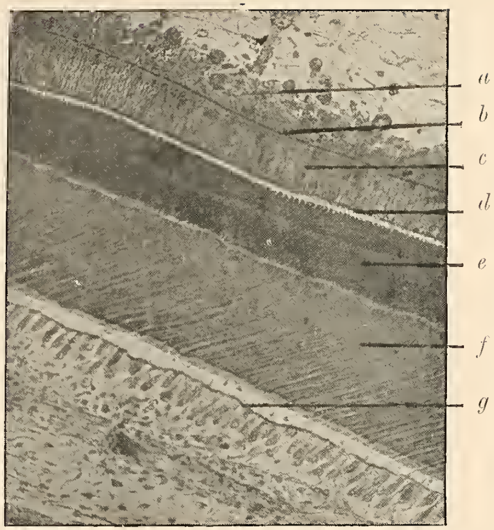


Fig. 1.—From developing Tooth of Embryo Lamb. × 150.

a. Cells of *stratum intermedium.* The "stellate reticulum" has disappeared and the epithelial cells of the outer tunic of the enamel organ have united with those of the *stratum intermedium*, and both are more or less regularly arranged about the blood-vessels. *b.* Membrane-like structure, to which I have given the name "outer ameloblastic membrane." A similar structure is shown at *d*, bounding the inner ends of the ameloblasts. *c.* Ameloblasts. *e.* Enamel. *f.* Dentine. *g.* Odontoblasts.

Fig. 2.—From section of persistently growing Incisor of Rat. × 400.

a. Cells of the *stratum intermedium*, arranged in the form of papillæ about capillary loops. *b.* Ameloblasts. *c.* Partially decalcified enamel, torn and showing fibrous character.

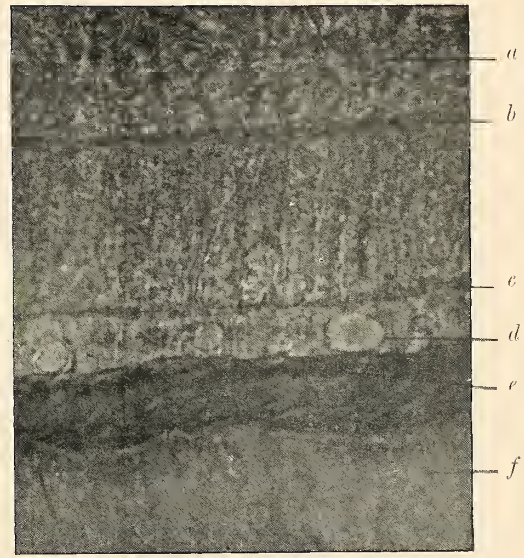


Fig. 3.—From section of developing Tooth of Lamb. × 800.

a. Stratum intermedium. *b.* Outer ameloblastic membrane. *c.* Inner ameloblastic membrane. *d.* Large globular masses of the albumen-like calcific-bearing material. *e.* Enamel. *f.* Dentine.

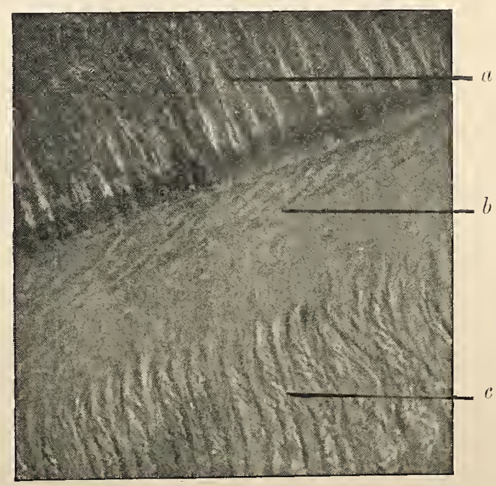


Fig. 4.—From section of persistently growing Incisor of Rat. × 600.

a. Ameloblasts. *b.* Outer layer of enamel, showing fibres passing in two directions. *c.* Showing fibres descending and twisting about each other to form stroma of enamel rods.

