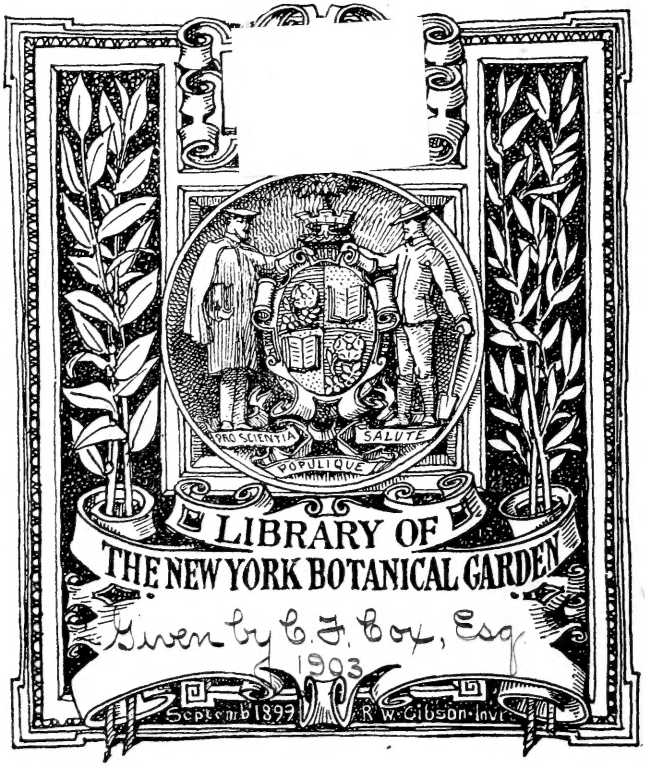
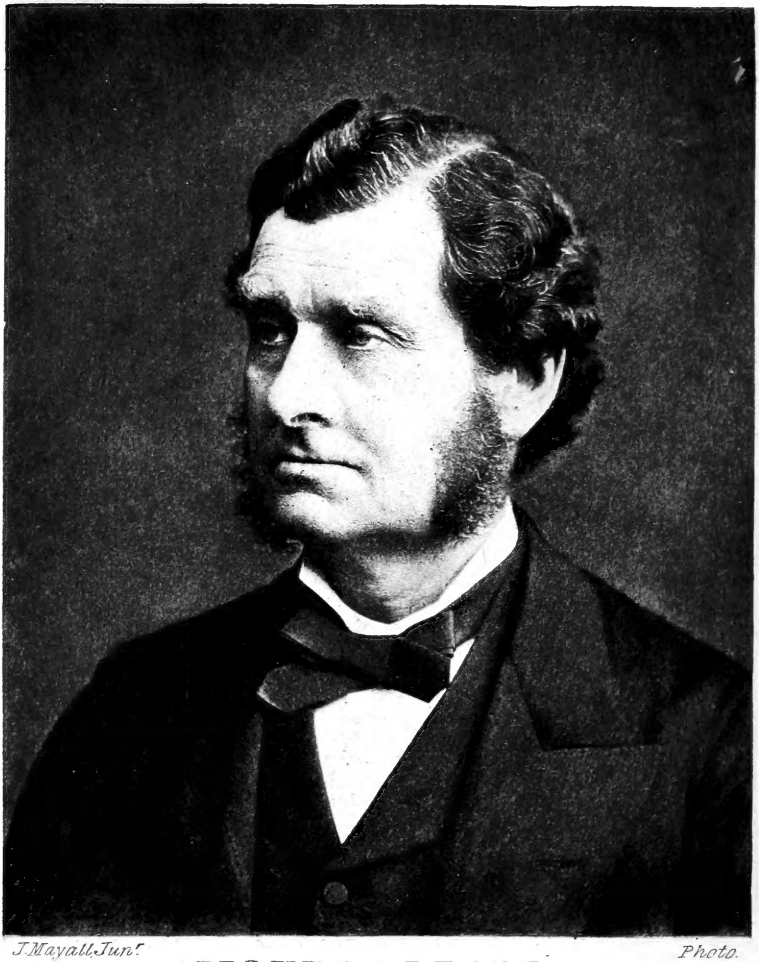

PRO SCIENTIA
SALUTE
POPULIQUE
LIBRARY OF
THE NEW YORK BOTANICAL GARDEN
Given by C. F. Cox, Esq.
1903
September 1897
R. W. Gibson. Invr.



J. Mayall, Jun.r Photo.

LIONEL S. BEALE,

M.B. (Lond.), F.R.C.P., F.R.S.,

Professor of the Principles and Practice of Medicine in King's College, London, and Physician to King's College Hospital, President of the Royal Microscopical Society, 1879-80.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY;

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS,

AND A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.

Edited by

FRANK CRISP, LL.B., B.A.,

One of the Secretaries of the Society

and a Vice-President and Treasurer of the Linnean Society of London;

WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

A. W. BENNETT, M.A., B.Sc., F.L.S., *Lecturer on Botany at St. Thomas's Hospital,*

F. JEFFREY BELL, M.A., F.Z.S., *Professor of Comparative Anatomy in King's College,*

JOHN MAYALL, JUN., F.Z.S.,

R. G. HEBB, M.A., M.D. (*Cantab.*),

AND

J. ARTHUR THOMSON, M.A., *Lecturer on Zoology in the School of Medicine, Edinburgh,*

FELLOWS OF THE SOCIETY.

Ser. II.—VOL. VI. PART 1.

PUBLISHED FOR THE SOCIETY BY

WILLIAMS & NORGATE,

LONDON AND EDINBURGH.

1886.

THE
Royal Microscopical Society.

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

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

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

Ordinary Fellows are elected on a Certificate of Recommendation, signed by three Fellows, stating the names, residence, description, &c., of the Candidate, of whom one of the proposers must have personal knowledge. The Certificate is read at a Monthly Meeting, and the Candidate balloted for at the succeeding Meeting.

The Annual Subscription is £2 2*s*., payable in advance on election, and subsequently on 1st January annually, with an Entrance Fee of £2 2*s*. Future payments of the former may be compounded for at any time for £31 10*s*. Fellows elected at a meeting subsequent to that in February are only called upon for a proportionate part of the first year's subscription, and Fellows absent from the United Kingdom for a year, or permanently residing abroad, are exempt from one-fourth of the subscription during absence.

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

Ex-officio Fellows (limited to 100), consisting of the Presidents for the time being of Biological and Microscopical Societies at home and abroad, are elected on the recommendation of the Council. They are entitled to receive the Society's Publications, and to exercise all other privileges of Fellows, except voting, but are not required to pay any Entrance Fee or Annual Subscription.

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

The Meetings are held on the second Wednesday in each month, from October to June, in the Society's Library at King's College, Strand, W.C. (commencing at 8 P.M.). Visitors are admitted by the introduction of Fellows.

In each Session two additional evenings are devoted to the exhibition of Instruments, Apparatus, and Objects of novelty or interest relating to the Microscope or the subjects of Microscopical Research.

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

The Library, with the Instruments, Apparatus, and Cabinet of Objects, is open for the use of Fellows daily (except Saturdays) from 10 A.M. to 5 P.M., and on Wednesdays from 7 to 9.30 P.M. also. It is closed for four weeks during August and September.

Forms of proposal for Fellowship, and any further information, may be obtained by application to the Secretaries, or Assistant-Secretary, at the Library of the Society, King's College, Strand, W.C.

Patron.

HIS ROYAL HIGHNESS

ALBERT EDWARD, PRINCE OF WALES,

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

Past-Presidents.

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

COUNCIL.

ELECTED 10TH FEBRUARY, 1886.

President.

REV. W. H. DALLINGER, LL.D., F.R.S.

Vice-Presidents.

*J. WILLIAM GROVES, Esq.
JOHN MAYALL, Esq., Jun.
ALBERT D. MICHAEL, Esq., F.L.S.
*PROFESSOR CHARLES STEWART, M.R.C.S., F.L.S.

Treasurer.

LIONEL S. BEALE, Esq., M.B., F.R.C.P., F.R.S.

Secretaries.

*FRANK CRISP, Esq., LL.B., B.A., V.P. & TREAS. L.S.
PROFESSOR F. JEFFREY BELL, M.A., F.Z.S.

Twelve other Members of Council.

JOSEPH BECK, Esq., F.R.A.S.
ALFRED WILLIAM BENNETT, Esq., M.A., B.Sc., F.L.S.
*ROBERT BRAITHWAITE, Esq., M.D., M.R.C.S., F.L.S.
REV. EDMUND CARR, M.A.
FRANK R. CHESHIRE, Esq., F.L.S.
G. F. DOWDESWELL, Esq., M.A.
JAMES GLAISHER, Esq., F.R.S., F.R.A.S.
JOHN MATTHEWS, Esq., M.D.
*JOHN MILLAR, Esq., L.R.C.P., F.L.S.
URBAN PRITCHARD, Esq., M.D.
WILLIAM THOMAS SUFFOLK, Esq.
CHARLES TYLER, Esq., F.L.S.

Librarian and Assistant Secretary.

MR. JAMES WEST.

---

* Members of the Publication Committee.

CONTENTS.

* In order to make the classification complete, (1) the papers printed in the 'Transactions,' (2) the abstracts of the 'Bibliography,' and (3) the notes printed in the 'Proceedings' are included here.

β. Histology.

γ. General.

B.—INVERTEBRATA.

Mollusca.

Molluscoida.

α. Tunicata.

β. Polyzoa.

γ. Brachiopoda.

Arthropoda.

a. Insecta.

β. Myriopoda.

γ. Prototracheata.

δ. Arachnida.

ε. Crustacea.

Vermes.

Echinodermata.

Cœlenterata.

Porifera.

Protozoa.

BOTANY.

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

a. Anatomy.*

* This subdivision contains (1) Cell-structure and Protoplasm (including the Nucleus and Cell-division); (2) Other Cell-contents (including the Cell-sap and Chlorophyll); (3) Secretions; (4) Structure of Tissues; and (5) Structure of Organs.

β. Physiology.*

---

* This subdivision contains (1) Reproduction (including the formation of the Embryo and accompanying processes); (2) Germination; (3) Nutrition; (4) Growth; (5) Respiration; (6) Movement; and (7) Chemical processes (including Fermentation).

B.—CRYPTOGAMIA.

Cryptogamia Vascularia.

Muscineæ.

Characeæ.

Vacat.

Algæ.

Lichenes.

Fungi.

Protophyta.

MICROSCOPY.

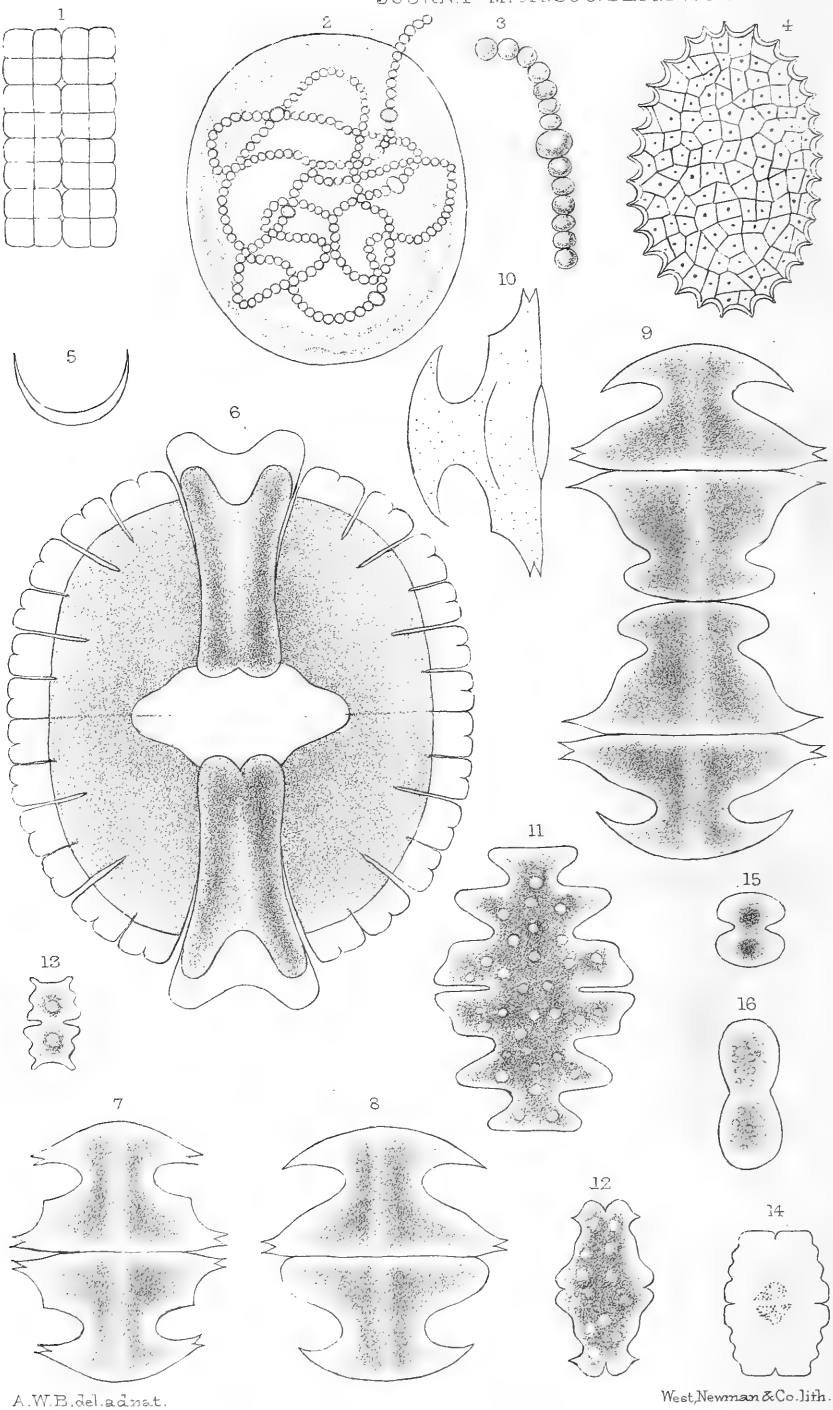
a. Instruments, Accessories, &c.*

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating Apparatus; (4) Other Accessories; (5) Photo-micrography; (6) Manipulation; (7) Microscopical Optics, Books, and Miscellaneous matters.

β. Collecting, Mounting and Examining Objects, &c.*

---

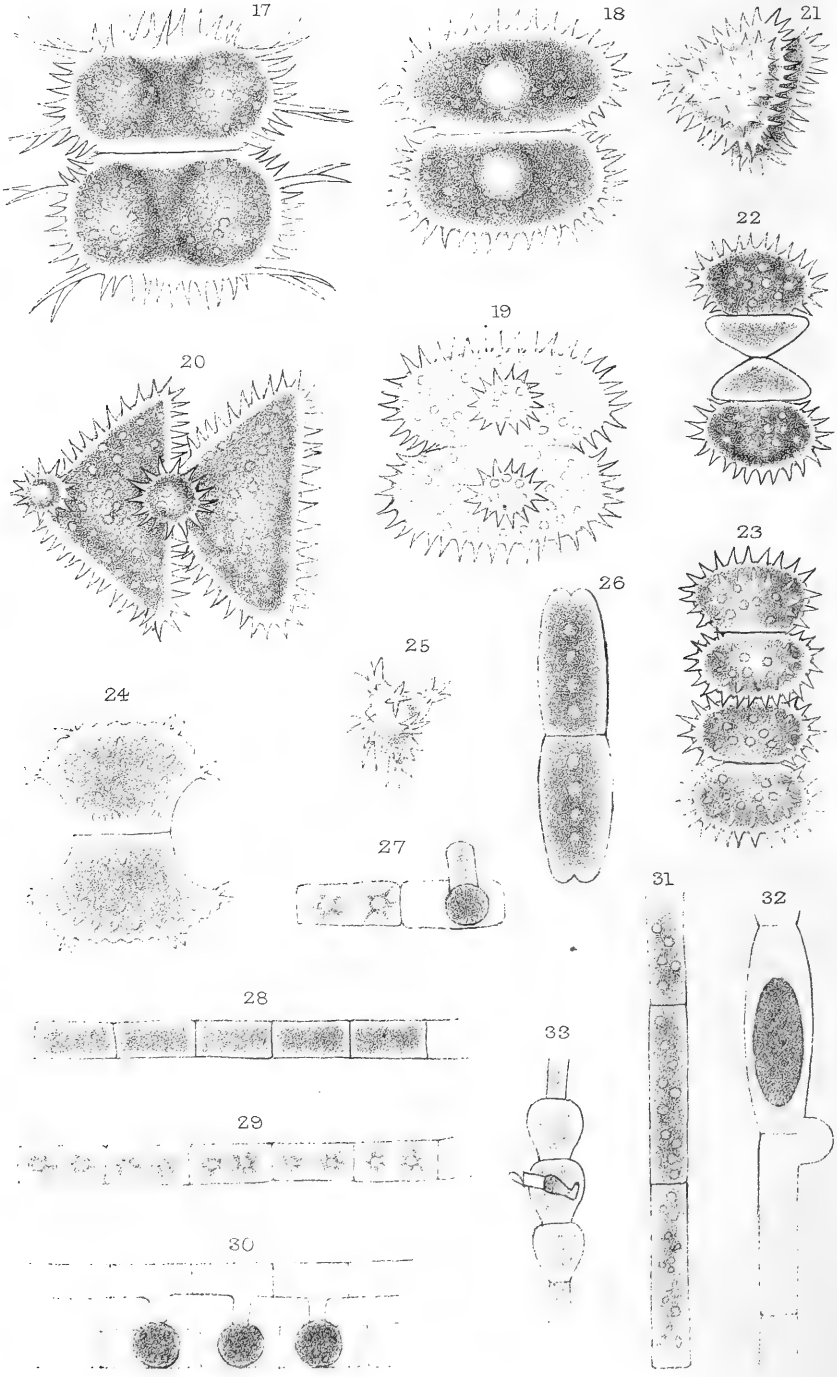
* This subdivision contains (1) Collecting Objects; (2) Preparing, (*a*) in general, (*b*) special objects; (3) Separate processes prior to making sections; (4) Cutting, including Imbedding and Microtomes; (5) Staining and Injecting; (6) Mounting, including preservative fluids, cells, slides, and cabinets; (7) Examining Objects, including Testing; (8) Miscellaneous matters.



A.W.B. del. ad nat.

West, Newman & Co. lith.

Algæ &c. of English Lake-District.



A. W. B. del. ad nat.

West, Newman & Co. lith.

Algæ &c. of English Lake-District.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

FEBRUARY 1886.

TRANSACTIONS OF THE SOCIETY.

I.—*Fresh-water Algæ (including Chlorophyllaceous Protophyta) of the English Lake District; with descriptions of twelve new species.*

By Alfred W. Bennett, F.R.M.S., F.L.S., Lecturer on Botany at St. Thomas's Hospital.

(*Read 13th January*, 1886.)

Plates I. and II.

The following is a record of the fresh-water organisms observed during a six weeks' stay in August and the early part of September 1885, in the district between Windermere and Langdale, Westmoreland. As nearly every day's observation added some fresh species to the list, it is probable that the record is a very incomplete one of the microscopic aquatic flora of this very rich district.

EXPLANATION OF PLATES I. and II.

Fig. 1.—*Merismopedia? paludosa* Benn. × 600.
„ 2.—*Nostoc hyalinum* Benn. × 200.
„ 3. „ „ portion of trichome, with heterocyst × 600.
„ 4.—*Pediastrum compactum* Benn. × 400.
„ 5. „ „ marginal cell × 1200.
„ 6.—*Micrasterias cornuta* Benn. × 200.
„ 7.—*Holocystis oscitans* Hass., most perfect form × 200.
„ 8. „ „ another form × 200.
„ 9. „ „ dividing × 200.
„ 10. „ „ empty frustule × 200.
„ 11.—*Euastrum multilobatum* Wood × 400.
„ 12. „ *ornithocephalum* Benn. × 400.
„ 13. „ *Lundellii* Benn. × 400.
„ 14. „ *crenatum* Ktz., empty frond × 400.
„ 15.—*Cosmarium Wittrockii* Lund. × 400.
„ 16. „ *oblongum* Benn. × 400.
„ 17.—*Xanthidium spinulosum* Benn. × 400.

Nor does it include even all the species actually observed, but only such as previous knowledge or the books at command enabled me to identify, or such as I had reason to believe were hitherto undescribed forms. In particular the Oscillariaceæ and Diatomaceæ require much more careful working out.

The Desmidieæ naturally form a considerable portion of the list. During the year 1884 the most important addition to the literature of this interesting class since Ralfs's 'British Desmidieæ' (1848) has been made, in the publication of the Rev. F. Wolle's 'Desmids of the United States.' Although something has been done in the interval by Archer, Cooke, Bisset, and others, yet, notwithstanding the great beauty and variety of the form in desmids, and the ease with which a large number of species can be recognized, it is probable that more still remains to be done in this group than in any other of the English flora. It is impossible to praise too highly the beauty and accuracy of the drawings, as a whole, in Ralfs's work. In many instances, however, my measurements ranged somewhat larger than those of the veteran desmidiologist.

With regard to the distribution of desmids, many species seem to be almost ubiquitous, occurring in nearly all gatherings, from all altitudes. Whether other species are, like those of flowering plants, limited in geographical area or in adaptability to climate, is a question which has yet to be answered, and the answering of which will be by no means easy. I have thought, however, that I have noticed that the larger and more striking species are especially abundant at high altitudes. Gatherings from about 1800 feet, above Codale and Easedale Tarns, were especially rich in these.

Unless otherwise stated, all the species named were observed in the district of Loughrigg, Westmoreland. The gatherings were

---

Fig. 18.—*Staurastrum bullosum* Benn. × 400.
„ 19. „ „ empty frond × 400.
„ 20. „ „ front view × 400.
„ 21. „ *teliferum* Ralfs var. *convexum* Benn., front view × 400.
„ 22. „ „ dividing, early stage × 400.
„ 23. „ „ „ later stage × 400.
„ 24. „ *tuberculatum* Benn. × 400.
„ 25. „ *enorme* Ralfs × 400.
„ 26.—*Tetmemorus penioides* Benn. × 200.
„ 27.—*Zygnema cruciatum* Cleve, zygosperm germinating while in parent-cell × 200.
„ 28.—*Zygnema Hassallii* Benn., filament in non-conjugating condition × 200.
„ 29. „ „ filament before conjugation × 200.
„ 30. „ „ filaments in conjugation × 200.
„ 31.—*Mesocarpus? neaumensis* Benn. × 200.
„ 32. „ „ with zygosperm × 200
„ 33.—*Œdogonium macrandrum* Wittr. × 200.

made especially from bog and moor pools, wet rocks, and the smaller streams. None were taken from the larger streams or lakes.*

PROTOPHYTA.

Palmellaceæ.

Eremosphæra viridis dBy.
Glœocystis vesiculosa Näg.
„ rupestris Rabh.
„ botryoides? Ktz.
Schizochlamys gelatinosa A. Br.
Palmella mucosa Ktz.
Botryococcus Braunii Ktz.

What may possibly prove to be a second species of this genus was frequently met with in bog pools. Each colony was about 40 μ in diameter, composed as a rule of thirty-two cells, with no evident investing gelatinous envelope, swimming with considerable velocity and at the same time rotating in the water, without any apparent motive power. The cells themselves were elliptical, and filled with a light green endochrome.

Rhaphidium falcatum Cooke (*R. polymorphum* var. *c falcatum* Rabh.).
Nephrocytium Agardhianum Näg.
„ Nägelii Grün.
Ophiocytium cochleare A. Br.

I take this to be identical with *O. majus* Näg.; but is the genus rightly placed under vegetable organisms at all?

Scenedesmus acutus Mey.
„ quadricauda Bréb.

Protococcaceæ.

Protococcus viridis Ag.
Chlorococcum gigas Grün.
Chlamydococcus pluvialis? A. Br.