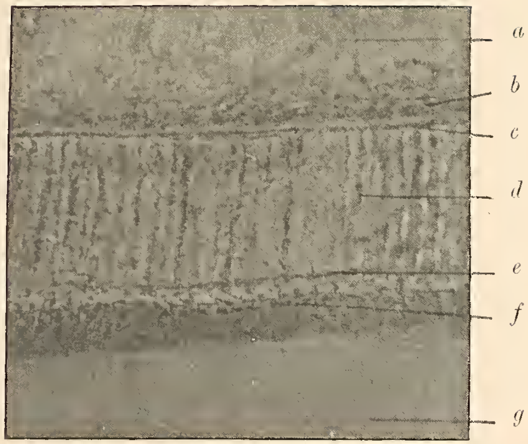


Fig. 5.—From section of developing Tooth of Embryo Dog. × 600.

a. So called "stellate reticulum." *b*. *Stratum intermedium*. *c*. Outer ameloblastic membrane. *d*. Ameloblasts. *e*. Inner ameloblastic membrane. *f*. Formation of enamel by calcification of successive layers of sections given off from the ameloblasts. *g*. Dentine.

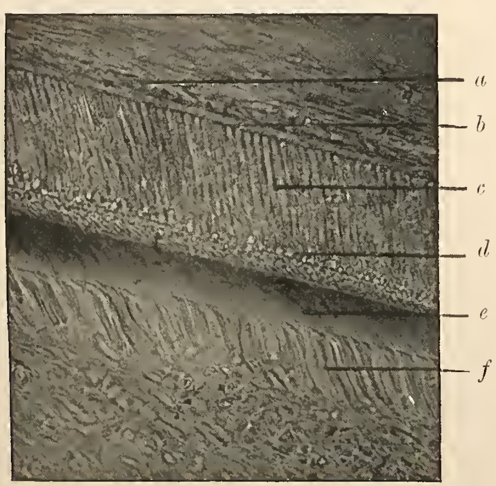


Fig. 6.—From section of persistently growing Incisor of Mouse. × 400.

a. Cells of *stratum intermedium*. *b*. Outer ameloblastic membrane. *c*. Ameloblasts. *d*. Formation of enamel. The commencement of the formation of the enamel rods is very clearly shown. *e*. Dentine. *f*. Odontoblasts.

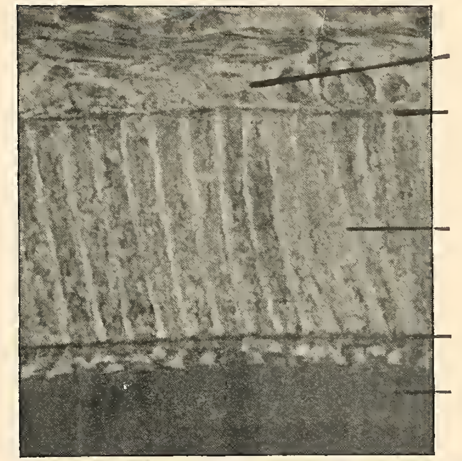


Fig. 7.—From section of developing Tooth of Embryo Dog. × 1000.

a. *Stratum intermedium*. *b*. Outer ameloblastic membrane. *c*. Ameloblasts, showing the cells filled with masses of the albumen-like calcific-bearing material from which enamel is formed. *d*. Inner ameloblastic membrane. *e*. Enamel.