Chroococcaceæ.

Chroococcus turgidus Näg. Wetherlam, Lancashire.
Aphanocapsa virescens Rabh.

Forming jelly-like masses on a moist rock along with *Nostoc humifusum*.

* The names of new species are printed in SMALL CAPITALS; those of species new to Britain in *italics*.

Aphanocapsa rivularis Rabh.

Forming large green shining jelly-like masses on grasses hanging over into a spring on Park Fell, Lancashire, inclosing numerous rhizopods, diatoms, &c.

Microcystis marginata Kirch.

This interesting organism was observed several times in gatherings from moor pools. The pale blue-green cells were seen to be in constant motion within the hyaline investing membrane.

Merismopedia glauca Näg. Wetherlam, Lancashire.

Merismopedia? paludosa n. sp. Plate I. fig. 1.

Each family composed of eight cells, closely packed together without intermediate spaces, and with no evident gelatinous envelope. Cells square in outline with rounded corners, remarkably regular in form, and each divided into four; cell-contents blue-green. Length of colony, 50 μ; breadth, 25 μ; cells 12·5 μ in length and breadth.*

The small number of cells in a colony, and the absence of spaces between the cells, seem sufficient to characterize the species. It was gathered in bog pools, Loughrigg.

Oscillariaceæ.

Oscillaria violacea Rabh.
„ tenuis Ag.
Lyngbya ochracea Thur.
„ inundata Cooke (*Phormidium inundatum* Ktz.). Ambleside.

Sirosiphoneæ.

Stigonema saxicolum? Näg. On damp rocks, along with *Nostoc humifusum*.

Nostocaceæ.

Anabæna Hassallii Nords. & Wittr.
Cylindrospermum macrospermum Ktz.
„ catenatum Ralfs. Furness Fells, Lancashire.
Nostoc humifusum Carm. On moist rocks.
Nostoc hyalinum n. sp. Figs. 2, 3.

Free-swimming, very minute. Gelatinous envelope globose or slightly ellipsoidal, 0·21 mm. in diameter, lamellose, perfectly colourless and transparent. Trichome single in each envelope;

* These measurements correspond nearly with those given by Nägeli ('Gattungen einzelliger Algen') for *M. glauca*, but I cannot reconcile Dr. Cooke's relative measurements of the different species of *Merismopedia* with his plates.

interwoven. Cells ellipsoidal or nearly globose, green, 5 μ in diameter (about forty to the length of the envelope). Heterocysts intercalary, very few in number, three to four in each envelope, spherical, green, 6–7 μ in diameter.

Several specimens obtained from a bog pool, Loughrigg Fell. It bears some resemblance to *N. minutissimum* Ktz., but is much smaller, and the trichomes are much less densely packed in the hyaline envelope. According to Kützing all the free-swimming *Nostocs* are attached at first; but this does not seem to be the case with this species.

ALGÆ.

Pediastreæ.

Pediastrum angulosum Ehrb.
„ Boryanum Turp.
„ Ehrenbergii A. Br.

Pediastrum compactum n. sp. Figs. 4, 5.

Cœnobium oval and perfectly regular, 0·09–0·16 mm. in length (or probably more), rather more than half as broad as long. Periphery composed of thirty-two lunate cells (in the smaller specimens), with two somewhat divergent, very slender tapering, not bidentate horns, quite as long as the cells themselves. Inner cells irregularly polygonal and densely packed, without any lacunæ, in 2–4 rows. Cœnobium invested with a distinct gelatinous envelope. Endochrome yellow-green; that of the peripheral cells of a deeper colour, which gives the appearance, under a low power, of a deep green border. Length of cells about 6 μ.

Bog pools, Loughrigg, not infrequent. The perfectly regular elliptical form, the much yellower endochrome, and the absence of any interstitial spaces between the cells, give this *Pediastrum* a very distinct appearance from all others with which I am acquainted. In shape it resembles *P. ellipticum* Ehrb. (judging from Ralfs's figure), but differs widely in other respects.

Ulotrichaceæ.

Hormiscia moniliformis Rabh.
„ cateniformis? Ktz.
Ulothrix zonata Ktz. Grisedale, Cumberland.

Confervaceæ.

Conferva fontinalis Berk.
„ tenerrima Ktz.
„ bombycina Ag.
Microspora vulgaris Rabh.
„ floccosa Thur.

CHÆTOPHORACEÆ.

Draparnaldia glomerata Ag. Furness Fells, Lancashire.

On previous occasions of observing this beautiful plant, I have been struck with the extremely long hyaline seta with which the branches end, many times longer than the green portion of the branch. This is not so figured in this species by either Hassall, Kützing, or Cooke, though it is in other less common species of the genus.

DIATOMACEÆ.

Eunotia Arcus W. Sm. Above Easedale Tarn.
,, diodon Ehrb.
Cymbella Ehrenbergii Ktz.
,, affinis Ktz.
Surirella biseriata Bréb.
,, linearis W. Sm.
,, pinnata W. Sm.
Nitzschia sigmoidea W. Sm. Above Easedale Tarn.
,, linearis W. Sm.
,, Amphioxys W. Sm.
Navicula rhomboides Ehrb.
,, rhyncocephala Ktz.
,, ovalis W. Sm.
,, amphirhynchus W. Sm.
Pinnularia major W. Sm.
,, viridis W. Sm.
,, oblonga W. Sm.
,, lata W. Sm.
,, acuta W. Sm.
,, radiosa W. Sm.
,, gracilis Ehrb.
Stauroneis Phœnicentrum Ehrb.
,, gracilis Ehrb.
,, anceps Ehrb.
Synedra pulchella? Ktz.
,, minutissima Ktz.
,, radians W. Sm.
,, Ulna Ehrb.
,, fasciculata Ktz.
Gomphonema geminatum Ag. Ambleside.
,, constrictum Ehrb. Do.
,, acuminatum Ehrb. Do.
,, tenellum W. Sm. Do.
Himantidium pectinale Ktz.
,, undulatum W. Sm.
,, Arcus W. Sm.

Odontidium hiemale Ktz. Ambleside.
Fragilaria capucina Desm.
Diatoma vulgare Bory.
„ grande W. Sm.
„ elongatum Ag.
Tabellaria flocculosa Ktz.
„ fenestrata Ktz.
Melosira varians Ag.

DESMIDIEÆ.

Hyalotheca dissiliens Sm.
Didymoprium Borreri Ralfs.
Desmidium Swartzii Ag.
„ quadrangulatum Ralfs.

Frequent in bog pools, Loughrigg, forming, together with *Hyalotheca dissiliens*, dense green slimy floating masses.

Sphærozosma vertebratum Bréb.
„ excavatum Ralfs.
Micrasterias denticulata Bréb.
„ rotata Grev.

MICRASTERIAS CORNUTA n. sp. Fig. 6.

Frond oval, very large, 0·355 mm. in length, 0·305 mm. in breadth. The two terminal lobes urn-shaped, very light green, slightly projecting beyond the margin, and quite distinct for their whole length, reaching down to an oval quite colourless piece in the centre; ends of terminal lobes colourless, concave, not dentate or fimbriate. Each quarter with two deep and three less deep incisions. Margin 27·5 μ wide, perfectly colourless, consisting of six distinct pieces, each with a deep indentation.

Stream between Codale and Stickle Tarns, at an elevation of about 1800 feet. Seems quite distinct, not only from its very large size, but in other characters. Differs from *M. denticulata* in the prominence and distinctness of the terminal lobes; from *M. rotata* in the terminal lobes and segments of the colourless margin not being bidentate.

Micrasterias fimbriata Ralfs.
„ papillifera Bréb.
„ truncata Corda.
„ crenata Bréb.
Holocystis oscitans Hass. (*Micrasterias oscitans* Ralfs; *Tetrachastrum mucronatum* and *oscitans* Dixon; *Micrasterias mucronata* auct.). Figs. 7–10.

This very polymorphic species seems to me to have been well separated by Hassall as the type of a distinct genus; and, according

to the laws of priority in nomenclature in use among phanerogamic botanists, his name excludes Dixon's *Tetrachastrum*. The complete absence of radiating lobes and of marginal incisions, as noted by Hassall, separates it well from *Micrasterias*. The general form and the thickness of the frond seems to me indeed to bring it nearer to *Euastrum*, which genus it approaches through *E. pectinatum*. The most perfectly developed form is that represented in fig. 7, which is not, however, drawn by either Hassall, Ralfs, or Wolle. The apical segment is bidentate; the basal segment bidentate at the base, and with an additional tooth on the shoulder; but any or all of the teeth may be wanting; and that this does not constitute specific difference is seen by the frequent occurrence of specimens, as shown in fig. 8, in which the two halves exhibit this character in very different degrees. Fig. 9 represents an individual dividing. The cell-wall is finely punctate, as shown in fig. 10. The size is as variable as the form. In the specimen figured, the length of the frond is 175 μ; breadth of basal segment, 140 μ; of apical segment, 115 μ; breadth of isthmus, 35 μ; width of neck, 55 μ. Both Ralfs's and Wolle's measurements are smaller; but I have seen specimens considerably larger.

Very common in bog pools. In the genus *Holocystis* I should include *Micrasterias pinnatifida* Ralfs, *M. laticeps* Nords., *M. Kitchelii* Wolle, and *M. disputata* Wood (probably none of these are specifically distinct); also *Euastrum intermedium* Cleve, and var. *cuspidatum* Wolle, and *E. urnæforme* Wolle.

Euastrum verrucosum Ehrb. Yewdale Fells, Lancashire, and Ambleside.
„ oblongum Grev.
„ *multilobatum* Wood ('Fresh-water Algæ of North America,' p. 135, t. xii. f. 10). Fig. 11.

Length of frond, 90 μ; breadth, 65 μ; breadth of isthmus, 25 μ. Differs from *E. oblongum* in its smaller size and in the more horizontal direction of the lobes, but agrees in general outline. The terminal lobe is also quite undivided by any vertical incision. The specimens observed by me correspond very closely to Wood's description and figure; the species has apparently not been observed before in Europe. Bog pool, Loughrigg.

Euastrum crassum Bréb.
„ pinnatum Ralfs.
„ affine Ralfs.
„ ampullaceum Ralfs.
„ insigne Hass.
„ cuneatum Jen.

This seems to me a very well-marked species.

Euastrum Didelta Turp.
„ ansatum Ehrb.
„ circulare Hass.
„ pectinatum Bréb.
„ gemmatum Bréb.
„ rostratum Ralfs.

Euastrum ornithocephalum n. sp. Fig. 12.

Frond minute, 57 μ long, 30 μ broad. Each frustule with a basal and central rounded lobe, and a terminal lobe moderately deeply divided vertically, and with a single projecting tooth, the lobe resembling a bird's head. Sutural division somewhat shallow. Cell-wall tuberculated. Near to *E. rostratum* and to *E. pseudelegans* Turn. (Journ. R. Micr. Soc., 1885, p. 935), from the United States, but somewhat larger; the terminal lobe resembling that of *E. elegans*. Bog pool, Loughrigg.

Euastrum elegans Bréb. β inerme Ralfs.
„ binale Turp.

Euastrum Lundellii n. sp. (*E. binale* γ *elobatum* Lund., Desm. Suec., p. 23, t. ii. f. 7). Fig. 13.

Frond very minute, 28 μ long, 14 μ broad, truncately elliptical in outline. Frustule three-lobed; terminal lobe truncate, gibbous, slightly concave, entire, 11 μ broad. Sutural constriction deep. Each frustule with a moderately conspicuous projection in the centre.

Among Sphagnum, Loughrigg. Agrees in form and size with Lundell's variety of *E. binale*, but seems sufficiently distinct to merit specific rank.

Euastrum erosum Lund.
„ insulare Wittr.
„ *crenatum* Ktz. (Phyc. Germ., p. 135). Fig. 14.

Frond minute, about the size of *E. elegans*, 45 μ long, 30 μ broad, hexagonal in outline; terminal lobe with quite straight extremity and very slight vertical incision, 20 μ broad. Each frustule with about three shallow crenations on each side. Suture shallow. Cell-wall not punctated.

Bog pool, Loughrigg. This little-known species presents well-marked distinctions from *E. elegans*. Although named in Ralfs's 'British Desmidieæ,' it does not appear to have been noticed in Britain before.

Cosmarium sublobatum Arch. (*Euastrum sublobatum* Bréb).

This species seems clearly to have been placed in the wrong genus by Brébisson and Ralfs.

Cosmarium quadratum Ralfs.
„ Cucumis Corda.
„ Ralfsii Bréb.
„ pyramidatum Bréb.
„ crenatum Ralfs.
„ undulatum Corda.
„ tetraophthalmum Ktz. Above Easedale Tarn.
„ Botrytis Bory.
„ margaritiferum Turp.
„ Brébissonii Menegh. A good species.
„ speciosum Lund.

This beautiful species has already been recorded from Ireland by Archer.

„ amœnum Bréb.
„ cœlatum Ralfs.
„ ornatum Ralfs.
„ cristatum Ralfs. Furness Fells and Wetherlam, Lancashire.
„ Logiense Biss. (Journ. R. Micr. Soc., 1884, p. 194, t. v. fig. 4).
„ turgidum Bréb.
„ Cucurbita Bréb.
„ moniliforme Turp.
„ *Wittrockii* Lund. (Desm. Suec., p. 31, t. iii. f. 14). Fig. 15.

Frond very minute, shape of *C. margaritiferum*, but not crenulated, nearly circular in outline, 25 μ long, 22·5 μ broad; the two frustules slightly unequal; constriction deep; isthmus 10 μ broad. Cell-wall not punctated, perfectly smooth.

Frequent in bog pools, Loughrigg; not recorded before in Britain. Certainly a mature form, as it was several times seen in division.

Cosmarium *oblongum* mihi (*Cosmarium* sp. Reinsch, Cont., p. 82, t. xlii. f. 3). Fig. 16.

Frond minute, 55 μ long, 22 μ broad at its broadest part; each frustule elliptical, longer than broad, equally rounded at the base and the apex; isthmus 11 μ broad. Cell-wall not punctated, perfectly smooth.

Bog pools, Loughrigg; new to Britain. Resembles *C. moniliforme*, except that the frustules are elliptical instead of circular.

Xanthidium armatum Bréb.
„ aculeatum Ehrb.
„ fasciculatum Ehrb.

Xanthidium spinulosum n. sp. Plate II. fig. 17.

Frond moderately large, the shape of *X. fasciculatum;* each frustule elliptical or slightly hexagonal, 80 μ long by 40 μ deep; isthmus 60 μ. Each frustule furnished with four pairs of geminate curved spines about 25 μ long; the whole of the rest of the edge ciliated with closely set spines or teeth, in one specimen about 12 μ long, in another specimen much shorter. Endochrome very granular, with a lighter less granular portion in the centre of each frustule.

Stream between Codale and Stickle Tarns, at an elevation of about 1800 feet. Resembles *X. fasciculatum* in general outline, the length and breadth of the frond being almost exactly the same; but the constriction between the frustules is much less deep, and the secondary spines seem sufficient to establish it as a distinct species.

STAURASTRUM BULLOSUM n. sp. Figs. 18–20.

Frond moderately large; each frustule elliptical, more than twice as long as broad; 85 μ long, 38 μ wide, triangular in front view, united by a narrow isthmus 35 μ wide. Each frustule with a hemispherical projection which is very conspicuous, especially on front view. Frond and projection uniformly verrucose. Both frond and projection fringed with colourless equidistant unbranched subulate spines.

Among moss in stream flowing out of Loughrigg Tarn, and elsewhere, apparently frequent. In outline and the equidistance of the spines, and in the triangular front view, this beautiful species is distinctly a *Staurastrum,* but it is double the diameter of *S. teliferum,* which it most nearly resembles. The hemispherical projection on each frustule, which is remarkably conspicuous, seems to indicate an affinity with *Xanthidium,* some species of which it closely resembles in general appearance.

Staurastrum dejectum Bréb. Forms α and γ.
„ Dickiei Ralfs.
„ muticum Bréb.
„ muricatum Bréb.
„ hirsutum Ehrb.
„ teliferum Ralfs β CONVEXUM n. var. Figs. 21–23.

One of the commonest *Staurastra* in moor pools. I am unable to distinguish it from Ralfs's species except by the sides being slightly convex, and therefore regard it as a variety of that species, which both Ralfs and Wolle describe as having concave sides on front view. The spines are much stouter and less numerous than in *S. hirsutum.* The process of division of this species is extremely interesting, and presents one of the most rapid

instances of growth with which I am acquainted. In one example, when first observed (fig. 22) the new pieces were but slightly smaller than the old pieces, only partially filled with endochrome, and the cell-wall perfectly smooth. While under observation and drawing they grew to their full size, and became entirely filled with endochrome. The first appearance of spines was now seen; they rapidly increased in stoutness, and within an hour from the time of first observation the new individuals were perfectly formed. During the whole of this time the individual was in constant motion, but became quiescent as soon as the new formation was completed. The pair remained in contact till the next morning.

Staurastrum Pringsheimii Reinsch.
„ alternans Bréb.
„ punctulatum Bréb.
„ dilatatum Ehrb.
„ polymorphum Bréb.
„ gracile Ralfs.
„ levispinum Biss. (Journ. R. Micr. Soc., 1884, p. 195, t. v. fig. 5).
„ controversum Bréb.

STAURASTRUM TUBERCULATUM n. sp. Fig. 24.

Frond moderately large, 70 μ long by 55 μ broad; each frustule nearly hexagonal in shape, 37 μ broad at the apex, 30 μ at the isthmus; the terminal and upper lateral edges nearly straight or slightly convex; the lower lateral edges concave. The whole margin, except the lower lateral edges, rough with pearly granules, which are larger at the corners. Surface of frond tuberculated.

Bog pool, Loughrigg. Belongs to the section with concave sides; near to *S. nitidum* Arch. and *S. Sebaldi* Reinsch.

Staurastrum? enorme Ralfs. Fig. 25.

This rare and remarkable desmid was gathered in a bog pool on Park Fell. Although, as described by Ralfs, it is by far the least symmetrical species of the genus, the bilateral symmetry is nevertheless seen in certain positions. The frustules are tuberculated, and from each tubercle springs a cluster of hyaline spines with a common base. Some writers give this as a synonym of *Polyedrium enorme* dBy., but probably in error, as a figure in Cooke's 'British Fresh-water Algæ' certainly does not represent this plant.

Arthrodesmus convergens Ehrb.
„ Incus Bréb.
Cylindrocystis diplospora Lund. (Desm. Suec., p. 83, t. v. fig. 7.)

Frequent. Probably frequently overlooked from its resemblance to the bicellular condition of a *Mesocarpus*, but easily distinguished

by its smaller size, and the very light green endochrome, with a distinct vesicle in the centre of each semi-cell or frustule.

Tetmemorus Brebissonii Menegh.

Zygosperm large, orbicular, olive-brown, about 1·66 times diameter of frond, not inclosed in a membrane, resembling therefore that of *T. granulatus* rather than of *T. lævis*.

Tetmemorus lævis Ktz.
„ granulatus Bréb.

Tetmemorus penioides n. sp. Fig. 26.

Frond about the size of *T. granulatus*, 190 μ long, by 47·5 μ broad, linear-elliptic, distinctly notched at each extremity, but without any lip-like process. Margin continuous, with scarcely any constriction. Cell-wall not punctated or granulated.

Among Sphagnum, Furness Fells, Lancashire, apparently frequent. This species appears to form a connecting link between the genera *Tetmemorus* and *Penium*. The absence of a central constriction is characteristic of the latter genus, while the terminal notch seems to bring it under the former.

Penium margaritaceum Ehrb., vars. α and γ Ralfs.
„ cylindrus Ehrb.
„ polymorphum Perty.
„ lagenaroides Roy. (Journ. R. Micr. Soc., 1884, p. 197, t. v. fig. 6).
„ cucurbitinum Biss. (l. c. p. 197, t. v. fig. 7).
„ digitus Ehrb.
„ interruptum Bréb. Park Fell.
„ closterioides Ralfs.
„ truncatum Bréb.
„ Brebissonii Ralfs.
Docidium nodulosum Bréb. Ambleside.
„ truncatum Bréb.
„ clavatum Ktz.
„ baculum Bréb.
Spirotænia condensata Bréb.
„ obscura Ralfs. Furness Fells.
Closterium Lunula Müll.
„ acerosum Schrank.
„ turgidum Ehrb. Park Fell.
„ Ehrenbergii Menegh.
„ Dianæ Ehrb.
„ didymotocum Corda var. β Ralfs.
„ costatum Corda.
„ striolatum Ehrb.

Closterium intermedium Ralfs.
„ juncidum Ralfs.
„ cornu Ehrb.
„ acutum Bréb.

ZYGNEMACEÆ.

Zygnema cruciatum Cleve. Fig. 27.

This is much the commonest species of the order in the mountain streams. It was rarely seen in conjugation; and in lateral conjugation not at all. Measurements showed in some instances the female cells distinctly larger than the male cells; in others there was no appreciable difference. In several instances one male filament was seen in conjugation with two female filaments, never the reverse. In one instance a zygosperm was seen germinating while still inclosed in the parent filament; and then, in harmony with observations previously made on *Spirogyra*,* the direction of the germinating filament was at right angles to the axis of the parent-cell. This was the more remarkable, as the zygosperm is in this species quite spherical.

Zygnema Hassallii mihi (*Tyndaridea anomala* Hass.; *Zygnema anomalum* Cooke, not Ktz.). Figs. 28–30.

Cells 52 μ in length, 28 μ in breadth; zygosperm perfectly spherical, 20·5 μ in diameter, olive-green to emerald-green. This species is common in roadside runnels, and presents several distinctive characters from others of the genus. In the non-conjugating and most frequent condition (fig. 28), the cells are almost entirely filled up by a dark-green endochrome; it is only when about to conjugate (fig. 29) that it becomes differentiated into two stars; and then not so distinctly as in *Z. cruciatum*. The mucous sheath by which the filaments are invested is distinctly visible at all stages. Conjugation seems to take place only when the filaments are nearly dried up, and has apparently only been observed in this country by Hassall, Ralfs, and Jenner. I can entirely confirm the statement of these observers that the zygosperms are formed in one of the conjugating filaments (fig. 30); Kützing's species, in which they are formed in a canal between the filaments, must, therefore, be a different one. I think, however, Hassall is in error in figuring the zygosperms as formed indifferently in either filament; this is quite contrary to numerous observations of my own.

Spirogyra porticalis Vauch.
„ longata Vauch.
„ tenuissima Hass.

* Journ. Linn. Soc. (Bot.) xx. (1884) p. 430.

MESOCARPEÆ.

Mesocarpus scalaris dBy.

MESOCARPUS (?) NEAUMENSIS n. sp. Figs. 31, 32.

Sterile cells 125 μ long by 20 to 25 μ broad. Endochrome in a single axile plate, with one row of large starch-corpuscles, and numerous smaller ones. Conjugation lateral, between two adjacent cells. Fertile cells somewhat ventricose, 200 μ long by 50 μ broad at the widest part, connected with the adjoining empty cell by an elbow 50 μ broad, across which the dividing septum reaches only about half-way. Zygosperm oval, 90 μ by 40 μ, always nearer to the end of the cell where conjugation has taken place; cell-wall of zygosperm quite smooth.

Gathered in a duck-pond, Neaum Crag, Skelwith Bridge. I am doubtful about placing this interesting species under *Mesocarpus*. It agrees with that genus altogether in general appearance and in the arrangement of the endochrome; but I am quite unable to detect the extra membrane to the zygosperm on which de Bary and Wittrock rely to establish the essential difference in the process of "spore-formation" in the Mesocarpeæ and Zygnemeæ; and wherever lateral conjugation has been observed in *Mesocarpus* (by de Bary), the zygosperm is formed not in one of the two cells, but in the connecting canal between them. In some respects, especially the ventricose appearance of the fertile cells, it approaches Wittrock's genus *Gonatonema*. If placed in *Mesocarpus*, *M. neaumensis* differs from all the other species with smooth membrane to the zygosperm, in the form of the cells, and in the size and form of the zygosperm, as well as in the mode of conjugation.