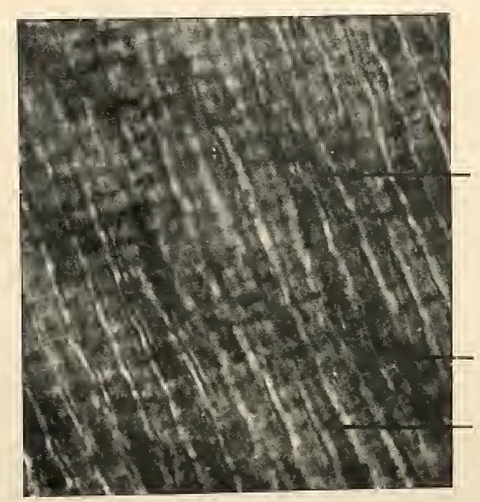
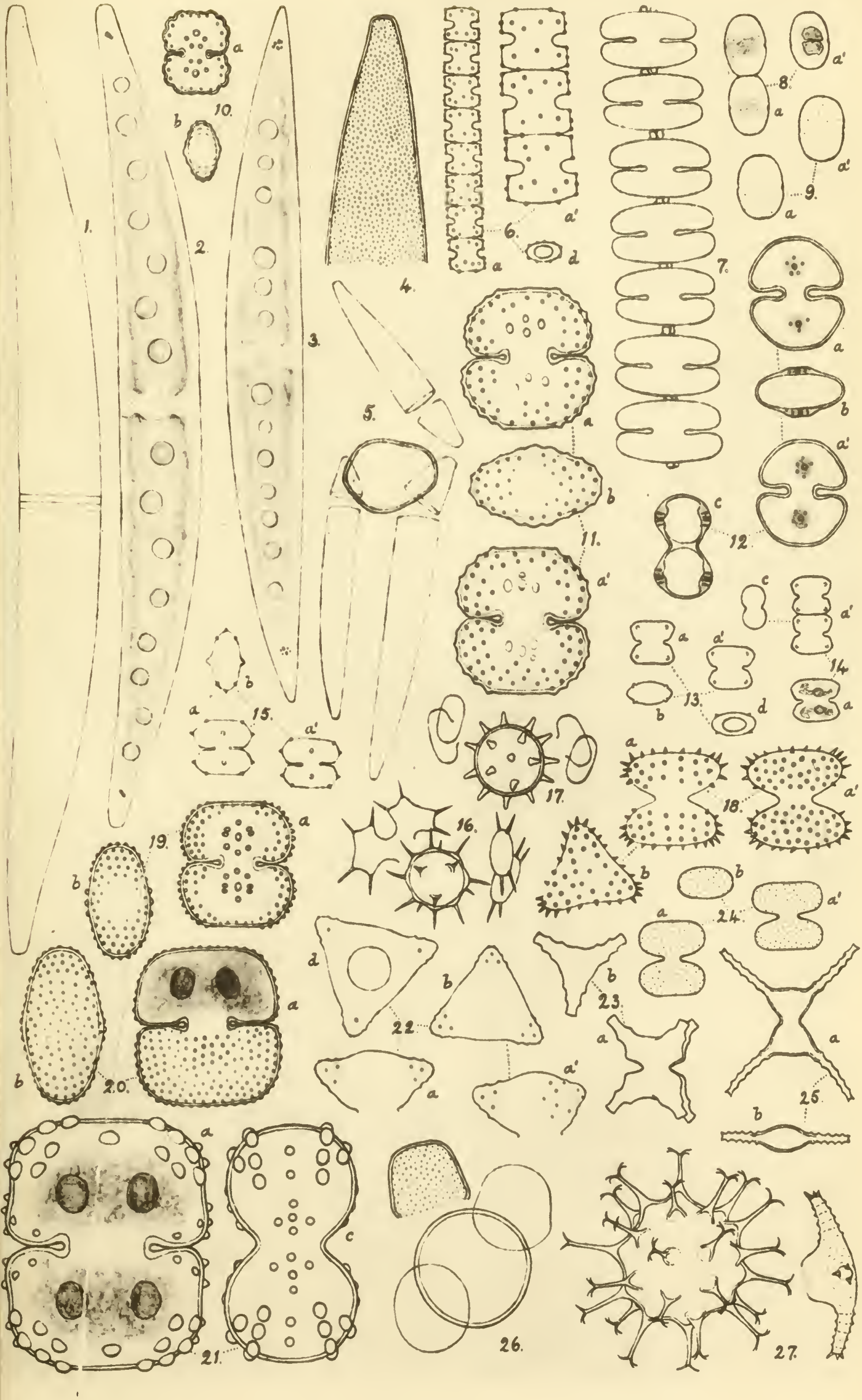