Staurospermum gracillimum Ktz.

SIPHONEÆ.

Vaucheria sessilis Vauch. Ambleside.

,, terrestris Lyngb. Pool in slate quarry, Yewdale Fells, Lancashire.

ŒDOGONIACEÆ.

Œdogonium vernale? Wittr. Furness Fells.

,, macrandrum Wittr. Fig. 33.

Oogonia pear-shaped, three together, 40 μ in length. Dwarf male as long as length of oogonium, two-celled, attached to the centre oogonium. Furness Fells.

Œdogonium acrosporum? dBy. Furness Fells.

Bulbochæte setigera Ag.

,, pygmæa Wittr.

II.—*Explanatory Notes on a series of Slides presented to the Society, illustrating the action of a diamond in ruling lines upon glass.* By Prof. William A. Rogers, F.R.M.S.

(*Read* 10*th June*, 1885.)

First Series. Ruled previous to 1882.

This series of slides was ruled with a knife-edge diamond.

No. 1. Before ruling the lines on this plate, the knife-edge was set as nearly parallel with the line of motion in ruling as was possible by sighting along the edge with a magnifying glass. The lines were ruled in the direction of the >. A few lines of each group were ruled with a forward motion of the diamond and the remainder with a backward motion of the diamond. Between each group the angle of inclination was changed. It will be seen that the last four lines of the last group show a decided improvement in quality.

No. 2. In this plate successive trials failed to give any decided improvement until near the end. In the last three or four groups the forward motion gave a heavy line with a pretty sharply defined groove near the middle of the line, while the edges are well defined by finer lines. When lines of this character are obtained, the diamond may be considered to be nearly in the best adjustment. The backward motion with the same pressure gave fairly good fine lines.

No. 3. This plate was ruled with the same setting as No. 2, but with heavier pressure. The lines when first ruled were very beautiful. After several days, the exact number being unknown, the first band *exploded* and the remaining lines took on the form of a strand of rope. The pressure of the diamond upon the glass was evidently too great, producing lines which remained in a state of tension until the rupture took place.

No. 4. Lighter pressure than in No. 3. Heavy lines retain their form and fine lines fairly good.

No. 5. Backward motion of diamond with the same pressure as the heavy lines of No. 4. A very curious specimen. Cover broken.

No 6. Windrows of fine particles of glass. A slightly different inclination of the diamond from that with which No. 5 was ruled.

No. 7. Many trial plates intervene between No 6 and No. 7. Various settings of the diamond were tried for the purpose of obtaining tolerably heavy lines, which should present nearly the same appearance after the surface of the glass was sharply rubbed *in the direction of the lines* as when fresh from the diamond and undisturbed. It must be understood that there is not one case in a thousand in which the line appears as well after the surface of the

glass is rubbed as before. In this case one edge of the undisturbed line is sharply defined and the same edge is fairly well defined after cleaning. The strand-like appearance of a few of the single lines first appeared several weeks after the lines were ruled. The diamond may now be said to be in a fairly good working condition.

No. 8. In order to be sure that the diamond with the same setting as in No. 7 would continue to rule good lines, the lines of this plate were ruled with a varying pressure and with both backward and forward motion of the diamond. The lines of this plate will bear careful study.

No. 9. In this plate, which immediately followed No. 8, I have for the first time succeeded in preserving positive proof of a fact long suspected, that the *best heavy lines* are not grooves in the glass but windrows of particles of glass thrown up by the diamond, but so fine that the Microscope cannot separate them. When first ruled, the lines of this plate were of the most beautiful character. After a while the single lines began to show indications of breaking up, while the lines of the band remained nearly intact. As a test, I removed the cover from the cell and rubbed the surface of the glass sharply, at right angles to the lines, but leaving about one-half of the lines undisturbed. *Now*, we have in the upper part of the band the original lines, retaining, it is true, only a portion of their former beauty, but clearly unlike those in which the particles of glass have been, by rubbing, scattered over the entire surface of the groove. The particles stick to the groove with great tenacity. It is impossible to remove them by rubbing crosswise. I shall show in the fourth series of slides that they can be removed by rubbing lengthwise. It will be seen that the undisturbed lines are to a certain extent broken up, appearing thus - - - - - - -. There was no evidence of this appearance for several weeks after the lines were ruled. It is my opinion that the appearance is due to the slight sweating which has taken place. At least I have seen several instances in which this particular appearance is shown in plates in which sweating has taken place. This plate will repay a careful study.

No. 10. Position of diamond changed a trifle from that with which No. 9 was ruled.

No. 11. Lines from forward motion of diamond very good. In this plate we have an illustration of what often occurs, namely the formation of minute specks several weeks after the ruling of the plate. I am inclined to believe that they are particles of glass. I am sure that the glass was perfectly clean when mounted.

No. 12. A slight elevation of diamond after ruling No 11. This is another illustration of the fact stated under No. 9. It is one of the most remarkable specimens I have ever obtained. The plate will repay a most careful study.

No. 13. This plate was ruled both with forward and backward motion of the diamond, and with varying pressure. Several plates intervened between this one and No. 12, in which the slightest possible adjustment of the diamond was made.

No. 14. Up to the present time (1881) this is the most perfect plate I have ever produced. I do not at first expect to be believed when I say that what appears to be the edge of the groove at one edge of the line is a windrow of glass turned up from the groove. Careful inspection, however, will show a clear space between the real edge of the groove and the jet black line. That is, one sees two faint lines which are the edges of the groove and the black line on the right, which is really a windrow of particles of glass. In a later plate I shall *prove* that this explanation is the true one.

No. 15. A test-plate for the limit of vision. Bands of fine lines following a heavy line. The lines of the last two bands invisible, but brought out clearly in a duplicate plate mounted in Professor Hamilton Smith's new medium. It should be said that the lines of this plate are far less sharply defined than when first ruled.

Second Series. Ruled in 1882–3.

No. 1. This plate preceded by several trial plates.

No. 2. Varying pressure of diamond. Sweating has taken place in this plate and in the preceding one. Attention is called to the fact that the sweating does not usually take place near closely ruled bands of lines, especially if the lines are heavy.

No. 3. A remarkable specimen of lines formed by furrows of glass. The lines are mounted lengthwise of the slide. Attention is called to the arrowheads at the end of each line and to the deposit of a particle of glass on every line a little distance from the end. It will be seen that the sweating upon the surface occurs at a considerable distance from the bands.

No. 4. Another illustration of the fact that sweating does not usually take place near heavy ruled lines. The lines of this plate are filled with graphite.

No. 5. Upon the whole this plate is the best illustration yet obtained of the action of a perfect ruling crystal. The curved lines, which are formed by the intersection of straight lines, take the graphite almost as well as the straight lines. This plate should be examined under a 1/4 or 1/5 in. objective.

No 6. This plate of squares 100 to the inch is a good illustration of a good groove well filled with graphite.

No. 7. In this plate the graphite presents a granular appearance, which is often seen when ruled lines are repeatedly filled with graphite. When the lines of this plate were first filled, directly

after being ruled, the plate presented a most beautiful appearance under a low power.

No. 8. The lines of this plate are filled with graphite. The peculiar mottled appearance of the glass will be at once noticed. With glass of this quality I have *always* obtained lines which fill perfectly with graphite.

No. 9. The observer is requested to examine the lines at the end of the band nearest the star on the label and to determine approximately the number of lines to the inch before examining the other end of the band of which the fifth and tenth lines are longer than the others.

Third Series. Ruled in 1883–4.

No. 1. A very remarkable action of the diamond.

No. 2. Varying pressure of diamond. Examine the very heavy chips thrown off at the end of each line.

No. 3. The only specimen of this peculiar action of the diamond ever obtained. Attention is called to the form of mounting which was here employed for the first time. The small hole in the edge of the metal ring allows a free circulation of air and absolutely prevents sweating.*

No. 4. This plate followed No. 3 with a slightly greater pressure of the diamond. There is a little dust between the plates. In fact, several of the plates are defective in this way, but upon the very rare occasions on which these and similar specimens were obtained, the sole and first object was to preserve the lines intact, as soon as possible and without regard to minor defects.

No. 5. Varying pressure of diamond. The fine lines superb, but in some places a little wavy.

No. 6. Examine the chips at the end of the heavy lines, also the quality of the fine lines.

No. 7. This plate will repay a careful examination as illustrating the action of the diamond similar to that in plate 9 of the first series.

No. 8. Upon the whole, the most remarkable specimen ever obtained. This plate, like No. 7, will bear a most careful study.

No. 9. Illustration of a *local explosion*. In this case the explosion took place at least one month after the lines were ruled. It is not known exactly when it occurred.

No. 10. Varying pressure of diamond. It will be seen that the slight rubbing of the surface has in some places disturbed the straightness of the fine lines.

No. 11. Varying pressure of diamond. Fine lines good.

* I am not quite sure of this statement. Oct. 1885.—W. A. R.

No. 12. With one exception the only ruling producing circular chips ever obtained.

No. 13. Examine the line at the bottom of the groove of the fine lines. This line is a real groove in the glass.

No. 14. Very delicate threads thrown off from heavy lines.

No. 15. Both threads and chips from the same diamond.

No. 16. A second instance of a local explosion. Examine the delicate threads beyond the ends of the lines.

Fourth Series. Ruled in 1885.

No. 1. Plates Nos. 1, 2, 3, 4, and 5 of this series furnish positive proof of the fact that the lines which appear to be the most perfect in form are not produced by grooves cut in the glass, but by windrows of minute particles of glass thrown up by the ruling diamond. In this plate the real groove is about $2 \cdot 2\ \mu$ in width, the space between one edge of the groove and the furrow is about $1 \cdot 0\ \mu$, and the width of the windrow is between $0 \cdot 1\ \mu$ and $0 \cdot 2\ \mu$.

No. 2. The windrow of glass is a little better defined on this plate than on No. 1, being if anything a shade narrower. The lines on Nos. 1 and 2 were ruled on the under side of the cover.

No. 3. This plate was ruled with exactly the same pressure of the diamond as Nos. 1 and 2, but the lines are upon the slide. Before the disturbance of the surface the lines presented precisely the same appearance, and had the same width as in those two plates. After rubbing the surface of the glass at right angles to the lines, the windrows were completely broken down and the particles of glass were scattered over the entire surface, clinging to the surface in the grooves only. Doubtless, the greater part of the windrow was entirely removed from the surface by rubbing. That the windrows are not entirely broken down, however, is evident from the fact that the extreme width of the lines is the same as before—viz. about $3 \cdot 2\ \mu$.

No. 4. In this plate the lines, after being ruled, were examined carefully, and were found to present the same appearance as in No. 3 before cleaning. Their width was also found to be the same. The lines were then rubbed crosswise when their appearance was precisely the same as in No. 3. They were then *scoured* by rubbing with a cleaning powder in the direction of the lines. The first thorough cleaning removed only about two-thirds of the débris. After a subsequent and more thorough cleaning they were covered. *The width of the lines is now the same as the width of the groove after ruling and before cleaning—viz. about* $2 \cdot 2\ \mu$.

No. 5. In order that it may not be said that the lines upon the cover-glass have a different width from that upon the slide, the lines of this plate were ruled upon the slide, and the surface was

cleaned by rubbing *in the direction of the lines only.* It will be seen that the particles of glass are more completely removed in this plate than in No. 4. It should be noted here that the best lines are *always* obtained by rubbing in the direction of the lines and *never* by rubbing at right angles to the lines. *That the width of the lines remains* 2·2 μ *seems to be positive proof that the portion removed was a real windrow of minute particles.*

No. 6. This plate, after ruling, presented the same appearance as No. 2. It was then sent to Prof. Hamilton L. Smith to be mounted in his new medium, with the expectation that the brilliancy of the spectrum would be sensibly increased. It will be seen that this expectation has not been realized. The only explanation which I can offer for this unexpected result, is that the apparent lines being elevations, appear as projections. By focusing upon the bottom of the real grooves, a very fine line is seen which was not noticed before. In a previous plate of heavy lines, kindly mounted for me by Prof. Smith, the sharpness of definition was increased to a very marked degree.

No. 7. This plate is half of a slide ruled upon my old machine in 1881. One set of lines was ruled on the slide, and another set upon the cover. Mr. Tolles aided me in a thorough examination of these bands. We were never able to see the fine lines which form the continuation of the 1/24000 band. This plate was sent to Prof. Smith for experiment with his new medium. He removed the cover from the rulings upon the slide, remounted the bands in his medium, and after cutting the slide into two parts sent one half to me. The lines are in every way improved, and the fine lines of the 1/24000 band are easily seen.

Fifth Series. Ruled in 1885.

No. 1. A convenient form of stage micrometer. Each successive band ruled with a lighter pressure of the diamond. As there may have been a slight disturbance of the diamond produced by removing the weights, the bands may not be exactly equidistant. The measurements, therefore, should be from lines composing the the bands.

No. 2. Metric stage micrometer similar to No. 1.

Nos. 3, 4, 5, 6, 7, and 8. Eye-piece micrometers of various patterns.

III.—*On the Preparation of Sections of Pumice-stone and other Vesicular Rocks.*

By H. J. Johnston-Lavis, M.D., F.G.S.

(*Read 11th November*, 1885.)

The art of making sections of rocks of a compact structure, or even slightly vesicular lavas, presents no other difficulties than those which have now been overcome; but when thin slices of pumice-stone or very bullate scoria are required, many difficulties arise.

In the first place, when the section reaches a moderate degree of thinness, it becomes an open network of substance that is very fragile, and the strain put upon the delicate trabeculæ by the friction of grinding breaks them down long before the requisite thinness is reached. In the case of pumice, unless the section is very thin, little can be learnt, on account of the darkness and clouding produced by the still unopened minute air-cavities. Another important difficulty is due to the different resistance of large crystals and the comparatively soft vitreous or microcrystalline base in which they are imbedded. In consequence of this, the very feeble support of the setting (so to speak) is insufficient to resist the grinding action, so that the crystals are torn out and plough a line quite across the preparation. The third difficulty is that any pulverulent substance, such as emery, must be avoided, since new cavities are continually being opened, which get choked with the detritus and spoil the preparation for examination.

In most books we are recommended to boil the pumice in Canada balsam, but a moment's thought will prevent our spending any time over such an experimental failure. We know that the vesicular cavities in pumice or scoria are *closed* except at the surface, where they are fractured, and therefore a balsam bath can only enter these superficial cavities, and immediately one commences to grind, fresh ones will be opened, whose walls are left unsupported by balsam. The method I have adopted is the outcome of a long series of experiments, by which I have produced many dozens of excellent slides, even from the most fragile pumices.

The pumice may be cut into a moderately thin slice by a saw (about 0·5 cm. is convenient to work with), or if an abundance of material is at hand a level surface may be obtained with a knife; if scoriaceous pumice or scoria, a well-watered grindstone may be used. The sawdust or other dust must be brushed, blown, or washed out of the inequalities in the moderately level surface, and the slice placed on a hot plate to dry and warm. When thoroughly dry, and while still on the hot plate, a stick

of hard balsam * is rubbed over its surface, so as to thoroughly fill in all the opened cavities and leave a superabundance on the surface. It should be left quiet on the hot plate for another minute or two, and more balsam added if the first should have much sunk in; it is then removed and allowed to cool whilst in a horizontal position. When cold it should be ground down on the side of a smooth grindstone, or, still better, upon a slab of sandstone slightly inclined, over which is flowing a constant stream of water.† The grinding should be continued till all the broken septa are brought flush with the surface. It should then be thoroughly washed with a camel's-hair pencil and submitted to a powerful jet of water from a tap or syringe, so as to clean the newly opened cells, after which it is dried and replaced on the warm plate and rubbed with the balsam stick. When cooled the excess of balsam may be removed by grinding it on the sandstone, after which it is washed.

The following solution, which is next required, should be kept ready in a bottle:—Yellow soap, 1 part; methylated spirit, 2 parts. Dissolve. Water, 3 parts. Prepare a hone (I use a Washita stone, but probably any hard hone stone would answer) of about 8 in. × $2\frac{1}{2}$ in. × $1\frac{1}{2}$ in. Fix it conveniently on a board slightly inclined, with the narrowest edge uppermost, and drop on a few drops of the soap solution. At its upper end a small quantity of water should be constantly dripping, which by preference should also be slightly soapy. Now grind and polish the specimen on the hone until the surface is brilliant. Whenever the balsam begins to "rool" or cause hitching of the specimen add a few drops of the soap solution.‡

The polishing being complete, the specimen is thoroughly cleansed and put aside in a warm and dust-free place to dry, after which it is cemented by hard balsam to a clean slide. Since it must never be removed from its new position, as is done in the case of more durable rocks, more care is required in protecting the glass from injury. We now grind down the opposite side to almost transparency on a well-watered grindstone, and by practice in presenting different parts of the specimen to the grinding surface we may reduce the slice to a sufficient thinness for almost any microscopic work. The specimen is then washed and ground perfectly level and polished on the hone, with water and soap-solution. The application of the latter requires much practice to regulate, since if too much be used it softens and saponifies the balsam, making an opaque preparation; or if insufficient, the balsam catches to the

* Prepared as usual for rock sections.

† Should the sandstone clog with balsam, it may be washed with a little strong soda lye.

‡ I have tried alkalies, spirit and many other lubricants, and feeble solvents of balsam, but the above answers best, as we want to dissolve the balsam at the same rate as we grind down the specimen.

stone and "rools," carrying the preparation with it. The slide is now washed with a camel's-hair brush and by means of a jet of water. It is then stood up to drain and left to dry. When the drying is complete (an important matter) take a soft camel's-hair brush and wash the surface of the specimen with equal parts of turpentine and benzol or chloroform, until the network begins to look raised; then drain but do not dry it. Drop on balsam dissolved in benzol or chloroform, and finish the slide in the usual way.

It is sometimes useful to employ the air-pump, but it should be done slowly and no attempt made to produce a high vacuum. The specimens improve very much at the end of a week or a fortnight.

The above process may appear long and tedious, but after a short apprenticeship the different processes become easy, and by preparing a number of sections simultaneously no large amount of time is consumed. The study of vesicular rocks is the key to the principal phenomena of volcanic eruptions, and by its means we can read the different phases in the history of any volcano we choose. In addition, the specimens so prepared form very beautiful slides (especially in the case of a moderately crystalline pumice). It need hardly be said that it has one great recommendation, and that is that no expensive apparatus is required, whilst the method may be extended to other structures. In this way Dr. Vosmaer, of the Naples Zoological Station, and myself have succeeded in applying the method to siliceous sponges, and we are now endeavouring to modify the method so as to prepare sections of them with the sarcode intact.

Fig. 1. *Cover-glass impression-preparation from a plate-cultivation. (fuchsine). Zeiss' AA. Oc. 2.*

BACILLUS FIGURANS.

Fig. 2. *The same preparation. Zeiss' 1/18. o.i. Oc. 4.*

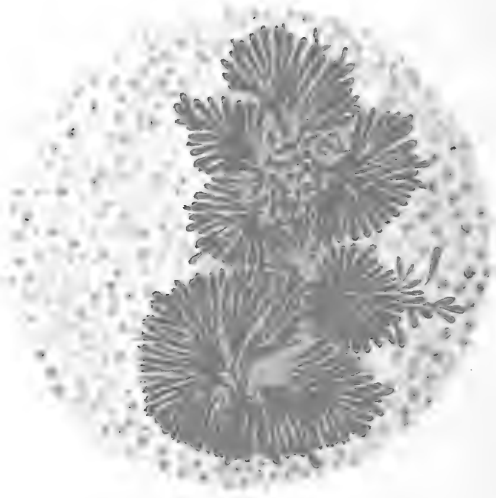
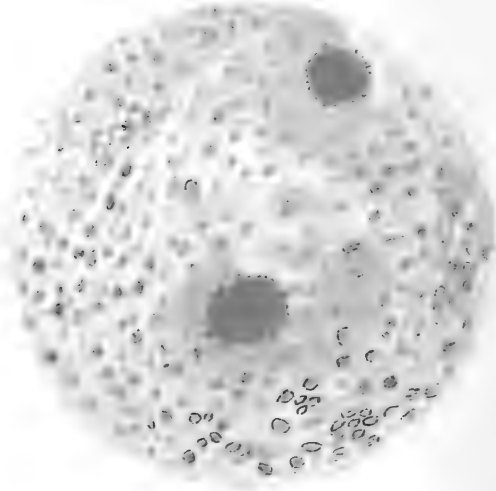


Fig. 1. From a section of a maxillary tumour in a cow.
Weigert's method. (Orseille and gentian-violet.) Zeiss' 1/12. o. i. Oc. 4.



ACTINOMYCES.

Fig. 2. From a section of the lung of a cow.
Weigert's method. (Orseille and gentian-violet.) Zeiss' 1/12. o. i. Oc. 2.

Edgar Cockshank, del. et lith.

Vincent Brooks Day & Son. Lith.

Fig. 1. From a section of a maxillary tumour in a cow. Plaut's method (Magenta and picric acid). Zeiss' AA. Oc. 4.

ACTINOMYCES.

Fig. 2. The same preparation. Zeiss' 1/12. o.i. Oc. 2.

Edgar Crockshank fec. et lith.

Vincent Brooks, Day & Son, Lith.

IV.—*On the Cultivation of Bacteria.*

By Edgar M. Crookshank, M.B. Lond., F.R.M.S.

(*Read 9th December*, 1885.)

Plates III.–V.

In the course of my remarks this evening upon the cultivation of bacteria, I shall touch upon several points which are well known to the Society. They will, however, lead me to bring forward many facts of extreme interest, and I trust of importance also, in that they disclose fresh fields for micro-biological research.

As is well known, there has been given during the last few years, more especially on the Continent, a very wide-spread stimulus to the study of bacteria. This is due in great measure to the encouraging results which have been obtained by employing the improved methods recently introduced for investigating micro-organisms.

The methods of cultivation on solid media have in many laboratories taken the place, almost entirely, of the old methods in which nutrient liquids were employed. I shall draw attention to some of the advantages offered by solid media, which may explain the reason for this change.

In the first place, the most essential thing in order to study the life-history of a particular micro-organism is to obtain and to maintain a "pure-cultivation." In the case of the pathogenic bacteria, this is emphasized by Koch as follows. Koch maintains that to prove satisfactorily that a particular micro-organism is the cause of a disease—

Firstly.—The micro-organism must be found in the blood, lymph, or diseased tissues, of man or animal suffering from, or dead of the disease.

Secondly.—The micro-organism must be isolated from the blood, lymph, or tissues, and cultivated in suitable media. These *pure cultivations* must be carried on through successive generations of the micro-organism.

Thirdly.—A *pure cultivation* thus obtained must, when introduced into the body of a healthy animal, produce the disease in question.

Lastly.—In the inoculated animal the same micro-organism must again be found.

Now, in the case of liquid nutrient media, it was no easy matter to obtain and maintain a pure cultivation.

If a drop of liquid containing several kinds of bacteria be introduced into a nutrient liquid, we have a mixed cultivation from

the very first: if then we require to isolate one species from the rest, the expenditure of much time is involved.

For example, to attain this object it was proposed, in the method of fractional dilution, to add sterilized nutrient fluid until there was an average of less than one germ to each drop of the fluid. If, then, fresh portions of sterilized nutrient fluid be inoculated with a single drop from the diluted mixture, some portions would in all probability receive no microbes, others would receive one or two, and others, again, one or more microbes of the same species. Then the growth of these microbes would give a pure cultivation of a particular species. It is obvious how complicated this process is, and how much the result would depend upon chance.

If, on the other hand, the mixture was left as a mixture, then the door was open to all sorts of conclusions. Some bacteria being unable to develope in the presence of others, or a change of temperature, or a change effected by the micro-organisms in the nourishing soil, allowing one form to predominate over another, the idea could arise that the various kinds of bacteria were but developmental forms of one and the same micro-organism. Further, very probably contamination of such cultivations led to the belief in the transformation of a harmless into a pathogenic bacterium.

In the case of solid cultivating media, on the other hand, the possible contamination of the nourishing ground by the gravitation of germs from the air is guarded against, not by elaborate apparatus or ingenious devices, but by the simple fact that test-tubes, flasks and other vessels can be inverted, and are inoculated from below.

The great secret of success in Koch's methods of cultivation consists in that we are able, from a mixture of micro-organisms, to isolate the individual species and establish a pure cultivation of each distinct form. By the same method, which is remarkable for its simplicity, if by any possibility contamination has occurred, we can separate the adventitious microbe and regain a pure cultivation.

This is accomplished in the following manner. A test-tube containing sterilized nutrient gelatin is warmed, and the liquefied jelly is then inoculated with a platinum needle from the mixture of bacteria, in such a way that the individual micro-organisms are distributed throughout the liquid medium. The liquid is then poured out upon a plate of glass, and allowed to solidify. The individual bacteria, instead of moving about freely as in a liquid medium, are fixed in one spot, where they develope individuals of their own species. In this way colonies are formed, each possessing its own characteristic biological and morphological appearances; if an adventitious germ fall upon the cultivation

during the few moments it is exposed to the air, it grows exactly upon the spot upon which it fell, and can be easily recognized as a stranger.

To maintain the colonies isolated from one another during their growth, and free from contamination, it is only necessary to thin out the micro-organisms sufficiently, and to limit the exposure of the plates to the air to as short a time as possible, both during their preparation and during their subsequent examination.

The result will depend upon the way in which the thinning or fractional cultivation has been carried out, and the colonies will be found to develope in the course of a day or two, the time varying with the rapidity of growth of the micro-organism and the temperature of the room.

If we have prepared three plates, we shall commonly find that the lower plate will contain a countless number of colonies which, if the micro-organism liquefies gelatin, speedily commingle and produce in a very short time a complete liquefaction of the whole of the nutrient medium. In the middle plate or "the first thinning," the colonies will also be very numerous; while in the uppermost plate, "the second thinning," the colonies are completely isolated from one another, with an appreciable surface of gelatin intervening. The microscopical appearances of the colonies can perhaps best be observed by placing the plate upon a slab of blackened plate glass, or upon a porcelain slab if the colonies are coloured.

The microscopical appearances are examined by placing a selected plate upon the stage of the Microscope, and it is better to have a larger stage than usual for this purpose. The smallest diaphragm is employed, and the appearances studied principally with a low power.

The morphological characteristics of the micro-organisms of which the colony is formed can then be examined in the following way. A platinum needle bent at the extremity into a miniature hook is held like a pen, and the hand steadied by resting the little finger on the stage of the Microscope. The extremity of the needle is steadily directed between the lens and the gelatin without touching the latter, until on looking through the Microscope it can be seen in the field above, or by the side of the colony under examination. The needle is then dipped into the colony, steadily raised, and withdrawn. Without removing the eye from the Microscope, this small operation may be seen to be successful, by the colony being disorganized or completely removed from the gelatin. It is, however, not easy to be successful at first, but with practice this can be accomplished with rapidity and precision. A cover-glass preparation is then made in the usual manner, by rubbing the extremity of the platinum needle in a droplet of

sterilized water, previously placed on the perfectly clean cover-glass. This, when dry, is passed three times through the flame of a Bunsen burner or a spirit-lamp, and stained with a drop of fuchsin or methyl-violet solution.

From the micro-organisms transferred to the cover-glass before it is dried and stained, from any remnants of the colony which was examined, and from other colonies bearing exactly similar appearances, inoculations should be made in test-tubes of nutrient gelatin and agar-agar. In this way pure cultivations are established, and the microscopical appearances of the growth in test-tubes can be studied.

The slower growth of the micro-organisms in solid media, and the greater facility afforded thereby for examining them at various intervals and stages of development, is an additional point in favour of these methods; and the characteristic microscopical appearances so frequently assumed are, more especially in the case of morphological resemblance or identity, of the greatest importance.

The colonies on plates of nutrient gelatin (examined with a low power) of *Bacillus anthracis*, or of *Proteus mirabilis*, the cultivations in test-tubes of nutrient gelatin of the bacillus of septicæmia in mice, and the brilliant and curious growth of *Micrococcus indicus* upon nutrient agar-agar may be quoted as examples in which the appearances in solid cultivations are absolutely pathognomonic.

As an example of the importance of these microscopical appearances in the case of morphological resemblance or identity, I need only refer to the comma-bacillus of Koch. This bacillus closely resembles in form the comma-bacillus of cholera nostras, and the comma-bacillus of the mouth, as well as a curved bacillus described as occurring in old cheese. From all these bacilli the bacillus of Koch is distinguishable by its mode of growth in nutrient gelatin when cultivated in test-tubes and on glass plates.

No one, so far as I am aware, has yet been able to demonstrate the existence of a curved bacillus, *which is exactly similar both morphologically and biologically* to the comma-bacillus of Koch. We owe, therefore, to the methods of cultivation on solid media that the presence of this bacillus serves as a reliable index to the existence of Asiatic cholera, although it may bear no causal relation whatever to the disease.

There are other facts brought to light by studying bacteria by the method of cultivation on the surface of nutrient gelatin. Not only do the colonies differ in size and colour, but sometimes the shapes assumed by the groups of bacilli are very characteristic. These appearances can be very readily demonstrated by making what is called in German a "Klatch-präparat"; by this method, we

can study the relative position of the individual micro-organisms one to another, and in some cases very beautiful preparations result. A perfectly clean cover-glass is carefully deposited on a plate, or potato-cultivation, and gently and evenly pressed down. One edge is then levered up with a needle, and the cover-glass lifted off by means of forceps. The preparation is then allowed to dry, passed three times through the flame, and stained as already described. In the case of plate-cultivations, especially where no liquefaction has taken place, the growth is bodily transferred to the cover-glass, and a vacant area mapped out on the jelly corresponding exactly with the form and size of the cover-glass which was employed.

In illustration of this method, I would call attention to a bacillus occasionally present in the air, of which I have been unable to find any written description, and for which I would suggest the name *Bacillus figurans*. (Plate III. figs. 1 and 2.)

In plate-cultivations this bacillus produces a cloudiness which gradually creeps over the surface of the gelatin. If a preparation is made in the manner I have just described, this growth is found to consist of rods which vary considerably in length. These rods lie parallel to one another, and form rows or chains which become twisted at intervals into the most curious convolutions, from which offshoots are continued in various directions. These long shoots or processes become in turn at intervals twisted into varying shapes and figures. If nutrient jelly in a test-tube be inoculated with a platinum needle charged with the bacilli, the growth appears in the form of windings on the free surface which are visible to the naked eye, from these fine filaments spread downwards into the substance of the jelly. Cultivated on a sloping surface of nutrient agar-agar the filaments spread transversely from the central streak, giving a feathery appearance.

Cheshire and Cheyne have described a peculiar mode of growth of the *Bacillus alvei* in plate-cultivations, and Hauser has photographed the peculiar grouping of certain bacteria connected with decomposition.

An interesting phenomenon which Hauser has also observed in connection with the last-mentioned bacteria, is the peculiar individual movement which they possess on solid media. This can be most conveniently studied by cultivating the bacilli in a glass capsule. The bacilli often move singly, or meet and progress in pairs, or form chain-like processions; possibly the movements are accounted for by the existence of a film of liquid as they are observed only on solid media containing less than ten per cent. of gelatin.

We may also apply the method of plate-cultivation to the examination of water, and to studying the bacteria which exist in

the soil or in food-substances, which can be sprinkled over the surface of the gelatin, and the colonies which develope studied as already described.

Lastly, if these biological appearances may be taken with other characteristics into consideration in the determination of species, we have a basis for a classification of bacteria into species, of which at present we stand in need.

These methods of artificial cultivation assist us also in determining the position in the scale of fungi of certain micro-organisms which is at present doubtful. In illustration of this, and in order to bring to your notice the specimens before you, I shall, in conclusion, say a few words with regard to the fungus *Actinomyces.*

Actinomycosis is a disease occurring not uncommonly in cattle, but very rarely in man. For the accounts of it, we are indebted chiefly to the writings of Bollinger, Israel, and Ponfick. The disease is caused by a parasite known as *Actinomyces,* or the "ray-fungus." The parasite appears in the form of a rosette, composed of club-shaped elements, and these rosettes are colourless or of a yellowish or yellowish-green tinge, and visible to the naked eye.

The fungus is believed to gain an entrance to the animal by the mouth, being taken in with the food, possibly through the medium of a wound of the gum, or a carious tooth. In whatever manner it has gained access to the living organism, it sets up inflamation, resulting in the formation of a new growth, composed chiefly of round cells, which resembles a tuberculous nodule. These nodules may break down and suppurate, or they may go on increasing in size; fibrous tissue developing between the nodules, large tumours eventually result, containing purulent cavities and excavations. In the slimy detritus, the little pale-yellow grains of fungus can be detected. In cattle, the lower jaw is usually affected, and then the upper jaw and neighbouring parts. The organism may also occur in nodular tumours of the pulmonary, subcutaneous, and intermuscular tissue; it is the cause of "wooden tongue," and has also been variously described, before its true nature was understood, as bone-canker, bone-tubercle, osteo-sarcoma.

In man the pulmonary formations tend to break down early, forming fistulæ and sinuses, with the clinical characters of empyema. In one case, there were symptoms of chronic bronchitis with fœtid expectoration. In other cases, the disease originating in the lung, spread to the prævertebral tissues. If the fungus attacks bones, it produces caries. This has been observed to occur in the bodies of the vertebræ. In another group of cases, the disease has been described as commencing in the intestinal canal. The parasite has also been detected in the crypts of the tonsils of healthy pigs, and a similar, if not identical, fungus in a diseased condition of the spermatic duct of the horse. The disease has been

transmitted from cattle to cattle by inoculation, and a rabbit infected by means of a piece of actinomycetic tumour from a human subject, introduced into the peritoneal cavity.

Until quite recently, *Actinomyces* has been classed as a hyphomycete, and the flask-shaped structures regarded as gonidia. From recent cultivation experiments, Bostrom regards the latter as a result of a degenerative stage in the life-history of the fungus. Inoculations of nutrient gelatin in the form of plate-cultivations and inoculations on blood serum and nutrient agar-agar, were made, it is claimed, with success. The cultures developed in five to six days, and best at a temperature of 33–37° C. Nutrient gelatin was not liquefied. The appearances of the cultivations were described as quite characteristic; a whitish granular appearance first occurs, followed after a few days by little yellowish-red spots which coalesce in the centre; in time the periphery also becomes dotted with little yellow-centred masses. The fungus thus cultivated has been described on examination as corresponding with the form found in man and animals, and further, at one stage to consist of thread-forms, short rods, and cocci. From these observations, Bostrom has come to the conclusion that *Actinomyces* should be classed with the bacteria, forming one of the *Cladothrix* group, and possibly closely allied to the *Streptothrix Försteri* of Cohn.

In conclusion, I would draw attention to the preparations of this fungus which are placed under the Microscopes on the table. These preparations have been stained by methods somewhat recently introduced. Very beautiful results can be obtained by either the methods of Weigert or Plaut. By the first-mentioned, sections are immersed in solution of orseille for one hour. They are then rinsed in alcohol, and placed in a solution of gentian-violet which is employed as a contrast stain. (Plate IV. figs. 1 and 2.)

In Plaut's method, the sections are placed in Gibbes' solution of magenta warmed to 45° C. They are then rinsed in water, and *after-stained* in concentrated solution of picric acid, for from five to ten minutes. After this they are immersed in water five minutes, laid in 50 per cent. alcohol fifteen minutes, passed through absolute alcohol and clove oil, and preserved in Canada balsam. (Plate V. figs. 1 and 2.)*

* Plates III.–V. have been taken from Dr. Crookshank's book on 'Practical Bacteriology' (see *infra*, Microscopy 8.), the original stones having been kindly placed by him at our disposal for that purpose.—Ed. J.R.M.S.

V.—*On the Appearances which some Micro-organisms present under different conditions, as exemplified in the Microbe of Chicken Cholera.*

By G. F. Dowdeswell, M.A., F.R.M.S., F.L.S., &c.

(*Read 13th January*, 1886.)

Plate VI.

The importance of understanding the conditions under which variations may appear in the morphological characters of a micro-organism is obvious, as without such a knowledge correct specific diagnosis is impossible.

A conspicuous example of this is afforded by the microbe of chicken cholera, a disease chiefly known from the accounts given of it by Toussaint and Pasteur. The organism has been described by the latter as a micrococcus of a figure-of-8 form, surrounded by a "petit halo"; and such is a correct description of its appearance under certain conditions, with moderate amplification, up to say 800 diameters, and ordinary illumination. In a preparation dried and stained in the usual method, e. g. with an aqueous solution of methyl-violet, these appearances are changed; there is no "halo," outer envelope, or capsule; though with the same power (800) the "dumb-bell" or "figure-of-8" form remains (plate VI. figs. 1 and 5), but when we come to employ higher powers (2000 diameters and upwards), and especially more perfect methods of illumination, these appearances in the form of the cells in the same preparation are found to be deceptive. It is seen that they are mostly uniformly cylindrical; the apparent constriction of the cell-wall which gives the dumb-bell form has in most cases no existence (fig. 4). It is the plasma of the cell, which is aggregated chiefly at the ends and which stains deeply, that gives this appearance, as I have already described * in the case of the microbe of Davaine's septichæmia.

If, however, a preparation of blood from a case of chicken

EXPLANATION OF PLATE VI.

Figs. 1 and 4.—From the same preparation × 800 and 2000 respectively, showing the microbe in the blood of the pigeon, dried, and stained with an aqueous solution of gentian-violet.

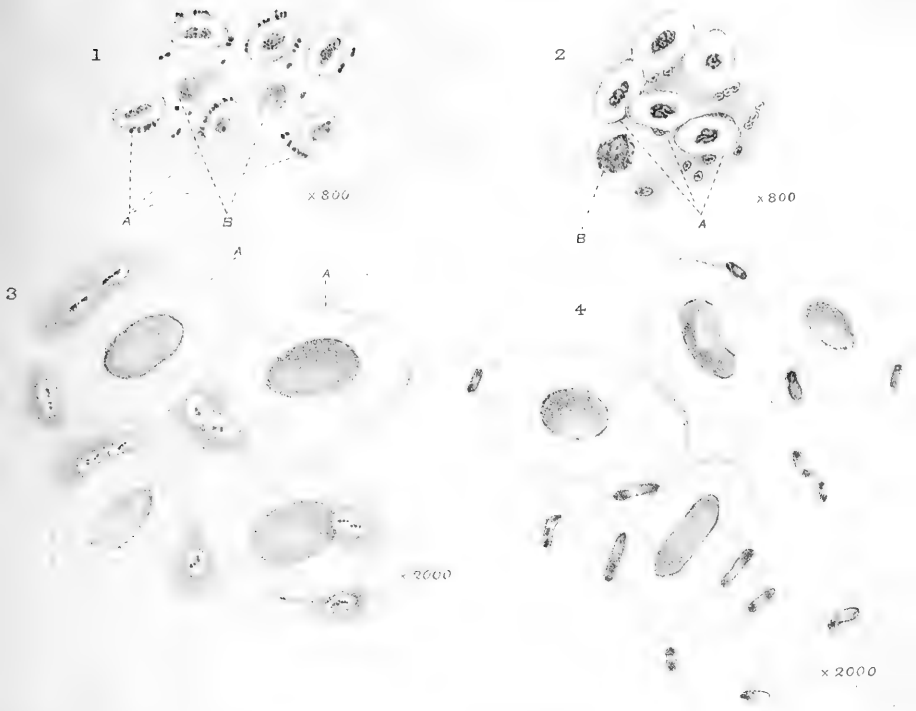
Figs. 2 and 3.—From another preparation × 800 and 2000 respectively, showing the microbe in the blood of the same case as figs. 1 and 4, but stained with an alcoholic solution of eosin, and then with a nuclear stain.

Figs. 5 and 6.—The same microbe in the blood of a rabbit, stained with an aqueous solution of gentian-violet.

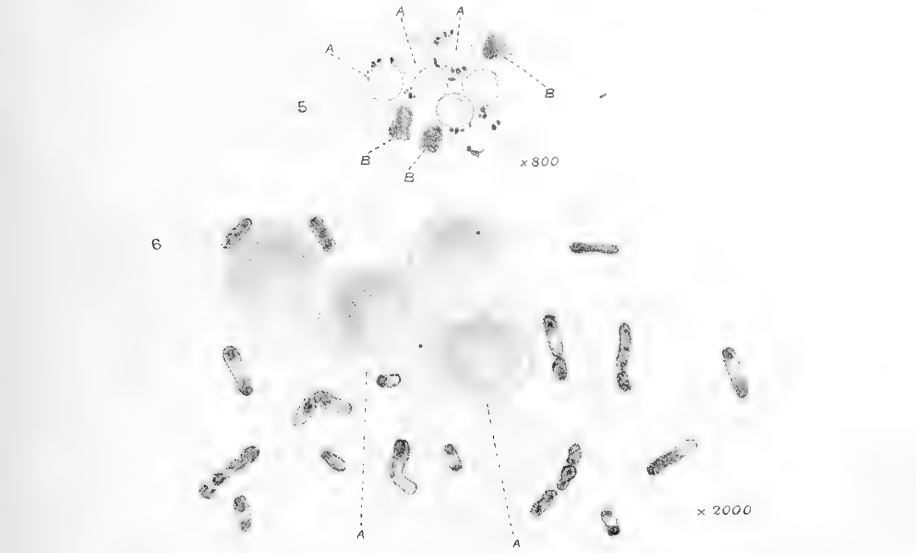
References to all the figures :—A, red, and B, white blood-corpuscles. The smaller bodies are the microbes. The larger figures are drawn with the camera lucida.

* See this Journal, ii. (1882) p. 310, and Quart. Journ. Micr. Sci., xxii. (1882) p. 66.

In blood of the Pigeon.



In blood of the Rabbit.



C.F.D. del ad nat.

West, Newman & Co. lith.

The Microbe of Chicken Cholera

cholera is dried and stained with an alcoholic solution of eosin, and subsequently with a nuclear stain, the characters of the microbe again appear totally different. The eosin stains the plasma of the blood, as also the stroma of the red corpuscles, leaving the substance of the "capsule" of the microbe unaltered; this appears white on a coloured ground, and of a considerable size. The nuclear stain colours the plasma of the cell of the microbe, but from some cause not yet evident it appears materially reduced in size, shrunk to a mere speck, totally unlike the body shown in preparations stained by the former method (figs. 2 and 3).

This appearance of a "halo" or capsule has been regarded in very different ways by different observers; some have considered it as merely an optical appearance, due to refraction and having no objective existence; others again as a specific character of particular microbes. From the preparations here shown it is evident that it has a substantial existence, but the fact that in the same organism it is visible under some conditions and in others not, proves that without further careful investigation it cannot be regarded as a specific character. It is probably mucoid or gelatinous; in unstained preparations its visibility no doubt depends upon its being of higher refrangibility than the surrounding medium, as in the blood-plasma; in dried preparations mounted in Canada balsam it is not apparent, either when unstained or stained by aqueous solutions of the usual anilin dyes; but is conspicuous as above described when an alcoholic solution of eosin is employed. In this case the reagent seems to have altered the whole character of the cell, as is seen by comparing the first and second, and the third and fourth preparations.

I lately obtained a cultivation of the virus of this disease, for which I have to thank Mr. W. Watson Cheyne, and have found on examination that morphologically the microbe is identical with that of the so-termed Davaine's septichæmia in rabbits above referred to, the slight modifications in form and size which it exhibits in different conditions being merely the variations which most, or probably all, species of the lower fungi are liable to under different conditions of nutrition, or sometimes, to all appearance, spontaneously. In blood of the fowl or pigeon it is nearly of the same size in breadth ($0{\cdot}5\ \mu$); it developes, however, to a somewhat greater length in the majority of the cells, to five or six times this size (fig. 4).

I had previously described* the microbe of Davaine's septichæmia in rabbits as a *Bacterium*, to the characters of which genus as defined by Cohn it seemed most nearly to correspond, as it occurred in the blood in these cases, but few cells being found in the organs and other tissues. Subsequently, however, I found

* Loc. cit.

in the liver some few rods of far too great a length to be classed as *Bacteria*. These were perfectly cylindrical and unsegmented, so that I concluded it corresponded more nearly to the genus *Bacillus* of Cohn. Further examination of the blood showed some few "rods" there too. It is probable that in blood of the living rabbit, and when examined shortly after death, the cells do not attain any considerable length, as in a parallel manner the typical bacilli of anthrax, it is well established, do not form spores in the living animal.

The microbe here in question, however, clearly does not, I think, form spores under any conditions yet observed, and artificial cultivations die out altogether after a comparatively short time, i. e. some weeks. In blood of the fowl, however, even when death has occurred within eighteen hours of inoculation, and is examined immediately afterwards, the long bacillar cells are numerous enough. The microbes here cluster round the margins of the red corpuscles (fig. 1), giving them a beaded appearance; the white corpuscles are enormously increased in number, amounting sometimes to one in ten of the red; the microbe is not usually found within either.

The blood of a fowl in these cases is fatally infective to a rabbit, and in minimal quantities, though the symptoms are widely different in the two animals. There is also some variation in the size and length though not in the form of the microbe, as might be expected from analogy. The virus here, i. e. from the blood of a fowl, seems to be fatal to rabbits in somewhat less time than usual in the typical form of Davaine's septichæmia when originated by inoculation with putrid blood, and transmitted from animal to animal, but the post-mortem appearances and other symptoms are identically the same in both cases, and differ markedly from those in fowls, in which the large intestine is the principal seat of affection, and in a general way justifies the term cholera, though dysentery would be more appropriate.

Dr. Sternberg, U.S. Army, has described * a fatal form of septichæmia in the rabbit, caused by the subcutaneous injection of human saliva, and has given photographs of the microbe which he found therein. His description corresponds pretty well with my own observations on the organism, and in the main with the symptoms of Davaine's septichæmia in the same animal, but the figures in his photographs were to me unintelligible; they represent a colourless circular body of about 2 μ in diameter, on a dark ground, and having a dark nuclear-like centre; but their appearances are not described in the text. Recently on staining a preparation of the blood of a fowl in a case of chicken cholera, in the manner above described (viz. with an alcoholic solution of eosin, &c.), I obtained exactly the appearances here described, and

* Studies Biol. Lab. Johns-Hopkins Univ., 1882, p. 183, and Nat. Bd. of Health Bull. U.S.A., ii. p. 781.

which I have above explained. In blood of the rabbit infected from a fowl and similarly stained, we also obtain the same appearance.

We have here an instance of the effect of different methods of preparation upon the apparent characters of one and the same Micro-organism, and an illustration of the necessity for studying and understanding their action in comparing these bodies with the descriptions and figures of others. Accurate as is the description in Dr. Sternberg's text, and correct necessarily and admirable as are his photographs, it would have been impossible for any one however familiar with the microbe to have identified it therefrom, unless he had seen it under the conditions here described; nor could any one without this experience ever conjecture that two preparations made by the different methods, seen under the Microscope, and the figures 3 and 4, were one and the same organism, made from the blood of the same animal. I must add that in the blood both of the fowl and the rabbit, I believe this microbe does not form true spores, neither does it grow to leptothrix filaments, and though in many cases the dumb-bell appearance is deceptive, yet that its regular method of multiplication is by transverse fission, which occurs in an early stage of development of the cells.