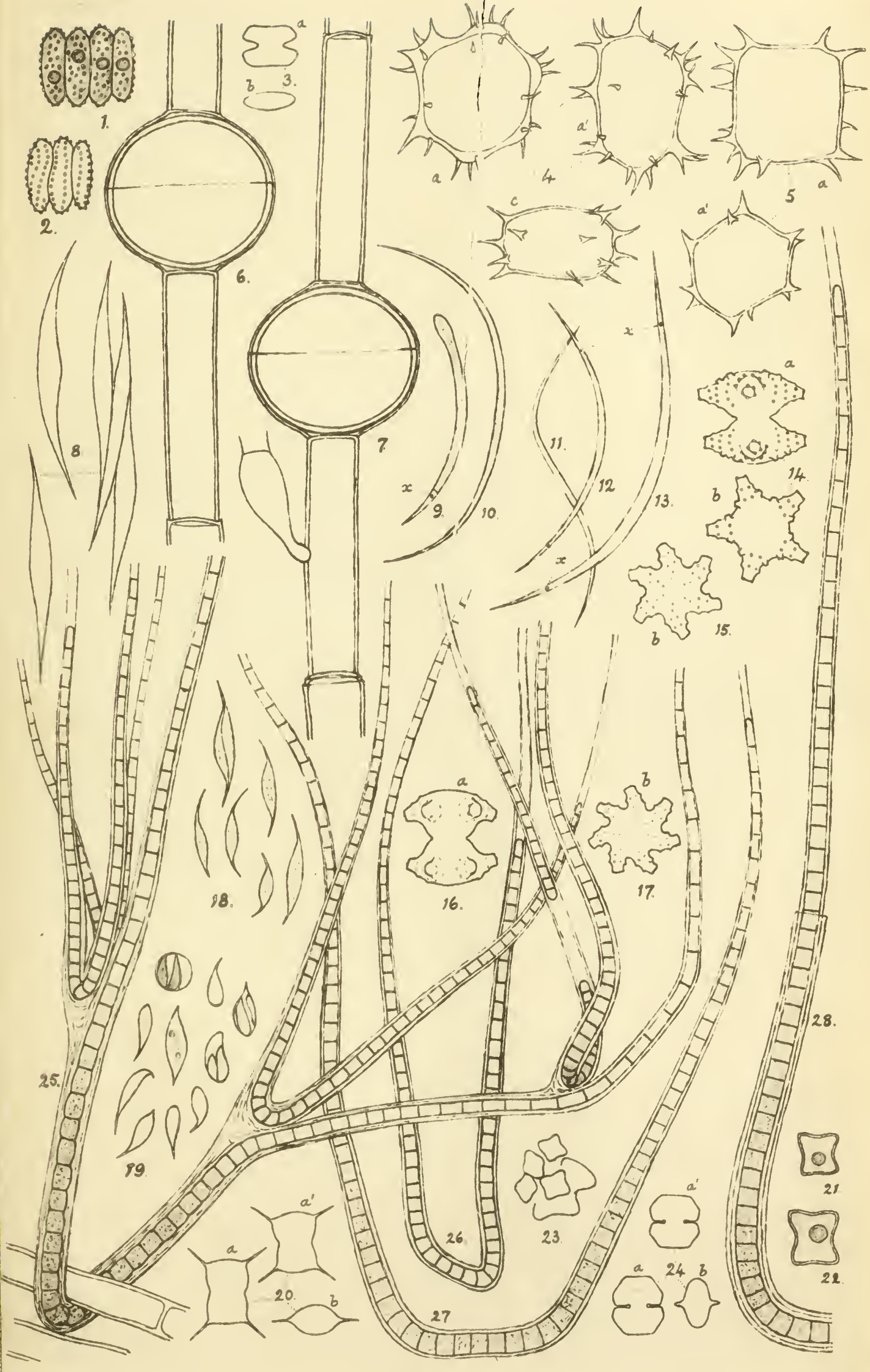
Fig. 8.—From section of mature Human Enamel. × 1000.

a, *b*. Bands of Retzius. *c*. Enamel rod passing through bands of Retzius without break in its continuity.



G. S. West, ad nat. del.

FRESHWATER ALGÆ.



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1897. Part 1. FEBRUARY. To Non-Fellows, Price 6s.

JOURNAL

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(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.

Edited by

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and Professor Emeritus in King's College, London;

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a. Instruments, Accessories, &c.

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(2) Eye-pieces and Objectives.

(3) Illuminating and other Apparatus.

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1897. Part 3. JUNE. To Non-Fellows, Price 6s.

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OF THE
ROYAL MICROSCOPICAL SOCIETY;

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS,

AND A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.