Taking into consideration all the characters I have observed, and here very superficially described, as also the behaviour of the microbe in artificial cultivations, as far as I have yet been able to compare the two cases, with the fact that their development is exceedingly slow and uncertain in all the media that I have yet tried, and that both thrive better in liquid than in solid cultivations, I am of opinion that the microbe of fowl cholera and that of Davaine's septichæmia in rabbits are specifically the same; as also probably is the microparasite described by Dr. Sternberg.* The epizooty here in question, prevalent sometimes in other countries to a disastrous extent, being caused by the same contagium as is Davaine's septichæmia; a microbe, the usual habitat of which is septic matter (putrid blood or human saliva), shows that there is no sharp distinction between epizootic, or (most probably) epidemic and septic diseases, and disposes of the assertion sometimes made, that Davaine's septichæmia is "merely" an experimental disease, originated in the laboratory, and having no occurrence in nature.

In this examination, and in making the drawings of the larger

* Since this was written I have been fortunate enough to meet Dr. Sternberg, one of our American Fellows. From a conversation with him he does not appear to consider the microbe of his form of septichæmia in rabbits identical with that of Davaine's. His opinion on such subjects is entitled to the highest consideration; but he may possibly find cause to modify it on examining preparations stained by different methods.

figures with the camera lucida, I have employed an amplification of 2000 or 2400 diameters obtained with the 1/16 or 1/20 immersion objective, and a 1 in. or 3/4 in. eye-piece. Though it is easy to obtain very much higher magnification by various methods, little is gained thereby in the examination of structure, and even with the powers here employed everything depends upon the methods of illumination.

From this demonstration it will be seen how different are the appearances of one and the same microbe, not only under the action of different reagents and methods of preparation, but even under different magnifying powers; this shows the absolute necessity in investigating such organisms, of examining them under different conditions, and in the first instance, always in as natural and unaltered a state as possible, to learn their true characters, which are frequently materially altered by the mere process of drying on the cover-glass. It should also induce caution in pronouncing two microbes to be specifically distinct, from apparently slightly different characters; a tendency to do this with the result of obscuring the subject and retarding scientific progress has recently been conspicuous in at least one important micro-pathological investigation.

Lastly, with respect to the systematic position of the microbe here in question, it scarcely answers completely to the characters of any one of Cohn's genera; it certainly is not a *Micrococcus*, nor is it a *Bacterium;* it is rather a *Bacillus* as shown by the length of the cells, but it has not yet been observed to form spores as the typical species of this genus do; I should therefore prefer to term it simply, at present, the microbe of chicken cholera.

VI.—*On "Central" Light in Resolution.*

By J. W. Stephenson, F.R.M.S., F.R.A.S.

(*Read 13th January*, 1886.)

It may perhaps not be inopportune to refer to the question of resolution by "central" light, as distinguished from oblique illumination, as we have heard from time to time of certain feats having been performed with "central" light which require explanation.

It has been said, for instance, that *Amphipleura pellucida* has been so resolved, a statement which, I submit with great respect, being inconsistent with the Abbe (diffraction) theory of microscopic vision, must necessarily be incorrect, although doubtless made in the most perfect good faith.

The reason why the supposed resolution of *Amphipleura* by "central" light is considered to be remarkable, depends upon the fact, that according to the diffraction theory, the full aperture of an objective can only be utilized when the direct beam and the diffraction beam or beams are seen at the extreme margin of the back lens of the objective. The nearer these beams approach each other, the smaller is the aperture made use of, so that when the direct beam is confined to a small area round the centre of the back lens, the aperture is reduced to one half. If then as many lines to the inch *could* be resolved in the latter case, as when the two beams are wide apart, the Abbe theory would fall to the ground.

The suggestion I have referred to arises, however, from some misunderstanding of what is "central" light.

The most elementary definition of a centre, is that it is a point within a circle, from which all parts of the circumference are equidistant. It might therefore be contended on this definition, that as a beam of light cannot be a *point*, strictly "central" light is impossible; but, as my object is to discuss the question practically, I should define "central" light as a beam whose axis coincides with that of the objective, and is as narrow as possible, consistently with sufficient illuminating power.

However narrow this *quasi* central beam may be, the peripheral portions must be strictly speaking more or less oblique; but with small obliquities, it may for all practical purposes be treated as central. With every increase in its width, however, the obliquity must also increase, so that when it becomes wide enough to fill the whole of the back combination of the objective (the maximum obliquity being attained), we have a beam which combines not only strictly central light, but every other degree of obliquity from zero upwards.

The term "central" light is obviously erroneously applied to such a beam as this, although its axis coincides with the axis of

the objective. If the particular object under examination requires light of extreme obliquity for its resolution, that light is present, and it is by that light that the resolution actually takes place, just as if we had shut out all the strictly "central" light by a diaphragm, and had used the oblique light alone undiluted (so to say) by the central rays.

Applying these considerations to the case of an objective of 1·50 N.A., illuminated by strictly "central" light, the aperture is reduced to 0·75, with which the resolution of *A. pellucida* having a striation of some 95,000 to 100,000 lines to the inch, is impossible.

By increasing the width of the illuminating beam to one-third of the diameter of the back lens, we increase the available aperture of the objective from 0·75 to 1·00 N.A Still further increasing its width, by making it equal to one-half the diameter of the back lens (still keeping it concentric with the objective), we raise the available aperture to 1·125 N.A., which exceeds the theoretical limit for the resolution of *A. pellucida*.

The resolution, however, instead of being effected by "central" light, is, under these conditions, effected by *oblique light* emanating from peripheral portions of the illuminating beam, not only unassisted by the central rays, but in spite of the diluting action of the more central light with which the field is flooded.

It may be useful to show diagrammatically the positions of the diffraction pencils of *A. pellucida* relatively to the effective portions of the illuminating beam under the different conditions which I have assumed.

Fig. 1, with a beam of *quasi* "central" light, A, shows the virtual positions of the two diffraction pencils *a a*, outside or beyond the back lens, which are therefore useless.

Fig. 1.

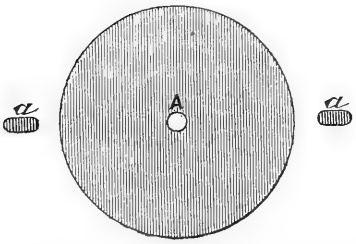


Fig. 2.

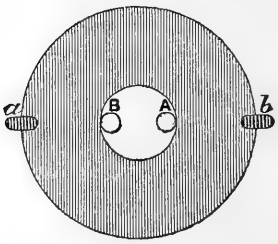


Fig. 2 shows the wider illuminating beam (equal to one-third of the diameter of the back lens), the more effective portions of which are indicated by the two small circles A and B, and their respective diffraction pencils by *a* and *b*, partly within the limits of the back combination; either pair A *a* or B *b* being sufficient to resolve if the more refrangible rays, which alone are assumed to be admitted, give sufficient intensity to the image.

In fig. 3 in like manner the small circles represent at A′ and B′ the still more effective (because more oblique) portions of the illuminating beam, with their respective diffraction pencils *a′* and *b′*. In this case the diffraction images within the limits of the back lens are more complete, and either A′ *a′* or B′ *b′* would resolve the striation on the valve, but a still more perfect image would be obtained if by a suitable stop, one pair, say A′ *a′*, and all the useless central light were shut out and the work done by B′ *b′* alone, as in fig. 4.

Fig. 3.

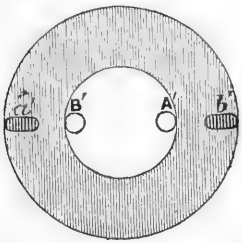
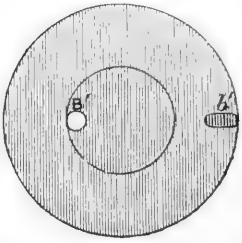


Fig. 4.



With any given objective on one and the same grating or valve, the distance between the illuminating pencil and the diffraction pencil thence arising is a constant quantity, and hence it follows that to be effective, this distance must always be less than the diameter of the back lens. Thus $A\,a = B\,b = A'\,a' = B'\,b'$, and just as A and B, or A′ and B′, recede from the centre on one side, so are their respective diffraction pencils *a* and *b*, or *a′* and *b′*, drawn towards it on the other, being as it were linked together by this condition. Nor is this distance in any way affected by the medium in which the object is mounted. In the cases which we have discussed it is a matter of absolute indifference (if the object adhere to the cover) whether it be in air, balsam, or phosphorus as far as *resolution* is concerned, although its *visibility*, depending as it does on the intensity of the lines, may be immensely influenced thereby.

It follows from what I have said that no objective with an aperture less than 2·00 N.A. is capable of resolving an ordinary valve of *Amphipleura pellucida* with a beam of "central" light.

Very few persons possess objectives of 1·50 N.A., but most of the Fellows can verify the truth of the theoretical considerations here put forth with an ordinary objective capable of resolving *Pleurosigma angulatum* with oblique light. It will be found that where a narrow central beam, from the smallest stop of a condenser, fails, the object will be immediately resolved by using a beam of light of greater width, although from the flood of central light the definition will be inferior to that obtained by a purely oblique pencil.

SUMMARY

OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(*principally Invertebrata and Cryptogamia*),

MICROSCOPY, &c.,

INCLUDING ORIGINAL COMMUNICATIONS FROM FELLOWS AND OTHERS.*

ZOOLOGY.

A. VERTEBRATA:—Embryology, Histology, and General.

a. Embryology.†

The Archistome Theory.‡—Mr. J. A. Ryder gives a brief sketch of a new theory of development.

He expands Häckel's gastræa theory in the light of more recent research, and agrees with Sedgwick's theory on the "origin of metameric segmentation," except as to the homology of the mouth and anus of the vertebrates with those structures of the invertebrates. He mainly concerns himself with the origin of the appendages. The medullary plate has been formed by the concrescence of the lips of an elongated blastopore in all forms. The mouth and anus of vertebrates are new structures.

The "archistome" is the elongated mouth of the larvæ of Bilateralia, or the whole area embraced by an unpaired median neural plate, or by a pair of neural plates. This archistome extends in vertebrates from the pineal gland along the whole length of the body, through the "secondary blastopore," and through the primitive streak to the point of closure of the "yolk blastopore."

If an actinozoon is elongated along the long axis of the mouth, the tentacles will become arranged in pairs on each side of the archistome; each has a portion of a gut-pouch continued into them; the telson and labrum may be supposed to be derived from the opposite extremities of the series of tentacles. The biramose appendages of Crustacea are derived from an actinozoon with two rows of tentacles or "archipodia," by the fusion of the bases of the tentacles of the

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

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

‡ Amer. Natural., xix. (1885) pp. 1115-21.

two rows. The parapodia of Polychæta are similarly derived, but the archipodia first became more lateral. The setæ of the Chætopoda are analogous with the "actinotrichia" or embryonic fin-rays of fishes and *Sagitta:* muscles pass to the bases of both these structures. In *Sagitta* the lateral fin represents a fusion of parapodia. In fishes, groups of actinotrichia fuse at their bases, and thus give rise to the branched fin-rays of the adults. The original continuous lateral and median fin-folds were formed by a fusion of originally metameric finlets, just as the bases of the fin-rays of the skate fuse to form propterygium, mesopterygium, and metopterygium.

The lateral fins are formed from notopodial elements, the median dorsal fin from fusion of two series of neuropodia, and the median ventral from a similar fusion of notopodia. The Chordata and Chætopoda are two divergent series from an original stock.

Development of Spermatozoa.*—Dr. G. von Wiedersperg concludes that the spermatozoa are solely developed from the so-called round testis-cells, the nuclei of which become the heads of the spermatozoa, while the tail is formed within the cell. He accepts the doctrine of Ebner that these round cells are the derivates of the continued division of the marginal cells, division in which commences with a differentiation of the substance in the nucleus itself, the chromatin becoming aggregated towards either pole. It is peculiar to this process of division that the two polar parts of the nucleus, as they separate, still remain connected by more or fewer filaments, which are ordinarily granular in appearance; in this way the nuclei of the new cells remain connected together by a bridge of fibres. A study of the developing spermatozoa of the rat shows that the seminal cells lie freely in the median cavity of the testicular canaliculi, surrounded by a varying number of layers of other cells; and these developing cells are so disposed that in transverse sections we see only one stage of development, and in a longitudinal section the gradual passage of one stage into another.

The nuclei present different characters at different stages; thus in the young seminal cells they take colour just like the nuclei of their mother-cells; in other forms the chromatin is completely differentiated from the ground-substance. Later on no colourless ground-substance is to be seen, and it appears, indeed, as if the chromatin had become dissolved in it. The older the cell becomes the less colouring matter does it take up. In some cases, as, for example, in the African elephant, paranuclei are to be seen.

In mature ejaculated sperm there are to be seen round cells, in which the head of the spermatozoon lies by the wall of the cell, and the tail, which has the form of an extremely fine filament, is likewise applied to it; in a larger number of cells the form was more or less oval, the head projected far beyond the contours of the cell-membrane, and the tail lay coiled up within the cell. Spermatocysts were also found; and there were others which were finely granulated, and executed amœboid movements, the processes being pale, club-shaped, spherical,

* Arch. f. Mikr. Anat., xxv. (1885) pp. 113–36 (3 pls.).

or knobbed in form. The author finds that it is not only the testicular cells that have the power of movement, but also the true seminal cells within which the spermatozoa are developed. In the spermatozoa the power of movement resides solely in the tail or flagellum; the power of free movement, of twisting and so on, is largely due to the absence of any investment. One of the most ordinary forms of spermatozoon is that with a nearly round head, in which the hemisphere that carries the flagellum is darker than the other half (this is in consequence of its being still covered by the nuclear membrane). Flagella with quite rudimentary heads are by no means rare.

Spermatogenesis.*—Dr. D. Biondi claims to have effected a synthesis of the divergent observations which have been of late the subject of so much discussion. The nature of his solution may be best explained by his own summary.

1. In all seminal canals, mature or immature, there is really only one kind of cell ("Samenzellen," or round cells).

2. The "epithelial cells" of Sertoli, the "Stützzellen" of Merkel and Henle, the "spermatoblasts" of von Ebner are all secondary modifications, arising from the protoplasmic remains of the round cells after these have produced spermatozoa.

3. All seminiferous cells ("Samenzellen") arise from primitive cells ("Stammzellen"), and lie in a semi-fluid albuminoid substance.

4. In functional testes each primitive cell produces a generation of cells which are arranged linearly in pillar-like fashion.

5. In each pillar three zones are to be distinguished: (1) outermost, one cell, the primitive cell ("Stammzelle"); (2) two or three mother-sperm-cells in a row ("Mutterzellen"); (3) four to six cells in an innermost row (daughter-sperm-cells, "Tochterzellen").

6. When the generation is complete, differentiation into sperms begins from the centre outwards.

7. The three portions of the spermatozoon are formed wholly from a nucleus, the anterior half of which forms the head and the other half the middle portion and tail.

8. The spermatozoa do not move towards the periphery.

9. After the complete modification of all the cells, each pillar has the appearance of a bundle of spermatozoa.

10. The expulsion of the sperms is effected by the expansion of the cells of adjacent pillars.

11. In the formation of sperms from the nuclei, there are remains of the latter left unused, which with the protoplasm form the semi-fluid, albuminoid, intermediate or connective substance ("Zwischensubstanz").

12. A bundle of sperms arising from a single pillar, imbedded in the connective substance, and compacted by pressure, form a "spermatoblast" of von Ebner.

13. As the pillar becomes modified into spermatozoa and connective substance, and as the former are expelled, the foundation of a new generation is laid by the division (tangential) of the primitive cell ("Stammzelle") of an adjacent pillar.

* Arch. f. Mikr. Anat., xxv. (1885) pp. 594–620 (2 pls.). See also this Journal, v. (1885) p. 979.

14. The nuclear division of this primitive cell does not occur in any constant direction, but in a direction conditioned by the adjacent vacant space.

Mechanism of Fertilization.* — Pfeffer's observations on the attraction of spermatozoa in cryptogams, suggested to Herr J. Dewitz the study of sperm movements with the view of determining how far their entrance into the ovum was effected by chance. His observations were made on spermatozoa of *Periplaneta (Blatta) orientalis*, and they led him to the following results:—(1) The spermatozoa are attracted to surfaces, e. g. were found moving on the cover-glass and on the slide, but not in the space left between them, or round the walls of a hollow glass ball, but not in the centre; (2) the spermatozoa move in a circle, and, for the observer, in the direction of the figures on a watch-dial. Therefore, in actual fertilization, Herr Dewitz maintains that the sperms are drawn to the surface of the ovum, move round it in slightly varying circles as above noted, and thus must reach a micropyle. Experiments on pieces of the egg-shells, the eggs themselves being too opaque, confirmed this opinion. In regard to mammals, he maintains a chemical attraction.

Blastodermic Vesicle of Mammals.†—Prof. A. C. Haddon suggests the view that in the blastodermic vesicle of mammals, at the close of segmentation, the inner mass, since it gives rise to the embryo proper, is perfectly comparable with the germinal disc of a fowl during the later stages of segmentation, which has sunk into the blastodermic vesicle owing to the absence of yolk. The outer layer corresponds to those epiblast cells which are gradually inclosing the yolk, the so-called blastopore of van Beneden indicating in an exaggerated manner the distinction between the embryonic and non-embryonic germinal layers. Epiblast cells grow over this "blastopore" and form the covering cells; eventually the invagination of the germinal area is rectified, and there is a diploblastic ovum, the covering cells forming the spurious third layer which misled van Beneden.

The segmentation of the ovum is next discussed, and the conclusion is arrived at, that the first immigration of blastospheres into the interior of the ovum (van Beneden's stage 3) indicates the gastrula stage. It would further appear that this immigration was asymmetrical, much as there is an asymmetrical invagination of the hypoblast in telolecithal ova. The extension of cells of the blastodermic vesicle over the embryonic area is probably to be accounted for in most cases by the sinking of the latter into the cavity of the former. These covering-cells are really a portion of the blastodermic vesicle, that is of the yolk-sac, and they form the first adhesion between the ovum and the parent. This is compared with the imperfect attachment of the embryos of marsupials to the uterine walls, which is

* Arch. f. d. Gesammt. Physiol. (Pflüger), xxxvii. (1885) pp. 219–23.
† Proc. R. Dublin Soc., iv. (1885) pp. 536–47 (7 figs.).

effected solely by the yolk-sac, as has been recently demonstrated by H. F. Osborn and Caldwell.

Hypertrophy and its value in Evolution.*—Mr. J. B. Sutton, after citing a number of more or less well-known cases of hypertrophy, comes to the conclusions that:—(1) In the lowest form of animal life hermaphroditism is the prevailing condition. (2) Cross-fertilization in hermaphrodites is the rule, and may, as with some Myzostomata, lead to division into sexes within the limits of a single group. (3) Sporadic cases of hermaphroditism are far more common in the lowest forms of life. (3) If in mammals both sets of organs grow concurrently, the individual is sterile. (5) Both sets of organs grow equally to a definite period in embryonic life. (6) Reproduction in vertebrates, so far as is known, is impossible unless hypertrophy of one set of organs occurs. The aim of the author in writing this essay is to try and substantiate the doctrine that pathological processes do not exist *per se*, but are in all cases to be regarded as physiological processes in excess. Pathology has so far played a part among the ordinary processes of evolution, that hypertrophied organs have been in some cases inherited.

Availability of Embryological Characters in the Classification of the Chordata.†—Mr. J. A. Ryder shows how complication after complication has been added to the developing germ, starting with a simple blastula developed by simple cleavage in the lancelet; in the amphibian and marsipobranch embryo there is a distinct neurenteric canal, and the neurenteron is continued into the enteric cavity, which traverses longitudinally the upper half of the segmented vitelline mass. In the next grade (*Ichthyes*) the vitellus is for a long time unsegmented, and is practically excluded from forming any part of the enteric walls; but the embryo is generally sessile, and while only part of the blastoderm leads to the differentiation of the embryo, no part of the ectoblast is ever folded off to form such provisional organs as the amnion. In the higher (endocyemate) types, where this does obtain, there is ordinarily a blastoderm with a relatively very large area, and only a small part of the ectoblast takes a permanent share in the formation of the embryo. In the Paratherian series (reptiles, birds, ornithodelphs) there is a large yolk developed, which seems to have determined the development of the hollow yolkless blastosphere of the Eutheria; the greater part of the walls of this vesicle are, by a process of folding off and ingrowth of the embryo, converted into a respiratory apparatus and secondary system of deciduous envelopes.

The form of the placenta seems to depend on several factors:—(1) The early or late attachment of the blastodermic vesicle to the uterine walls; (2) the early or late invagination of the embryo; (3) the extent of subzonal membrane covered by the allantois, and the mode in which the latter is extended; (4) the form of the uterine cavity; (5) the position and disposition of the uterine mucosa; (6) the disposition of its crypts and folds; (7) the arrangement of

* Proc. Zool. Soc. Lond., 1885, pp. 432–45.
† Amer. Natural., xix. (1885) pp. 815–9 and 903–7.

the uterine vessels. These influences are largely of a mechanical character.

The facts known to us seem to show that the amnion is the result of the gradual invagination of the embryo into the blastodermic vesicle; and it is probable that the cavity of the false amnion is the homologue of the cleavage cavity of certain of the lower forms.

Sexual Dimorphism.*—Mr. J. Stolzmann, basing his views on a study of birds, comes to the result that sexual dimorphism is often to be explained as being due to natural selection; where it is only feebly marked we may believe that it is to be explained by the law of the correlation of growth; a female, externally, may be regarded as an incompletely developed male; the rôle of the female is more difficult than that of the male, and the ovaries require a larger blood supply than the testes; this view is supported by the fact that old or sickly females take on the male characters.

Spermatogenesis of Bombinator.† — In continuation of his researches on spermatogenesis, Prof. v. la Valette St. George describes the structure and development of the spermatozoa of *Bombinator*, with a critical review of the relative literature.

Structure.—The spermatozoon is a spindle-shaped body, ending anteriorly in a clear blunt tip, and drawn out at the other end into a fine process. Close to the anterior tip a filament is attached, which runs alongside of the body, more or less separated from it, and continued beyond it. On this is borne the vibratile fringe, which does not, however, extend the whole length of the filament. The vibratory movements occur from the anterior end backwards to the fine point. The whole spermatozoon is probably surrounded by an envelope of protoplasm, the contractility of which is specially differentiated in the fringe region. The forward movement of the sperm is rotatory, produced partly by the spiral twistings of the vibratile membrane, and partly by the worm-like bendings of the body itself. The author maintains that the structure described is that of the perfectly mature sperm.

Development.—The development of the spermatozoa of *Bombinator* is in accordance with the author's previous results; (1) spermatogonia surrounded by a follicular envelope ("Follikelhaut") with nuclei, divide with nuclear karyomitosis; (2) the resulting spermatocytes multiply in a similar manner and form masses termed spermatocysts, surrounded by a cyst-envelope ("Cystenhaut") with nuclei, perhaps the same as the follicular membrane; (3) from the repeated division of the spermatocytes, spermatides or undifferentiated sperms result, from which by elongation of nucleus to form the body, formation of filament, diminution of protoplasm, &c., the (4) mature spermatozoa arise.

Influence of Saline Water on the development of Tadpoles.‡—M. E. Yung finds that a tadpole placed in sea-water of the Mediterranean, which contains about 4 per cent. of salts, dies, shrivelled up, in

* Proc. Zool. Soc. Lond., 1885, pp. 421–32.
† Arch. f. Mikr. Anat., xxv. (1885) pp. 581–93 (2 pls.).
‡ Comptes Rendus, ci. (1885) pp. 713–4.

three to twenty minutes, according to its age, and ova do not develope. In 1 per cent. solution of marine salts a tadpole dies at the end of some hours, unless it has been previously prepared by a series of solutions of 2, 4, 6, 8 per 1000. Experiments were made with young, placed some in fresh water and others in solutions of 2, 4, 6, 8 per 1000, and it was seen that the tadpoles developed the more slowly the more concentrated the solution. When the water was kept undulating, tadpoles developed even when the solution contained 12 parts per 1000 of marine salts.

Influence of the Number of Individuals in One Vase, and of the Form of the Vase on the development of Tadpoles.*—M. E. Yung concludes from his experiments that the time taken in the development of tadpoles is proportionately as long as their number is greater in the same quantity of water, when there is an ample supply of food. This influence of the water supply has already been demonstrated by Prof. Semper to be true of *Lymnæus*, but M. Yung does not accept the explanation that there is some as yet unknown matter in the water which is the cause of this; it rather appears to him to be a question of aeration. For he found that the tadpoles develope the more rapidly the greater the diameter of the vessel which contains them, and consequently, the greater the surface of aeration. How far pressure has anything to do with the matter must be reserved for further experiments.

Relations of Yolk to Gastrula in Teleosteans.† — Mr. J. T. Cunningham describes the ova of *Gadus æglifinus*, *G. morrhua*, *G. merlangus*, and *Trigla gurnardus*. He was able to observe in the eggs of cod and haddock that the cells of the blastoderm are, at an early stage, continuous with those of the periblast; but the invaginated layer of the germinal ring is not so continuous; the whole edge of the blastoderm represents the ancestral blastopore, and the formation of the embryo by concrescence is merely the closing of the blastopore from before backwards. The edge of the blastoderm in Amphibia, *Petromyzon*, and Ganoids is homologous with that of Teleostei. But the edge of the Elasmobranch blastoderm is not so homologous, the inflected part representing the whole of the Teleostean edge. The anterior part of the primitive streak in Sauropsida is regarded as representing the ancestral blastopore, while the posterior part represents the coalesced uninflated part of the blastodermic rim in Elasmobranchs; the edge of the Sauroid blastoderm seems to correspond to a hernia in the blastoderm of Elasmobranchs. Part of the periblast probably forms the floor of the intestine, and the rest forms part of the splanchnopleural mesoblast.

Ova of Callionymus lyra.‡—Prof. W. C. M'Intosh finds that the ova of this fish are pellucid and pelagic; they are very small, and are invested, when mature, in a very fine hyaline zona radiata; they may be distinguished by their external hexagonal reticulations.

* Comptes Rendus, ci. (1885) pp. 1018-20.
† Quart. Journ. Micr. Sci., xxvi. (1885) pp. 1-38 (4 pls.).
‡ Ann. and Mag. Nat. Hist., xvi. (1885) pp. 480-2.

Structures resembling Ova.*—Prof. McIntosh has taken near the Forth certain peculiar dull yellowish structures resembling ova; they adhered to each other, and were nearly circular; their capsule was yielding, and the contents consist of a structureless gelatinous substance.

β. Histology.†

Morphology of the Cell-nucleus.‡—Dr. W. Pfitzner comes to the conclusion that the nucleus is always a completely independent structure inclosed in the cell; and that karyokinesis is the expression of a process going on within the cell-nucleus, in which no morphological constituents of the cell-body take any active part. The first of these dicta leads to certain consequences, for it is clear that a new nucleus can never arise. The extraordinary constancy which is seen from the Protozoa to man leads us to believe that the existence of the cell as a biological unit is connected with the presence of a central body of complicated internal structure, and that, therefore, the chromatin structures are not secondarily acquired, but are the prime conditions of the vital existence of the cell. Further, karyokinesis is not a special mode of nuclear division, but is the mode *κατ' ἐξοχήν*. The author recognizes that these views are not those of the authorities on the subject, and he offers some criticisms on the recent results of Flemming and Lavdowsky.

Contraction of Striped Muscle.§—With the aid of an apparatus which he terms the myoscope M. F. Laulanié has studied the contraction phenomena of muscles retained in their normal environment and connections. He follows up his previous (1875) observations on the muscles of the aquatic larva of *Corethra plumicornis*, and supplements them by a study of the phenomena exhibited by the unisolated hyoid muscles of the frog. While the circulation continued normal in the *Corethra* larva or in the frog, undoubtedly simultaneous contractions were observed; but as the circulation became irregular, waves of contraction set in, progressing from either extremity of the fibre, or sometimes from both ends at once, annihilating one another as they met. While the contraction wave was being observed along the fibre, *simultaneous* contractions also occurred without apparently affecting the former. In the frog the muscular wave was but rarely observed, except in some apparently highly functional fibres, and was characterized by the extreme slowness of its progress, sometimes effecting contraction only over a very limited area.

M. Laulanié distinguishes three modes of activity: (1) total and simultaneous contraction (*secousse*); (2) partial contraction; (3) muscular wave, or partial and progressive contractions. He regards the first as characteristic of normal activity in conditions where the muscles retain their full excitability, and the muscular wave as

* Tom. cit., p. 485.
† This section is limited to papers relating to Cells and Fibres.
‡ Morphol. Jahrb., xi. (1885) pp. 54–77 (1 pl.).
§ Comptes Rendus, ci. (1885) pp. 669–71.

indicative of the collapse of the organism or arrest of the circulation, and as occurring in cases where the muscular elements act in isolation from the collective life. His theory of the phenomena is reserved for a future paper.

γ. General.*

Markings of Animals.†—Eimer has advanced the view that the markings on animals are primitively longitudinal stripes, which may subsequently be broken up to form dots, and these fuse to form transverse rings. This view is supported by the ontogeny of many animals. Dr. W. Haacke controverts this view from the study of an Australian fish, *Helotes scotus*. The adult fish is marked by eight longitudinal black bands; young specimens have in addition a row of clear transverse bands, which disappear when the fish attains to maturity.

B. INVERTEBRATA.

Chromatology of Blood of Invertebrates.‡—Dr. C. A. MacMunn describes the spectroscopic or chemical characters of the blood of various worms and molluscs; one of the most interesting pigments which he has detected is that which he calls echinochrome, and which he has obtained from the perivisceral cavity of *Strongylocentrotus lividus;* the corpuscles present all degrees of coloration from a brilliant lake red, through a pale orange, to colourless, and they vary in having one or more nuclei. Echinochrome deepens on exposure to air, and this seems to be at least partly due to oxidation; it is certainly capable of existing in two states of oxidation, and is therefore respiratory; the author gives a detailed account of its spectra and solubility, and states that he has not met with any animal colouring matter which resembles it.

Radial Disposition of Medusæ and Echinodermata.§—Dr. W. Haacke attempts to decide what ought to be regarded as the primitive number of "segments" in radiate animals. Häckel regards the Asterids as nearer to the primitive ancestors of the Echinodermata than other groups, because in them there are species with varying number of arms as well as species with a constant number, and that a high one. On the other hand, the Echinoidea and Holothuroidea exhibit no such variations. Dr. Haacke records the fact that in *Amblypneustes* he has seen individuals with four and with six parameres; Häckel's views, therefore, cannot be considered as at all trustworthy. According to the latter, the primitive number of parameres in Medusæ is four, and Dr. Haacke from his own researches is inclined to agree. It is possible that four parameres and not five are typical for the Echinodermata, but the question is as yet an open one.

* This section is limited to papers which, while relating to Vertebrata, have a direct or indirect bearing on Invertebrata also.

† Zool. Anzeig., viii. (1885) pp. 507–8.

‡ Quart, Journ. Micr. Sci., xxv. (1885) pp. 469–90 (2 spectroscopic charts).

§ Zool. Anzeig., viii. (1885) pp. 505–7.

Pennington's 'British Zoophytes.'*—Mr. A. S. Pennington has prepared an introduction to the Hydroida, Actinozoa, and Polyzoa found in Great Britain, Ireland, and the Channel Isles, which should be useful to English naturalists; the microscopic structure of the various forms described is not neglected.

After a short historical account of the study of "zoophytes," the general classification of the groups and an account of their bathymetrical distribution is given. For the Hydrozoa Mr. Hincks's classification of the Hydroida into Athecata, Thecaphora, and Gymnochroa is adopted, reference being made to that of Professor Allman, where differences obtain. Gosse's classification of the Zoantharia is brought into conformity with the systems of Hertwig and Andres. For the Polyzoa, Hincks and Busk are chiefly followed. The book concludes with some hints on the collection and preservation of the organisms which have been described; and there are a bibliography, a glossary, and an index of popular names.

Mollusca.

Nerve-centres of Cephalopoda.†—M. Vialleton "assimilates" the dotted substance found in the nerve-centres of Cephalopods with the fibres of the neuroglia in vertebrates, denying that it is a new form of tissue, but that it is only transitory in vertebrates. All the ganglia of Cephalopoda are at first formed of embryonic cells, in the midst of which the dotted substance soon appears as an inextricable plexus of fibrils arising from these cells, which early loses its reticular character and takes on the appearance of a uniformly granular substance; some ganglia, such as the optic, retain this structure in the adult. In the subœsophageal portion the cells become larger, and tend to have the form of ganglionic cells. In the visceral ganglion small cells, identical with those of the optico-cerebral centre, are seen in contact with the dotted substance, and at the periphery of the cortex there are true ganglionic cells with a prolongation, resembling the filament of Deiters, which can be easily followed through the dotted substance to a nerve; in other words, there is the same continuity of cells and cylinder-axes as in vertebrates. The mode of development of the nervous tissue is the same in both groups, but in the cephalic centre of Cephalopods it does not proceed as far as in vertebrates.

Size and External Sexual Characters of the New Zealand Octopus.‡—Professor T. J. Parker refers to a species of *Octopus* found near Vancouver's Island, which measured 5 ft. along one arm, and was hitherto supposed to be the largest known specimen. The measurements of *Octopus maorum*, however, show it to exceed the former in size. The whole length of body is 1 ft. 1 in.; the longest arm, 5 ft. 5 in., is the first on the left side; the others all exceed

* Pennington, A. S., 'British Zoophytes,' 363 pp. (24 pls.), 8vo, London (L. Reeve and Co.) 1885.

† Comptes Rendus, ci. (1885) pp. 1016–8. ‡ Nature, xxxi. (1885) p. 586.

4 ft., except the third one on the right, which is 2 ft. 11 in., and is hectocotylized.

As a sexual character he calls attention to the gradual decrease in size of the suckers in passing from the proximal to the distal end of the arm in the male; whilst in the female the suckers soon become indistinct, and are replaced by closely-set tubercles. In a male there were 300 suckers on one arm, and only 100 in a corresponding arm of a female of the same size.

Post-oral Band of Cilia in Gasteropod Veligers.*—Dr. J. P. McMurrich draws attention to a post-oral band of cilia, in addition to the pre-oral band, in larvæ of *Crepidula fornicata*, *Fulgur carica*, *Neptunea*, *Montaguia*, and others. Between these two bands are numerous cilia, continuous with those lining the mouth, as in *Polygordius*.

The following phylogenetic history is suggested for the Gastropods; the ancestor of these and of other annelids was a "Trochophore," which in the former developed the (larval) shell: the presence of this rendered the pre-oral cilia insufficient, and hence the formation of the velum; the presence of the shell may be connected with the absence of metameric segmentation.

Development of Fissurella.†—M. L. Bontan comes to the conclusion that *Fissurella* by its development, shows itself to be a true Gastropod, and not to be allied to the worms; it has a persistent larval shell, its larvæ are emarginuliform, and rimuliform, before reaching the adult condition; the apparent symmetry of the adult is really an asymmetry which gradually becomes marked.

Limacidæ of Saint-Vaast-la-Hougue.‡—M. S. Jourdain contends that malacologists have divided too finely the species of Limacidæ. Instead of basing their diagnoses on the general form, coloration, structure of the shell, and conformation of the jaws, characters which vary with age and habitat, they ought to have recourse to the internal organs, and especially to the arrangement of the generative apparatus. The pedal gland is also of service; it contains a cylindrical excretory canal which extends more or less along the median line, and receives the mucoso-glandular secretions of the lobules of a racemose gland on either side of it; the internal face of the canal is vibratile. In the Limacidæ it arises as an invagination of the ectoderm, and subsequently becomes branched; the extremities of the branches are invested by mesodermic cells which rapidly become secretory. M. Jourdain limits the number of species found in the environs of Saint-Vaast-la-Hougue to five—*Arion rufus*, *Limax agrestis*, *L. maximus*, *L. variegatus*, and *Milax gagates;* and he gives diagnoses of these, limiting himself, however, here to the characters which have been especially neglected by malacologists.

Spermatogenesis in Pulmonata.§—Herr G. Platner describes the spermatogenesis in *Arion* and *Helix*, and reviews the relative researches

* Johns-Hopkins Univ. Circ., v. (1885) pp. 5–6.
† Comptes Rendus, ci. (1885) pp. 710–2. ‡ Ibid., pp. 963–6.
§ Arch. f. Mikr. Anat., xxv. (1885) pp. 564–581.

of other investigators. After describing the hermaphrodite glands of *Arion* and *Helix* and their relation to the enveloping liver-mass, he gives a detailed account of the different stages in the development and differentiation of the sperms.

(*a*) The spermatogonia are at an early stage the only cells in the gland besides the ova. They possess little protoplasm, a large slightly granular nucleus, a distinct nucleolus, but no enveloping membrane. Each contains a peculiar body independent of the nucleus; in *Arion*, apparently consisting of a number of small rods forming a more or less regular figure, in *Helix* in the form of a coiled filament. The spermatogonia exhibit indirect division, and the peculiar rods or coils are also doubled during the process, but when the spermatogonia in ceasing to divide, have formed a mass of spermatocytes, the peculiar bodies have finally disappeared.

(*b*) The spermatocytes are smaller than the spermatogonia, have not, as has been mentioned, that peculiar body, and their nuclei never exhibit the quiescent condition, nor consequently a nucleolus. The spermatocytes group themselves round basal cells, which appear at an early stage from the cells adjacent to the alveolar wall, and resemble spermatogonia in form, though not in history. Their large oval, granular nucleus, which does not divide, is surrounded by a finely granular protoplasm. With these centres the spermatocytes are directly associated. All spermatogonia, however, do not form spermatocytes, a large proportion of them persist, arranged in pillars, between the spermatocyte groups, and form subsequently, not only a new generation of spermatocytes, but also new basal cells, after the others have disappeared.

(*c*) The spermatocytes divide indirectly to form spermatides or undifferentiated spermatozoa. In both this division and that of the spermatogonia the protoplasmic separation is not very complete. The spermatides have a large granular nucleus and a narrow rim of protoplasm, and sometimes exhibit slow amœboid movements. From the protoplasm a primary sperm filament or tail grows out as a process. The granular substance of the nucleus retires to the periphery and becomes crescentic, while in the protoplasm an "accessory corpuscle" ("Nebenkern") is formed, whether from the nucleus or not, Herr Platner was unable definitely to determine. In *Arion* the accessory body has the appearance of a polyhedron formed of 4–6 rods, in *Helix* it forms an irregular circular, subsequently coiled figure. The nucleus of the spermatide forms itself anew, and exhibits a peculiar invagination, becoming sack-like; the uncoloured internal portion of the sack forms the axial portion of the future head, and is continued backwards into the above-mentioned extra-cellular primary tail. The intra-cellular portion grows in length and becomes bent, or sometimes even spirally twisted, the head also stretches and pushes out of the cell, the protoplasm and the accessory body come to lie ever further and further back along the primary tail, the final result being that the accessory body degenerates and the protoplasmic sheath acquires the definite structure of two (in *Helix* three) threads coiled round the axial filament or primary tail. The

fate of the accessory body is the same in both *Arion* and *Helix*, and the observations which have repeatedly credited it as the origin of different portions of the spermatozoon, are due to its losing at a certain stage its strongly refracting character and becoming invisible, except under very high powers. Platner ascribes no function whatever to the accessory body. The second half of the paper consists of a critical review.

Movement of the Foot in Lamellibranchs.*—Dr. A. Fleischmann comes to the conclusion that the "pori aquiferi" in the feet of Lamellibranchs are either the orifices of glands or artefacts; this being so, they cannot serve as a means of communication between the blood-vascular system and the surrounding water; such streams of water as are seen on contraction are not normal vital phenomena, but are pathological. Even if there were pores, they could not, for mechanical reasons, have the functions that have been ascribed to them. The swelling of the foot is due to the entrance of a certain quantity of blood, which, during repose, is stored up in the pallial reservoirs; the blood is aided by the closure of a strong valve and by the simultaneous relaxation of the musculature of the foot, the lacunæ of which become filled by blood. When the foot undergoes erection there is no change of volume of the whole animal, but only a change in the volume of separate parts due to the dislocation of the blood. It has not been proved that water is taken up by the kidneys or intercellular ducts. The Lamellibranchs do not need to take in water. What is true of them is true also of other groups of molluscs.

Resting-position of Oysters.†—Dr. K. Möbius refers to a letter by Mr. J. T. Cunningham, wherein the opinion was expressed that oysters rested on the clean right, and not on the left, valve. Out of 140 shells examined by Dr. Möbius, only a very few had any foreign organism on the right valve, whilst the rest had sponges, hydroids, &c., on the left valve. Forty-three of these bore on their left valve the body to which the spawn fixed itself. The bottom of an oyster-bed formed by old oyster-shells is not smooth: the young ones being fixed obliquely, the right valve may sometimes be protected so that embryos of other organisms, e. g. sponges, cirripedes, &c., may attach themselves and grow.

Green Oysters.‡—Prof. E. Ray Lankester discusses the cause of the green colour of the gills and labial tentacles of "green oysters," or "huîtres de Marennes," which, as Gaillon observed sixty-five years ago, have associated with them in the same waters *Navicula ostrearia*, and that where there is no such diatom there is no greening. The belief that the green colour is due to copper is discussed, and an account is given of cases where purveyors of oysters have so coloured them.

Navicula ostrearia contains a light-blue pigment, which it is

* Zeitschr. f. Wiss. Zool., xli. (1885) pp. 367–431.
† Nature, xxxiii. (1885) p. 52.
‡ Quart. Journ. Micr. Sci., xxvi. (1885) pp. 71–94 (1 pl.).

proposed to call "marennin," which is diffused through the protoplasm; when this blue marennin is deposited in the yellowish-brown gill-filaments of the oysters, it has a greenish hue; there can be no doubt that marennin derived from *N. ostrearia*, taken as food, is present either unchanged or slightly modified in the gills of the green oyster, and is the cause of the colour. The pigment is localized in certain peculiar cells of the superficial epithelium of the gills and tentacles, viz. in the large subspherical "secretion cells," which are placed at intervals among the more numerous smaller columnar cells; this is possibly the only known instance of a pigment introduced through the alimentary canal being eliminated by gland-cells in an unaltered condition.

Cephalic Appendages of Gymnosomatous Pteropoda.*—Dr. P. Pelseneer has investigated the cephalic appendages of *Clione*, *Clionopsis*, and *Pneumodermon*, the homologies of which are very obscure. There are always two pairs of tentacles, and the author does not think it rash to identify them with the two pairs of the euthyneurous Gastropods; in the Thecosomata there is a pair of rudimentary tentacles, and if they do not possess eyes when adult they have them in some stage of their development; these correspond to the posterior or nuchal oculiferous pair of tentacles in the Gymnosomata, while the disappearance of the anterior is to be explained by the swimming lobes encircling the head. Most of the Gymnosomata have a pair of buccal appendages between the two pairs of tentacles, and these, though varied in aspect, are probably similar in origin; it is explained, how in *Clione* they are really inserted on the external wall of the buccal cavity just as in *Cirrifer* and *Pneumodermon;* but at the same time it is to be remembered that this part of the buccal cavity is an "introvert," and not a true part of the oral cavity.

Molluscoida.

a. Tunicata.

Cynthiidæ of the Coasts of France.†—MM. H. de Lacaze-Duthiers and Y. Delage have examined the simple Ascidians which belong to the group of the Cynthiidæ chiefly by the aid of *Cynthia morus*, which is very abundant at various places on the coasts of France. They describe its external appearance and the differences in expanded and contracted forms; the spines appear to be polymorphic, but there is one character which is very useful in diagnosis, the microscopic bodies which are found on the internal surface of its orifices. If a small piece of the epidermis be cut out and examined under the Microscope, one can in all cases detect a rounded projecting scale, which is similar in the most dissimilar-looking individuals.

After describing in detail the anatomy of the type, the authors point out the affinities which exist between the Cynthiidæ and the Molgulidæ; these are to be found in the characters of the mouth and

* Quart. Journ. Micr. Sci., xxv. (1885) pp. 491–509 (1 pl.).

† Comptes Rendus, ci. (1885) pp. 784–90.

gills, the infundibula of the latter being alone simpler in the Cynthiidæ; the intestine of *Cynthia* describes a wide curve, that of *Molgula* is looped, and the heart is longer and more anteriorly placed; notwithstanding these and other slight differences we can easily pass from the Molgulid to *Cynthia morus;* the more aberrant Cynthiidæ of course present greater difficulties.

β. Polyzoa.

Morphology of Polyzoa.*—Dr. A. A. Ostroumoff notes the most important discoveries in a forthcoming work on the Polyzoa of the bay of Sebastopol.

The calcareous skeleton is formed in the ectoderm which exists throughout life, either as a subskeletal layer (*Membranipora*), or as two layers between which is the skeleton (*Lepralia*). The body-cavity contains "mesenchymatous" (Hertwig) elements, and is not lined by an endothelial layer. The internal sac of the larva forms in the Chilostomata the basal face, in the Vesiculariæ the stolo prolifer; from these regions alone are formed by budding the new members of the colony, with the exception of certain pallial avicularіæ. What is termed the polypide is formed from the ectodermal rudiments, plus the brown body. The paper concludes with some observations upon the metamorphosis of the Bryozoa, illustrated by a diagram of a "Probryozoon."

New or little known Polyzoa.†—Dr. P. H. MacGillivray, in two papers, describes two new genera and several new species of Polyzoa.

Maplestonia (n. gen.) consists of a series of single or geminate cells, which are membranous in front and imperforate behind; there are no avicularіæ nor vibraculæ; it belongs to the *Celleporidæ*. *M. cirrata* has the cells in a linear series; the posterior surface is transversely striated. *M. simplex* branches dichotomously, at the angle of a cell; posterior surface smooth.

Favosipora (n. gen.) consists of an adherent zoarium, raised at intervals into rounded ridges. It belongs to the *Discoporellidæ*. *F. rugosa* is allied to *Densipora corrugata*.

The new species belong to the following genera:—*Cellaria*, *Tubulipora* (6), *Diastopora* (3), *Catenicella*, *Cauda*, *Tubucellaria*, *Beania*, *Urceolipora*, *Cabasea*, *Membranipora* (2), *Microporella* (2), *Schizoporella*, *Lekythopora*, and *Cellepora* (6).

γ. Brachiopoda.

Recent Brachiopoda.‡—In the first part of an exhaustive monograph on recent Brachiopoda, by the late Dr. T. Davidson, the author reviews the labours of his predecessors with regard to the shell, the anatomy of the adult, and the embryology. As regards the perplexing question of affinities, he remarks:—"Now, although I do not admit the Brachiopoda to be worms, they, as well as the Mollusca and

* Zool. Anzeig., viii. (1885) pp. 577–9.
† Trans. and Proc. Roy. Soc. Victoria, xxi. (1885) pp. 92–9, 106–19 (8 pls.).
‡ Trans. Linn. Soc. Lond.—Zool., iv. (1886), not yet published.

some other groups of invertebrates, may have originally diverged from an ancestral vermiform stem, such as the remarkable worm-like mollusc, *Neomenia* would denote." He lays stress on the brachiopodous individual being the product of a single ovum, and not giving rise to others by gemmation. He considers that the shell, the pallial lobes, the intestine, the nerves, and the atrial system afford characters amply sufficient to define the class. The greatest depth at which a living species has been found alive has been 2990 fathoms.