Edited by

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

Lecturer on Botany at St. Thomas's Hospital;

WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

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1·52	..	..	180° 0′	146,543	158,845	193,037	2·310	·658
1·51	..	..	166° 51′	145,579	157,800	191,767	2·280	·662
1·50	..	..	161° 23′	144,615	156,755	190,497	2·250	·667
1·49	..	..	157° 12′	143,651	155,710	189,227	2·220	·671
1·48	..	..	153° 39′	142,687	154,665	187,957	2·190	·676
1·47	..	..	150° 32′	141,723	153,620	186,687	2·161	·680
1·46	..	..	147° 42′	140,759	152,575	185,417	2·132	·685
1·45	..	..	145° 6′	139,795	151,530	184,147	2·103	·690
1·44	..	..	142° 39′	138,830	150,485	182,877	2·074	·694
1·43	..	..	140° 22′	137,866	149,440	181,607	2·045	·694
1·42	..	..	138° 12′	136,902	148,395	180,337	2·016	·709
1·41	..	..	136° 8′	135,938	147,350	179,067	1·988	·709
1·40	..	..	134° 10′	134,974	146,305	177,797	1·960	·714
1·39	..	..	132° 16′	134,010	145,260	176,527	1·932	·719
1·38	..	..	130° 26′	133,046	144,215	175,257	1·904	·725
1·37	..	..	128° 40′	132,082	143,170	173,987	1·877	·729
1·36	..	..	126° 58′	131,118	142,125	172,717	1·850	·735
1·35	..	..	125° 18′	130,154	141,080	171,447	1·823	·741
1·34	..	..	123° 40′	129,189	140,035	170,177	1·796	·746
1·33	..	180° 0′	122° 6′	128,225	138,989	168,907	1·769	·752
1·32	..	165° 56′	120° 33′	127,261	137,944	167,637	1·742	·758
1·30	..	155° 38′	117° 35′	125,333	135,854	165,097	1·690	·769
1·28	..	148° 42′	114° 44′	123,405	133,764	162,557	1·638	·781
1·26	..	142° 39′	111° 59′	121,477	131,674	160,017	1·588	·794
1·24	..	137° 36′	109° 20′	119,548	129,584	157,477	1·538	·806
1·22	..	133° 4′	106° 45′	117,620	127,494	154,937	1·488	·820
1·20	..	128° 55′	104° 15′	115,692	125,404	152,397	1·440	·833
1·18	..	125° 3′	101° 50′	113,764	123,314	149,857	1·392	·847
1·16	..	121° 26′	99° 29′	111,835	121,224	147,317	1·346	·862
1·14	..	118° 0′	97° 11′	109,907	119,134	144,777	1·300	·877
1·12	..	114° 44′	94° 55′	107,979	117,044	142,237	1·254	·893
1·10	..	111° 36′	92° 43′	106,051	114,954	139,698	1·210	·909
1·08	..	108° 36′	90° 34′	104,123	112,864	137,158	1·166	·926
1·06	..	105° 42′	88° 27′	102,195	110,774	134,618	1·124	·943
1·04	..	102° 53′	86° 21′	100,266	108,684	132,078	1·082	·962
1·02	..	100° 10′	84° 18′	98,338	106,593	129,538	1·040	·980
1·00	180° 0′	97° 31′	82° 17′	96,410	104,503	126,998	1·000	1·000
0·98	157° 2′	94° 56′	80° 17′	94,482	102,413	124,458	·960	1·020
0·96	147° 29′	92° 24′	78° 20′	92,554	100,323	121,918	·922	1·042
0·94	140° 6′	89° 56′	76° 24′	90,625	98,223	119,378	·884	1·064
0·92	133° 51′	87° 32′	74° 30′	88,697	96,143	116,838	·846	1·087
0·90	128° 19′	85° 10′	72° 36′	86,769	94,053	114,298	·810	1·111
0·88	123° 17′	82° 51′	70° 44′	84,841	91,963	111,758	·774	1·136
0·86	118° 38′	80° 34	68° 54′	82,913	89,873	109,218	·740	1·163
0·84	114° 17′	78° 20′	67° 6′	80,984	87,783	106,678	·706	1·190
0·82	110° 10′	76° 8′	65° 18′	79,056	85,693	104,138	·672	1·220
0·80	106° 16′	73° 58′	63° 31′	77,128	83,603	101,598	·640	1·250
0·78	102° 31′	71° 49′	61° 45′	75,200	81,513	99,058	·608	1·282
0·76	98° 56′	69° 42′	60° 0′	73,272	79,423	96,518	·578	1·316
0·74	95° 28′	67° 37′	58° 16′	71,343	77,333	93,979	·548	1·351
0·72	92° 6′	65° 32′	56° 32′	69,415	75,242	91,439	·518	1·389
0·70	88° 51′	63° 31′	54° 50′	67,487	73,152	88,899	·490	1·429
0·68	85° 41′	61° 30′	53° 9′	65,559	71,062	86,359	·462	1·471
0·66	82° 36′	59° 30′	51° 28′	63,631	68,972	83,819	·436	1·515
0·64	79° 36′	57° 31′	49° 48′	61,702	66,882	81,279	·410	1·562
0·62	76° 38′	55° 34′	48° 9′	59,774	64,792	78,739	·384	1·613
0·60	73° 44′	53° 38	46° 30′	57,846	62,702	76,199	·360	1·667
0·58	70° 54′	51° 42	44° 51′	55,918	60,612	73,659	·336	1·724
0·56	68° 6′	49° 48′	43° 14′	53,990	58,522	71,119	·314	1·786
0·54	65° 22′	47° 54′	41° 37′	52,061	56,432	68,579	·292	1·852
0·52	62° 40′	46° 2′	40° 0′	50,133	54,342	66,039	·270	1·923
0·50	60° 0′	44° 10′	38° 24′	48,205	52,252	63,499	·250	2·000
0·45	53° 30′	39° 33′	34° 27′	43,385	47,026	57,149	·203	2·222
0·40	47° 9′	35° 0′	30° 31′	38,564	41,801	50,799	·160	2·500
0·35	40° 58′	30° 30′	26° 38′	33,744	36,576	44,449	·123	2·857
0·30	34° 56′	26° 4′	22° 46′	28,923	31,351	38,099	·090	3·333
0·25	28° 58′	21° 40′	18° 56′	24,103	26,126	31,749	·063	4·000
0·20	23° 4′	17° 18′	15° 7′	19,282	20,901	25,400	·040	5·000
0·15	17° 14′	12° 58′	11° 19′	14,462	15,676	19,050	·023	6·667
0·10	11° 29′	8° 38′	7° 34′	9,641	10,450	12,700	·010	10·000
0·05	5° 44′	4° 18′	3° 46′	4,821	5,252	6,350	·003	20·000

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β. Schizomycetes.

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(3) Cutting, including Imbedding and Microtomes.

(4) Staining and Injecting.

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

(6) Miscellaneous.

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0·76	98° 56′	69° 42′	60° 0′	73,272	79,423	96,518	·578	1·316
0·74	95° 28′	67° 37′	58° 16′	71,343	77,333	93,979	·548	1·351
0·72	92° 6′	65° 32′	56° 32′	69,415	75,242	91,439	·518	1·389
0·70	88° 51′	63° 31′	54° 50′	67,487	73,152	88,899	·490	1·429
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0·64	79° 36′	57° 31′	49° 48′	61,702	66,882	81,279	·410	1·562
0·62	76° 38′	55° 34′	48° 9′	59,774	64,792	78,739	·384	1·613
0·60	73° 44′	53° 38	46° 30′	57,846	62,702	76,199	·360	1·667
0·58	70° 54′	51° 42	44° 51′	55,918	60,612	73,659	·336	1·724
0·56	68° 6′	49° 48′	43° 14′	53,990	58,522	71,119	·314	1·786
0·54	65° 22′	47° 54′	41° 37′	52,061	56,432	68,579	·292	1·852
0·52	62° 40′	46° 2′	40° 0′	50,133	54,342	66,039	·270	1·923
0·50	60° 0′	44° 10′	38° 24′	48,205	52,252	63,499	·250	2·000
0·45	53° 30′	39° 33′	34° 27′	43,385	47,026	57,149	·203	2·222
0·40	47° 9′	35° 0′	30° 31′	38,564	41,801	50,799	·160	2·500
0·35	40° 58′	30° 30′	26° 38′	33,744	36,576	44,449	·123	2·857
0·30	34° 56′	26° 4′	22° 46′	28,923	31,351	38,099	·090	3·333
0·25	28° 58′	21° 40′	18° 56′	24,103	26,126	31,749	·063	4·000
0·20	23° 4′	17° 18′	15° 7′	19,282	20,901	25,400	·040	5·000
0·15	17° 14′	12° 58′	11° 19′	14,462	15,676	19,050	·023	6·667
0·10	11° 29′	8° 38′	7° 34′	9,641	10,450	12,700	·010	10·000
0·05	5° 44′	4° 18′	3° 46′	4,821	5,252	6,350	·003	20·000

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