As to classification, he groups the recent species in two great divisions, viz.:—I. Anthropomata (Owen) = Clistenterata (King); II. Lypomata (Owen) = Tretenterata (King). The Anthropomata he divides into three families:—(1) Terebratulaceæ, with seven subfamilies, thirteen genera and subgenera, seventy species, and twenty-one uncertain species; (2) Thecideidæ, with one genus and two species; (3) Rhynchonellidæ, one genus, one subgenus, and eight species. The Lypomata he also divides into three families, five genera and subgenera, twenty-three species, and seven uncertain species:—(1) Craniidæ, with one genus and four species; (2) Discinidæ, with one genus, one subgenus, and eight species; (3) Lingulidæ, with one genus, one subgenus, and eleven species. He does not accept M. Delongchamp's scheme (1884) of classifying the Terebratulina, bringing forward Mr. Dall's observations on *Waldheimia floridana* of delicate spiculæ in the floor of the great sinuses as telling evidence against the arrangement. The various genera and species are then dealt with, followed by remarks on the Terebratulaceæ, with copious descriptions and observations.

Arthropoda.

a. Insecta.

Development of Reproductive Organs in Insects.*—The precocious appearance of the reproductive organs of insects has been repeatedly noted since Suckow first remarked it in the Lepidopteran embryo. The fact acquired greater interest when, in 1865, Leuckart and Metschnikoff observed in the viviparous larvæ of *Cecidomyiæ* that the polar globules formed the pseudovarium, a discovery afterwards confirmed (1870) by von Grimm in the case of a parthenogenetic *Chironomus*. Prof. E. G. Balbiani further corroborates this origin of the reproductive organs in a sexually-produced and producing species of *Chironomus*.

He describes at length the laying of the band of eggs and the elastic attachment by which they are kept below water, the appearance of the newly laid ova with clear peripheral layer and granular central mass, the gradual retraction of the vitellus from the enclosing membrane, the consequent formation of a space filled by the *liquor vitelli*, the successive or rarely simultaneous expulsion of the polar globules, the characteristics of these globules with their refracting granules and clear nucleus, their immediate division into eight, and

* Recueil Zool. Suisse, ii. (1885) pp. 527–88 (2 pls.).

the probable origin of their nuclei from part of the lower half of the germinal vesicle. He distinguishes these polar globules, of course, from *vesicules directrices* or "*Richtungskörper*," not yet certainly seen in insects, and notes the importance of not confounding them with small drops of protoplasm of varying number, which appear without nucleus, division, or morphological constancy, at the anterior as well as at the posterior pole, and which are probably in part squeezed out by the contraction of the vitellus.

Soon after the formation of the polar globules, the blastoderm-cells appear, preceded by wavy protrusions of the clear outer plasma. Balbiani is unable to decide as to the origin of the blastoderm nuclei, though inclining to believe that they result from the division of the germinal vesicle, move outwards to the periphery, there gather protoplasm round them and form cells.

As the blastoderm becomes more distinct the polar globules begin to sink into the vitellus, but the exact way in which this is accomplished Balbiani is unable to determine. As the insinking continues, the blastoderm cells become further differentiated at the expense of an internal plasmic layer (*blastème germinatif interne*, or *couche plasmique secondaire*), which appears between the young blastoderm and the granular central vitellus. The mode of this further growth is fully described.

He follows in detail the invagination of the polar globules and of the two folds of the blastoderm, the ventral—thickening to form the caudal portion of the embryo, the dorsal—thinning to become the delicate caudal fold of the amnion; and further, the various stages by which the reproductive cells, as the polar globules prove themselves to be, find their final position in the hatched larva. After invagination the eight cells are reduced, probably by fusion, to four, bilaterally arranged in pairs. Each of the four naked cells contains four or more nuclei, while the protoplasm shows as yet at most only hints of division. In a larva five days old a delicate membrane round the rudimentary sex-gland can be detected, and this is prolonged at each end to form anteriorly the dorsal attaching filament, and posteriorly, probably the rudimentary excretory duct.

In some larvæ the gland thus formed is narrow and fusiform, in others, bluntly pointed and oval. This slight difference is the first hint of sexual differentiation. Each gland exhibits a transverse partition, and nuclei surrounded by zones of protoplasm, but these daughter-nuclei and cells in what turns out to be the male gland are smaller and more numerous than in the rudimentary ovary. At a later stage Balbiani observes in both glands, not simple cells, but groups of pear-shaped cells, radiately arranged round a central mass from which they have probably been budded off. This arrangement in the female he compares to the well-known disposition of elements in the terminal ovarian chamber of the adult insect; each radiately arranged group of cells would be homologous with the contents of a terminal chamber. In the similar rosettes in the male, the radiately arranged cells are, like their predecessors, smaller and more numerous than those of the young ovary. He compares the male rosettes and

their mother-cells respectively, to the "spermatogemmæ" and "spermatogonia" of La Valette St. George.

Prof. Balbiani recognizes the cellular nature of the epithelial coat, and inclines to believe that it results from a condensation of peripheral cells of the sexual mass, rather than from a transformation of surrounding embryonic cells.

The chief results of this important and suggestive research may be summed up in a sentence. The polar globules or cells, as yet peculiar to Diptera, are the primitive sex cells; they appear before the blastoderm formation, at the posterior pole and at the expense of the homogeneous plasmic layer; after sinking into the vitellus, reaching their ultimate position, and decreasing in number, they multiply endogenously, and almost the only noteworthy difference between the male and female glands consists in the greater number and smaller size of the nuclei and daughter-cells of the former.

Prof. Balbiani indicates the relation of his researches to the much debated subject of the origin of the generative organs. Reviewing the various epochs of differentiation of reproductive cells in the different groups, he shows how they might be thus chronologically arranged. (*a*) Diptera and perhaps Aphides—sex-cells formed first. (*b*) Daphnids—differentiated during segmentation. (*c*) Chætognatha—appearing in gastrula stage, and so on to vertebrates, where they appear in an embryo already furnished with all its organs; while the climax of postponement is illustrated by those Hydroids where they appear only in the completely developed, i. e. in the Medusoid individual. Referring to Weismann's theory that the reproductive cells are generally differentiated when the organism is otherwise fit for reproduction, which is beautifully corroborated by the coincidence of precocious appearance of generative cells and precocious reproductive activity in Diptera, Daphnids, and Aphides, Balbiani notes that *Chironomus*, though most strikingly illustrative of the former characteristic, is divergent as regards the latter, since it remains larval and without reproductive activity for several months. He also notes the interesting relation of his researches to the theories of heredity advanced by Nussbaum and Weismann, though refusing to commit himself to any definite support of either.

Histology and Embryology of Insects.*—M. H. Viallanes demonstrates the existence of a subcutaneous nerve-plexus in many insects. The hollow sensory hairs are each secreted by a modified hypodermic cell, in whose protoplasm the prolongation of the nerve-cell ends. The "dorsal vessel" is formed of a single layer of cells, but "each cell is contractile through the presence in it of striated muscular fibrils," each of which begins and ends in a small disc; this condition verifies the ordinary theory. The motor muscles of the wing differ from those of the legs; in the former there is no sarcolemma, and only a few fibrils, but in the latter a sarcolemma encloses a single fibre. In muscles consisting of one fibre, the nerve separates at once into its constituent fibrils, whilst where the muscle consists of several fibres,

* Amer. Natural., xix. (1885) p. 1001, from 'Rev. Scientifique.'

the nerve branches like a tree, as in Vertebrates. He describes the destruction of the muscular tissue, &c., during the metamorphosis, and its solution in the body-cavity. The integuments of the adult are not derived from those of the larva, but from "imaginal discs," produced during the metamorphosis. Each muscular fibre is produced from cells, which become the nuclei, imbedded in a homogeneous matrix, which becomes contractile.

M. Viallanes has traced the nerve from the facet of the eye into the brain: he shows that all the parts of the adult eye are enclosed in the larva within the brain.

Origin of the Elements in the Insect Ovary.*—Dr. E. Korschelt contributes a somewhat lengthy paper upon this subject, which is partly a criticism of the work of other observers, and partly a statement of the author's own results; his investigations deal with a number of types which are severally described; the general conclusion arrived at is contrary to that of Will, and may be stated as follows: in certain insects the cell-elements of the egg-tubes, that is, the epithelium and the nutritive cells, arise by direct metamorphosis of the elements of the terminal chamber, and may be followed into the indifferent tissue of the terminal thread.

Metamorphosis and Anatomy of the Male Aspidiotus Nerii.†—Herr O. Schmidt distinguishes five periods in the metamorphosis of this insect, defining two larval and two chrysalis stages. He describes the anatomy of the alimentary, respiratory, nervous, muscular, and reproductive systems, noting both in regard to anatomy and metamorphosis the differences between male and female. His anatomical results, which are essentially corroboratory of those of Tozzetti, do not contain any new facts of general interest. The spermatogenesis is described as consisting of the division of the hexagonal testicular cells into five or six "spermatoblasts," from each of which a bundle of spermatozoa is formed.

Vision of Insects.‡—M. F. Plateau communicates a preliminary note of experiments made in order to prove whether or not insects can really distinguish by vision the form of external objects. The old mosaic theory of J. Müller having been shown by Exner to be, on anatomical and physical grounds, untenable, M. Plateau has endeavoured to settle the question experimentally.

In a darkened room, with two differently shaped, but approximately equal, light openings, one square and open, the other subdivided into a number of small holes, and therefore of more difficult egress, he observed the choices of opening made by insects flying from the other end of the room. Careful practical provisions were made to eliminate error; the light intensity of the two openings was as far as possible equalized or else noted; no external objects such as trees, &c., were within view, &c. The room must not be darkened beyond the limit at which ordinary type ceases to be readable, else the insects

* Zool. Anzeig., viii. (1885) pp. 581–6 and 599–605.
† Arch. f. Naturgesch., li. (1885) pp. 169–200 (2 pls.).
‡ Bull. Acad. R. Sci. Belg., x. (1885) pp. 231–50.

refuse to fly, an observation in accordance with the familiar fact that during the passage of a thick cloud, or similar darkening, insects usually cease to fly. M. Plateau's observations were made on insects provided with or without ocelli in addition to the compound eyes, and with the same results.

From numerous experiments on Diptera, Hymenoptera, Lepidoptera, Odonati, and Coleoptera, of which tabular summaries are given, M. Plateau concludes that insects with compound eyes, with or without ocelli, pay no heed to differences of form in the light-openings of a half-darkened room, but fly with equal readiness to the apparently easy and apparently difficult way of escape, that they are attracted to the more intensely lightened opening, or to one with apparently greater surface, and that in short they cannot by vision distinguish form, or only to a very slight extent.

Sense of Smell in Insects, &c.*—In continuation of his well-known researches on light-perception, in which the general sensitiveness of the body-surface was demonstrated in many animals, Prof. Veit Graber has made an extensive series of experiments on the degree and localization of the sense of smell. Among his interesting results the following are the most important:—

(1) Odours are perceived by many invertebrates (Molluscs, Discophora, Chætopods, Insects, &c.) with extreme rapidity—sometimes in one-third of a second, and even through an intervening layer of 1–2 mm. of water; (2) that the sensitiveness is enormously quicker than was exhibited by the vertebrates experimented on (amphibians, lizards, birds); (3) that insects deprived of their feelers are still able to smell, in various degrees in different insects and with different odours, some fine odours being apparently perceptible only through the feelers; (4) that the perception of smell by way of the respiratory organs, which has been often maintained, is not at any rate rapid or important; (5) that in some cases the palps are more sensitive than the feelers, and that therefore the latter cannot, any more than the eyes in his previous researches, be described as in any way possessing a monopoly of sensitiveness.

Foot-glands of Insects.†—In reference to Herr J. Dahl's researches on the foot-glands of insects,‡ Herr H. Dewitz asserts that these are for the most part only a corroboration of his work on the same subject.§ Apart from the question of priority, he affirms, with an appeal to Dr. K. Brandt and Dr. Joh. Frenzel, that the structures on the soles of Locustidæ are not mere rods, but are hollow, and that similarly the tarsal attaching hairs of other insects have a terminal opening, situated either at the very end or somewhat laterally.

* Biol. Centralbl., v. (1885) pp. 385–98.

† Arch. f. Mikr. Anat., xxvi. (1885) pp. 125–8.

‡ See this Journal, v. (1885) p. 989.

§ SB. Gesellsch. Nat. Freunde Berlin, 1882, Jan. and July; Zool. Anzeig., vii. (1884) pp. 400–5; Arch. f. Naturg., l. (1884) pp. 146–93; Pflüger's Arch. f. d. Gesammt. Physiol., xxxiii. (1884) pp. 440–81. See this Journal, iv. (1884) p. 716.

Bees and other hoarding Insects.*—Mr. E. A. Curley suggests a manner in which colonies of bees, &c., have become differentiated into males, females, and workers.

After referring to the offspring of a cross between a black Spanish and a buff Cochin fowl, as an example of the law of hereditary variation of offspring, he proceeds to show that insufficiency of food is a great factor in this variability, and "filial love" is another. He then traces the history of a family of primitive bees up to the present complicated social habits of these insects. This primitive bee is thrifty and "affectionate," but it lays more eggs than can be properly nourished, and some of the young will be imperfect: insufficiency of food affects the genital organs of some of these young, which will, however, live, and while the other perfect ones will mate and leave the family, these imperfect ones develope great "filial love" and help the mother. He instances the affection of the young mule for its mother. These "helpers" then provide food for the mother, who now is well fed, and produces young which will be properly nourished and hence perfect, so that in the new generation none will be workers, but all will leave the family: the mother-bee then will be poorer, and some of the new brood of young will be again imperfect, and so on. But at the same time, some of the imperfect ones of the first brood will mate and produce similar imperfect ones, who will become "workers," who will in each succeeding generation help more and more in getting food, till ultimately only one female is allowed to produce: while the workers, at first both male and females in equal number, have the number of males much reduced: and it is in this sort of way that the existing conditions of bee and ant life have been brought about.

Antennæ of Honey-bee.†—Mr. T. J. Briant describes the anatomy, musculature, and sense-organs of the antennæ of the working honey-bee.

The scape or unjointed half of the antenna, moving on a fulcrum point within the hemispherical cranial cup, is furnished with three muscles, the insertion of which is described. The larger 12-jointed flagellum or shaft bends on the scape with a simple motion of flexion and extension effected by two muscles. The individual segments though moveably connected, do not exhibit any muscles or voluntary movement. Besides the hairs of the cup, which he regards as mechanical, Mr. Briant describes on the flagellum—(*a*) openings with a convex-rimmed membrane; (*b*) smaller openings, not closed but drawn out into a pointed hair; (*c*) hairs springing from still smaller pits; (*d*) on the last segment delicate hooked hairs, bent at right angles at about half their length; (*e*) tubular, slightly conical structures imbedded in granular nervous matter within the flagellum segments, and in immediate contact with the walls of the antennæ, through which they communicate with the exterior by fine grouped pores.

He regards the hooked hairs as actively sensory, and the other

* Nature, xxxiii. (1885) pp. 64–7.

† Journ. Linn. Soc. Lond.—Zool., xix. (1885) pp. 84–8.

structures as passive, some of them probably olfactory. They are described as touch and smell organs by Dr. Paul Schiemenz,* in a contemporaneous paper, which Mr. Briant has since seen.

Sense of Hearing in Ants.† — That ants have a more than rudimentary sense of hearing is forcibly suggested by the Rev. E. C. Spicer's observations on an unnamed Australian ant, which produces "a series of rapid, jerky, hissing and chirping sounds quite easily heard three inches from the human ear." It remains, however, to demonstrate in this species auditory organs better developed and less problematical than those as yet known.

Origin of Endoderm in Lepidoptera.‡—Mr. A. T. Bruce, working on *Thyridopteryx*, confirms Kowalevsky's opinion on this point.

After describing the formation of the amnion and embryo, he describes the appearance of the shallow longitudinal groove (blastopore) along the ventral surface: the cells at each side of this proliferate and divide into an outer and an inner layer; the latter will enclose the yolk and is the endoderm: the yolk takes no share in the formation of the intestinal epithelium.

Generative Apparatus of Nematois metallicus.§—M. N. Cholodkovsky has investigated the generative organs of this small lepidopterous insect; the abdomen is remarkably large, owing to the presence of a number (not less than twelve) of ovarian tubes in each ovary; all known Lepidoptera, with the exception of *Psyche helix*, which has six, have four tubes in each ovary; in *N. metallicus* the majority have twenty tubes. The bursa copulatrix is very feebly developed, and the ordinary spiral efferent canal connecting it with the vagina is wanting; this arrangement corresponds exactly with some of the phases in chrysalid development. Seven segments can be made out externally in the abdomen of the female, but if the abdomen is slightly compressed, a whitish cone is protruded, which consists of a compact chitinous membrane, and has the generative orifice at its tip; the vagina likewise consists of a whitish chitinous tubule, which is imbedded in the cone, and fused with its walls. On the ventral surface of the cone there are two pairs of chitinous setæ which are directed backwards; to these, muscles are attached, and by their contraction, the membranous cone and its setæ are protruded, so as to apparently form an ovipositor; the setæ, as it seems, bore into various substances, in which the eggs are deposited. The inner lip of each seta has a small transparent finely dotted chitinous disc; the outer end is pointed, and just behind it, each of the two lateral setæ has a flattened lateral enlargement, which is partly fused with the chitinous plate of the vagina.

The accessory internal organs of the male are excessively short; each half of the apparently azygous testis consists of about twenty tubes, or, in other words, corresponds with the number of the female

* See this Journal, iii. (1883) p. 364.
† Proc. Roy. Soc. Queensland, i. (1884) pp. 79–81.
‡ Johns-Hopkins Univ. Circ., v. (1885) p. 9 (2 figs.).
§ Zeitschr. f. Wiss. Zool., xli. (1885) pp. 559–68 (1 pl.).

tubes; each follicle has the form of an elongated saccule, formed by a structureless membrana propria and the seminal elements. The similarity in number confirms the view that the testicular and ovarian tubes are homologous; their general arrangement indicates their affinity with the Phryganidæ.

As to the external male organs, for which the author laments the absence of a suitable terminology, he states that the eighth abdominal segment is conical, and has its tip directed backwards; dissection is necessary to reveal the ninth segment, which is circular in form, and has the dorsal much smaller than the ventral half; the penis appears to be the chitinized end of the vas ejaculatorium, and forms a fine tube, which is invested by a thin præputium, and has a soft enlargement at its end—this may be called the balanus; at the hinder end of the ninth segment there are two valvular appendages, and with these a small chitinous ring is connected dorsally; the anal orifice is within this ring.

The study of this small lepidopterous insect leads to points which seem to be important in the morphology of the Insecta; in their organization the Lepidoptera exhibit some very primitive characters —for example, they sometimes have ten abdominal segments; in *N. metallicus* there are a large number of seminal follicles, and this must be reckoned a primitive arrangement. The author thinks that the possession of only two Malpighian vessels in some butterflies is very remarkable, and says that it suggests to him a theory of periodic atavism which he will develope more fully in a future work.

He suggests that the embryology of the "Microlepidoptera" should be investigated, as the system of this group (as its name alone is sufficient to show) requires to be thoroughly revised.

Development of the Flea's Egg.*—Mr. M. H. Robson describes some stages in the development after completion of segmentation. The egg being transparent, its development is easily followed: from three to twenty-four eggs are laid separately by a female. Thirty-six hours after laying, the blastoderm occupies one-third the circumference of the egg, by the fourth day the embryo has absorbed the yolk and nearly fills the egg. It hatches on the sixth day. When hatched, the larva is destitute of appendages, except a pair of small antennæ and a pair of mandibles, and resembling many other insect larvæ. After eight days the larva spins a fluffy cocoon, from which the young flea emerges in nine days.

Development of Epicauta verticalis.†—M. H. Beauregard has examined the life-history of this vesicating insect with the object of seeing whether, like the American species described by Riley, it is parasitic in the nests of Acrididæ; placed with a nest of *Œdipoda* (*Œ. cæruleus*, and *Œ. germanica*), on August the 28th, it increased in size, and on October the 15th was in pseudochrysalis stage, which is the hibernating form of all the vesicating insects. On the other hand, efforts to rear the larvæ on honey were fruitless, and it became

* Sci.-Gossip, 1885, pp. 252–4 (7 figs.).
† Comptes Rendus, ci. (1885) pp. 754–6.

clear that they were not parasitic in the cells of subterrestrial Hymenoptera. The particular species of Orthopteron is of slight importance so long as the eggs are in sufficient quantity and can be easily attacked by the mandibles; the Acrididæ best conform to these conditions.

Proboscis of Hemiptera.*—Herr H. Wedde adds to the numerous recent researches on the oral organs of insects a careful investigation of those of the *Rhynchota*, or *Hemiptera* in the wider sense. He analyses the jointed rostrum of those insects and the piercing and suctorial organs which it ensheaths, and gives besides a detailed account of the associated musculature, chitinous framework, glands, &c.

(*a*) *The labium* is shown to be really double by its frequent terminal splitting and slight ventral furrow. Herr Wedde maintains further, that in this united organ, *cardo*, *stipes*, and *palpi* are really present. The terminal joint is furnished not only with tasting rods, but with a delicate umbrella-shaped organ which serves to surround the wound, and to prevent the escape of the desired juice. The furrow of the labium is, as is well known, roofed over by the labrum, the borders of which are bent down, so that between the upper and lower lip a distinct tube is formed.

(*b*) *The piercing and suctorial organs* lie between the two, and consist of a pair of clear, hollow, terminally toothed mandibles, and within these two, very closely united, but anatomically and physiologically distinct, dark brown, hollow, terminally toothed maxillæ, of which the upper is in continuous connection with the pharynx, and serves exclusively for the entrance of the nutritive juice, while the lower is the exit canal of the salivary glands, from which there issues a strongly alkaline fluid, stimulating the flow of food from the wound.

(*c*) *The musculature* consists mainly (1) of the *levatores* and *depressores labii*, which also affect the dependent movement of the labrum; (2) of longitudinal muscles running along the joints of the labium and effecting horizontal and vertical movements; (3) of muscles running across from the inner side of the labial joints to the chitinous lining of the furrow, and probably narrowing the latter; (4) of the important retractors and protractors of the maxillæ and mandibles; (5) of four dilators of the pharynx, which widen the cavity and produce that alteration of pressure which in great part causes the upward flow of the food-fluid; (6) the complex muscles of a force-pump arrangement to be afterwards noted. He describes in detail the structure and functions of the chitinous framework associated with the pharynx.

(*d*) *The force-pump*, first discovered by Landois, is a chitinous structure lying below the widest portion of the pharynx. Provided with valves, piston, and powerful muscles, it has, however, no connection with the pharynx nor the suctorial act, but effects exclusively the flow of the salivary fluid through the lower maxillary tube to the exterior. It is characteristic of all the orders of Rhynchota with piercing organs and suctorial tube, which Herr Wedde would distinguish as R. setifera, from the lower Pediculidæ and Mallophaga, which have neither piercing organs nor force-pump, and which he

* Arch. f. Naturgesch., li. (1885) pp. 113-43 (2 pls.).

would designate R. asetifera. He notes the interesting fact that in those Hemiptera which live on the more readily flowing juices of animals, the pump is less developed; and this reduction of salivary functions may go so far that in *Cimex hydrometra*, for instance, the lower maxillary tube, usually of exclusively salivary function, may fuse with the upper suctorial one.

(*e*) *Glands.* After describing the salivary glands, Herr Wedde notes the position and nature of other, hitherto unobserved, glandular masses, one situated where the narrowed anterior end of the pharynx passes into the upper maxillary tube, and two smaller ones lying between the exit canal of the pump and the chitinous band which fixes it. As to their function, he suggests that they secrete an oily fluid, diminishing the friction of maxillæ, mandibles, &c.

(*f*) *The ascent of the nutritive fluid*, after the wound has been made and the flow stimulated by the salivary secretion, is effected by the above-mentioned dilatation of the pharynx, a return flow being prevented by the successive slackening of the dilator muscles and consequent re-narrowing of the pharynx from before backwards. The ascent is also essentially aided by capillary action within the long maxillary tube.

Anatomy of the Mallophaga.*—Dr. F. Grosse deals principally with an account of a new species of *Tetrophthalmus* (*T. chilensis*), taken from a pelican in Chili. The anatomy is systematically discussed.

The head and the mouth-organs are first described; the statement of Melnikow that the labium is a provisional structure which falls away at the ecdysis, is explained by the supposition that he examined forms just after ecdysis, in which the parts being thin and membranous might be overlooked; a labium is certainly always present. The thorax and the legs are next described; the male is provided with tarsal lobes and spinous setæ at the end of the tibiæ, by means of which it is able to hold the female. As in the other Mallophaga, the abdomen varies in form with the sex; while the female has ten, the male has only nine segments externally. Kramer's results on the histology of the enteric tract are summarized, and the author makes some additions based on his own observations; from the structure of the pharyngeal skeleton the author concludes that it is not adapted for sucking, but for seizing and taking up the particles of feathers among which it lives; the buccal cavity has the same histological character as the integument; the roof is thick-walled and folded longitudinally; in some genera a group of long flat backwardly diverted teeth are to be found in its lumen. These prevent the particles of feathers from passing into the stomach before they have been properly softened and broken up. Dr. Grosse denies to the chyle-stomach the lining of chitin which was ascribed to it by Kramer. With regard to the food of the Mallophaga, he states that, though he has examined a large number of forms, he has found blood in the intestines of but few; but in such cases, as in one he was able to observe, the skin of the bird had been injured, and there was coagulated blood among the

* Zeitschr. f. Wiss. Zool., xli. (1885) pp. 530–58 (1 pl.).

feathers. The Malpighian tubes are filamentar, four in number, never branched; the salivary organs are arranged in two pairs, and consist of gland and reservoir; they are ordinarily elongated and oval, but in a species of *Læmobothrium* each gland was found to consist of twenty small tubes.

The copulatory organ is excessively complicated; the apparently missing segment of the male is invaginated, and is continued forwards as a tube; around its wall there are five to six layers of circularly arranged muscles, and at the upper end there is a well-developed bundle of longitudinal muscles, which no doubt serve to withdraw the organ into the body; within one tube there lies another which has thin walls; this is continuous anteriorly with a flagellum, which is beset with a number of spines or setæ. Posteriorly it is grooved and there receives the ductus ejaculatorius; in copulation it is completely everted. The oviduct is of considerable length, has a homogeneous investing membrane and a circular layer of muscles, which increases in thickness towards the orifice. There are seven pairs of stigmata, of which six are abdominal and one prothoracic. In addition to a cylindrical fat-body there are separate cells arranged in groups; these are continued into a thin and rather long stalk. The author was unable to dissect out the dorsal vessel.

The eyes are, as in other Mallophaga, simple stemmata, each of which is directly innervated from the œsophageal ganglion. The nervous system has been figured and described by Nitzsch.

Nervous System of Phylloxera.*—M. V. Lemoine has made his observations on *Phylloxera punctata*, and apterous agamic forms developed from agamic and from "dicœcious" ova, the nymph, the winged agamic form, and the male and female, have been examined. In the adult agamic form the brain is reduced, the subœsophageal ganglion contains three pairs of distinct centres, the thoracic ganglion forms an elongated mass, terminating in a large elongated nerve-trunk which is divided into a number of branches; these nerves for the viscera contain small masses of nerve-cells. In the young forms the subœsophageal mass is more elongated and the commissural peduncles are shorter; this last character is very remarkable in the embryo; in the nymph the ganglionic chain is more and more concentrated in the anterior regions of the body. As a result of the modifications which go on, the optic lobes increase in size, and the compound eyes, which are new formations, become intercalated in front of the three primitive ocelli, which have persisted. In a female which had recently been set free, and was consequently very favourable for study with transmitted light, the antennary nerve was seen to present two successive dilatations, the second of which was above the olfactory fossa. The sympathetic system appears to be well developed.

Classification of Insects.†—Prof. Brauer points out several facts in the phyllogeny of insects, such as the early appearance of highly

* Comptes Rendus, ci. (1885) pp. 961–3.

† SB. K. Akad. Wiss. Wien, xci. (1885). Cf. Amer. Natural., xix. (1885) pp. 999–1001.

organized (neuroptera) forms in palæozoic strata; the absence of any primitive forms tending to unite the existing orders, &c. He proposes to divide the hexapoda into two classes:—1. *Apteryogenea*, and 2. *Pterygogenea*; the latter he divides into sixteen orders, based on the structure of the gnathites, instead of the existing six orders.

δ. Arachnida.

Duration of Life in Spiders.*—Herr F. Dahl in reply to the criticisms of Dr. Bertkau and Dr. Karsch,† states that he proved to be a certainty the seasonal dimorphism of *Meta segmentata*, which was only rendered probable by the investigations of other naturalists. The main aim of his paper was, however, to direct the attention of naturalists to other species, such as *Micrommata viriscens*, of which Dahl himself could not obtain specimens. With regard to the duration of life of spiders, it was pointed out that in the majority of spiders, particularly the males, the season of sexual maturity was always definitely fixed; and this fact appears to point to a very short span of life in these species; moreover, in certain seasons no individuals whatever of some species can be found—which further supports the same conclusion.

Embryology of Limulus.‡—Dr. J. S. Kingsley was unfortunately unable to study the earlier stages in the development of *Limulus*, but he comes to the conclusion that the yolk is wholly hypoblast, and that the primitive groove is the homologue of the blastopore. The history of the development of the mouth seems to show that the functional mouth is not a strictly homologous structure throughout the animal kingdom, but that in those forms with a mouth it has been considerably modified in position. The history of the "brick-red glands" with the corresponding ones in the scorpion, and the so-called shell-glands of Crustacea, leads the author to regard them as segmental organs. The abdominal appendages are from the first broad and leaf-like, and so differ from the corresponding limbs of Arachnids.

The nervous system first appears as two longitudinal epiblastic thickenings, one on either side of the middle line; there is no external neural groove, but one on the inner surface of the cord; this is doubtless due to the egg filling its envelope so completely that an inward bending is impossible. The commissural portions are separated from the epiblast before the ganglionic areas. The brain is at first separate from the rest of the nervous system; it arises as two halves, each of which has a marked similarity to those of spiders.

The study of the development of *Limulus* has convinced Dr. Kingsley of the Arachnidan affinities of this animal, but its relationship to the Phyllopoda is also marked; it is a "synthetic type." He regards the eyes of all Arthropods as really specialized portions of the epiblast of the head, and as having a common phylogenetic origin

* Zool. Anzeig., viii. (1885) pp. 629–31.
† See this Journal, v. (1885) pp. 993 and 994.
‡ Quart. Journ. Micr. Sci., xxv. (1885) pp. 521–76 (3 pls.).

from an annelid ancestor. There is a full discussion of the arguments *pro* and *con.* the arachnidan affinities of *Limulus.*

In conclusion, the systematic position of the Arachnida is treated of, and it is thought likely that the ancestral Hexapod left the main Arthropod stem some time before the separation of the Crustacea and "Acerata"; the characters of the common ancestors of the three, and of the two latter groups are enumerated, and some of the arguments in their favour briefly stated.

Embryology of Limulus polyphemus.*—Messrs. W. K. Brooks and A. T. Bruce describe the unfertilized ovum as consisting of a homogeneous mass of yolk-globules, covered at one pole by a protoplasmic cap without a nucleus. From this, after fertilization, protoplasmic processes grow downwards, so as to divide the yolk into a number of "yolk-balls," in which at present no nuclei are visible. As the cap gradually decreases nuclei appear in it, and the yolk-balls increase in number, whilst a nucleus appears in each of them. The cap ultimately disappears. The cells at the surface of the egg now become smaller and lose their yolks, becoming at the same time columnar, so as to form a complete epithelial layer round the large central yolk-containing cells. The former becomes ectoderm and mesoderm, whilst the latter becomes endoderm, and perhaps also mesoderm. The blastodermic cells give rise to a "protoderm," or embryonic chitinous cuticle. A "primitive annulus" is formed from the blastoderm, very like that which Balfour figures for the spider's egg. The mesoderm grows in from between two ventral bands (nerve-cord) and spreads internally; this soon splits to form the cœlom. The yolk becomes segmented by mesodermic partitions. The entosternite is formed by a thickening of the splanchnic mesoderm. The stomodœum is placed in front of the first limb-buds, and for some time ends blindly against the yolk. When the embryo hatches there are no endodermal structures. This layer is formed by the peripheral cells of the yolk-mass becoming columnar and transparent. The liver is marked off from the axial intestine by mesodermic upgrowths from the entosternite. The proctodœum does not appear till after the formation of intestine. The commissure between the ganglia of the first pair of appendages is *in front* of the mouth. The lateral eyes are formed by a specialization of the ectoderm cells, but the retinal portion of the median eyes is formed by ectodermal ingrowths from the *ventral* mid-line; this development corresponds to the difference in structure as described by Lankester for the eyes.

The authors conclude by remarking that "the embryonic history of *Limulus* finds its closest parallel in the embryology of the Arachnida." They refer to Balfour's summary of the differences in the development of the mesoderm in Arachnida and in the Crustacea, in the difference in the mode and time of formation of the mid-gut, &c., as tending to unite *Limulus* with the Arachnida.

Metamorphosis of Limulus polyphemus.†—Soon after fertilization the yolk of the egg becomes irregularly divided up, but Prof.

* Johns-Hopkins Univ. Circ., v. (1885) pp. 2–4 (1 fig.). † Ibid., p. 2.

H. L. Osborn regards this as probably a pathological condition, which, however, does not prevent normal development. About two days after fertilization a protoplasmic cap appears at one pole; though it stained deeply, it was structureless; in a surface view this has the appearance of a dark pit. Its relation to future changes is unknown. It, however, disappears, and a white mound makes its appearance on the surface—the "primitive cumulus"—but its relation to past and future changes is unknown. The next thing observed was a semicircular depression, between the limbs, of which three pairs of buds appear in succession; these are the three anterior pairs of appendages. The mouth is an elongated antero-posterior slit, in front of the first pair of limbs. All these structures are situated on an oval area, marked off from the rest of the egg. The anus is not yet formed. The remaining pairs of appendages appear in succession, as well as the ventral nervous system, which appears as a thickening along the ventral mid-line. He contradicts Packard and agrees with Dohrn as to the position of the compound eyes; they appear on the fourth somite.

Chemical Composition and the Coagulation of the Blood of Limulus, Callinectes, and Cucumaria.*—Dr. W. H. Howell describes the bluish coloration of the blood of *Limulus* after exposure to the air. The blood clots immediately, but never forms a solid mass. Coagulation could not be prevented by the usual methods. It shows the presence of four albumens, the highest of which is exceedingly difficult to precipitate. He describes the actions of various reagents, and concludes that the albumens are related to paraglobulin. The blue colour of the serum is due to a compound of copper with albumen. The fibrin of the clot is formed by the corpuscles.

In *Callinectes*, the serum contains two albumens, and is similar to that of Limulus.

The red corpuscles in the perivisceral fluid of *Cucumaria* contains hæmoglobin: coagulation results from the fusion of the white corpuscles which entrap the red ones. Thus the coagulation of the blood of these forms is similar to that in the Mammalia, as is also the fibrin.

Coxal Gland of Limulus and other Arachnida.†—Mr. G. L. Gulland brings forward evidence in favour of the view that the coxal gland of *Limulus* and other Arachnida is a modified nephridium. In a note, Prof. E. Ray Lankester thinks that the facts of the young *Limulus* having the gland in the form of a tube opening to the exterior by one extremity, and to the primitive cœlom by the other, and of its being a paired organ belonging to a single segment, make clear that it has the essential anatomical features of a "nephridium"; its conversion into a ductless gland of the adult is paralleled by the history of the suprarenal body of vertebrates, to which it is, apparently, similar, both morphologically and physiologically. Prof. Lankester reminds us of the correspondence seen in the case of the "shell-gland" of Entomostraca, and puts forward the hypothesis that the

* Johns-Hopkins Univ. Circ., v. (1885) pp. 4, 5.
† Quart. Journ. Micr. Sci., xxv. (1885) pp. 511–20 (1 pl.).

genital ducts of Arthropods are also modified nephridia. He states that he has recently ascertained that the blood-system in the larger Arthropoda is altogether distinct from the general system of lacunæ of the connective tissue.

c. Crustacea.

Blind Brachyurous Crustacean.*—Mr. J. Wood-Mason states that four species of Brachyura were dredged in the Bay of Bengal from depths exceeding 100 fathoms during the past season by H.M.'s Indian Marine Survey steamer 'Investigator.' They belong to the genera *Amathia*, *Ethusa*, *Encephaloides* (n. gen. allied to *Collodes* Stimpson), and *Lyreidus*, of which the last-named (*L. Channeri*) is especially interesting on account of the rudimentary condition of the eyes.

These organs are unequally reduced, the cornea of the left being of the normal form and extent, but opaque and devoid of all traces of facets, as in *Munidopsis*, *Orophorhynchus*, *Nephropsis*, and other blind forms of the deep sea, while that of the right is entirely aborted, its place being only indicated by a small smooth spot marked out by the transparence of a lead-coloured pigment similar to that which is seen through the integument around the base of the left eye. This interesting brachyuran—which is at once distinguished from the Japanese and American species by having the anterolateral margin of the carapace armed with two pairs of long and slender spines—were trawled up from a depth of 285–405 fathoms.

Notes on the Stomatopoda.†—Dr. W. K. Brooks traced the development of the larvæ of *Squilla empusa*, and *Lysiosquilla* sp., by means of the general appearance of various stages, not being able to obtain the eggs nor to keep the younger larvæ alive in confinement.

The youngest *Lysiosquilla* was in the stage of "Claus' larva"; this is followed by the Erichthus stage, which he traced into a young *Lysiosquilla*. Several facts in the natural history of these forms are given. *Squilla* produces a striduating noise by rubbing the serrated spine of the swimmeret across the serrated ridge of the telson.

Structure of the Brain of Sessile-eyed Crustacea.‡—Dr. A. S. Packard describes the brain and other nerve-centres in the head of *Asellus communis* and the eyeless *Cecidotæa stygia*. The ganglion-cells have not, as in the brain of the lobster, a simple nucleus, but ten to twenty nuclei; they appear to be entirely unipolar; the "Punktsubstanz" of Leydig, which Dr. Packard proposes to call the myeloid substance, is not, as in many, differentiated into distinct spherical masses, and in this respect there is a wide difference between the brains of Decapoda and Hedriophthalmata. All the ganglion-cells appear to give rise to fibres, some of which pass directly through or above or around the myeloid substance of the cerebral lobes and form the commissures.

Though far less complicated than that of the Decapoda, the brain

* Proc. Asiatic Soc. Bengal, viii. (1885) p. 104.
† Johns-Hopkins Univ. Circ., v. (1885) p. 10.
‡ Mém. Nat. Acad. Sci., iii. (1885) 14 pp. (5 pls.).

of Isopods and Amphipods is a syncerebrum, the components being the brain proper or procerebral lobes, the optic ganglia, and the first and second antennal lobes; as compared with the Decapoda, these lobes are quite separate from each other. The author prefers to use the term procerebrum, as the lobes are not the homologues of the cerebral lobes of vertebrates; they are more than twice the size of any of the other ganglia; the eyes of *Asellus* being small, the optic lobes and nerves are small also. The mouth-parts in the Asellidæ, if not all the Isopoda, are not innervated from a single subœsophageal ganglion, but each appendage is supplied by a nerve arising from a separate ganglion.

In *Cecidotæa* the optic ganglia and nerves are lost, while the eyes have lost their retinal cells; very rudimentary lens-cells are still inclosed in the black pigment-mass.

"The steps taken in the degeneration or degradation of the eye, the result of the life in darkness, seem to be these:—(1) The total and nearly or quite simultaneous loss by disuse of the optic ganglia and nerves. (2) The breaking-down of the retinal cells. (3) The last step being, as seen in the totally eyeless form, the loss of the lens and pigment." Dr. Packard thinks that a modified modern form of Lamarckianism will account for the origination of these forms.

Processes formed by Cerapus on Tubularia indivisa.*—Prof. W. C. McIntosh finds that the domicolous Amphipod *Cerapus* sp. constructs groups of flexible tubes on stems of *Tubularia indivisa;* unlike those made by *C. rubricornis* they are partly composed of grains of sand, spines and bristles of annelids, hairs of sea-mice, and fine horny fibres. On the same stems are processes which project from the cœnœcium like branches, three to four inches long, smoothly rounded; they are usually at some distance from the nests or tubes of the crustaceans which climb actively on them; it is unknown whether their function is to afford a larger area for the capture of prey or a more extensive surface for the resting of the minute forms which serve as the crustacean's food; but it is probable that they subserve some useful purpose. Unlike the equally peculiar spinous processes which are not uncommon on the tubes of annelids, they are not to be credited with a protective function.

Vermes.

Development of the Trochophore of Eupomatus uncinatus.†—Dr. B. Hatschek has investigated the history of the larva of this Serpulid, the study of which has suggested to him that the auditory vesicles had appeared in the "Trochozoon" and had been thence inherited both by molluscs and annelids. The larva in question has a peculiar ectodermal vesicle at its hinder end.

It is found that most of Stossich's observations on this worm are incorrect, and that author appears to have had to do with abnormally developed embryos.

* Ann. and Mag. Nat. Hist., xvi. (1885) pp. 484–5.

† Arbeit. Zool.-Zoot. Inst. Wien, vi. (1885) pp. 121–48 (5 pls.).

The ovum is spherical and its contents fairly transparent; the stages preceding division are typical; cleavage is much as in *Pomatoceros*, and is described in detail. After the sixteen-cell-stage the ectodermal cells are those which increase most rapidly. The gastrula is formed by invagination, and the blastopore shortly afterwards becomes partly closed, and forms a small orifice which is pushed towards the oral side; this excentric position is to be explained by the closure of the cleft taking place from behind forwards. The primitive mesoderm-cells begin to be differentiated immediately after the invagination of the ectoderm, and the process is typical in character.

The formation of the larval organs from the germinal layers is next described, and it is stated that at the end of the embryonic period the cell-nuclei and the cell-boundaries are not always to be detected; in the protoplasm of the cells the distribution of the yolk-granules and the consequent change in colour, as well as the appearance of new pigment-granules are to be observed. The red colour which was at first general is gradually concentrated around the equatorial cells which carry the circlet of cilia. The large pigment-granules of the eye are new formations which appear at the end of the embryonic period.

The mode by which the body acquired its form is next discussed. Some attention is directed to the nervous system; this, it may be supposed, resembles that of the larva of *Polygordius*, but it was not possible to observe any other than the circular nerves. Close behind the post-oral circlet of cilia two ectodermal vesicles appear on the third day after fertilization, and after all the typical organs of the trochophore-larva have been already developed. They each arise from an ectodermal cell which grows inwards, and becomes hollowed out by a vacuole; it was not possible to determine whether this "vacuole" makes its way in from the exterior. Later on mesodermal cells become connected with each cell; these structures are regarded by Dr. Hatschek as being auditory organs.

The canal of the head-kidney is formed by a single mesodermal cell, which at first elongates in a spindle-shaped fashion, and then forms a short rounded filament; a lumen later on becomes apparent, and cilia are developed which work backwards; the hinder end of the kidney extends to the close neighbourhood of the anus; the author directs especial attention to the fact that, at first, the hinder protoplasmic swelling of the longitudinal muscle has exactly the same relations as the other terminal cells of the head-kidney.

The paper concludes with some notes on an allied larva from Faroe, which is especially remarkable for having persistent auditory vesicles in the hinder part of the cephalic region; they are placed at the anterior end of the ventral medulla, and externally to the œsophageal commissure.

Lumbrici with bifid ends.*—Prof. F. Jeffrey Bell gives an account and figure of a *Lumbricus terrestris* with a bifid hinder end, and states

* Ann. and Mag. Nat. Hist., xvi. (1885) pp. 475–7.

that he has seen also a similar specimen of *L. fœtidus*; he points out that it is not a case of budding, and, remarking that the clitellum only became apparent just before the hinder ends were lost, says that, if the two facts are correlated, it only shows that asexual reproduction (to which reproduction of parts is *pro tanto* comparable), is not compatible or contemporaneous with sexual reproduction. It is possible that the phenomenon of a bifid tail is not rare among earthworms, but only one such case has before been put on record.

Development of Branchiobdella.*—Prof. W. Salensky commences with a note on the species of *Branchiobdella*; of these he has used that which is parasitic on *Astacus leptodactylus*, the eggs of which are of a size which lends itself to the preparation of sections; these eggs are attached to the gills of the crayfish by a very delicate pedicle, and are invested by two membranes, the outer of which forms a thick chitinous capsule, is very hard and very elastic, and cannot be detached from the living egg. It is necessary to make use of chromic acid, which causes the membrane to swell, and after some time, to soften. The inner or vitelline membrane is so delicate, and so closely applied to the yolk that it cannot be removed without injuring the egg itself.

The yolk consists, as in various Annelids, of a large number of highly refractive granules; the nucleus is spherical and small, and contains several nucleoli; the first changes that occur in a freshly deposited egg affect the form and situation of the nucleus; the author was unable to observe the copulation of the two pronuclei and the formation of the first segmental nucleus. Segmentation, while recalling in some particulars that of *Nephelis*, differs in some essential points; the blastomeres are from the first formation of two macromeres asymmetrical, and this asymmetry becomes more and more marked; there is, further, great individual variability in the form and distribution of the blastomeres, and this even in the earliest stages of segmentation. The micromeres divide much more rapidly than the macromeres, and we meet therefore with epiboly. The variations cause, as may be supposed, considerable difficulty in the orientation of the eggs.

Regarding the process of segmentation as a whole we find essential differences between *Branchiobdella* and *Clepsine* or *Nephelis*; the position of the poles and of the ovular axes as compared with the poles and axes of the embryo is different; there are differences also in the history of the macromeres, for, in *Branchiobdella*, they multiply during the whole period, and they give rise to the endodermal cells, to those which appear to correspond to the neuroblast of *Clepsine*, and to the ectodermal cells. The author regards the differences as due to differences in biological conditions, and suggests that such, and the absence or presence of the gastrula-stage ought to be explained as being cenogenetic.

The external modifications of the embryo are next considered; when segmentation is ended, the embryo becomes pyriform, and the

* Arch. de Biol., vi. (1885) pp. 1–64 (5 pls.).

cells on the surface are arranged in a special or characteristic manner, which is described in detail.

Even in the latest stages of segmentation one can only distinguish two layers, an ectoderm formed by the micromeres and some of the macromeres; and a meso-endoderm represented by cells varying in size and form, but all derived from the macromeres; after the appearance of the medullary groove the meso- and endoderm become differentiated; by a reference to his figures, the author demonstrates that the large cells at the hinder end of the body undergo a retrograde development; the ectoderm thickens, and gives rise to the ventral pads or medullary plates; at the top of the cephalic tubercle it thickens, and becomes composed of several layers, so as to give rise to the "sincipital plate"; the endoderm begins to form the œsophagus.

The nervous system is developed from the ventral pads or plates, which are homologous to the similar organs described in other Annelids, and which give rise to the ventral ganglionic chain, and from the sincipital plate which forms the cephalic ganglia. The history of these is given in detail. The cerebral commissure appears later than in the Chætopoda, and is not complete till the time when the embryos are just about to escape, and it consists of nerve-cells; the cephalic ganglion after its separation from the ectoderm is composed of a continuous cellular mass; in the adult there are two pairs of ganglia, but this structure is a secondary and not a primitive one, for it is produced in a relatively late stage, and only just precedes the formation of the mouth.

On the whole, the formation of the cœlom is as in other Annelids; the differences in the mode of formation of the dissepiments and their relation to the external membranes is discussed; as to the sucker, Prof. Salensky can only confirm the results of other observers as to its being a modification of the posterior metameres of the embryo. The endoderm is at first a compact mass of cells, and the enteron is, compared with that of other Hirudinea, formed late; the stomo- and proctodœa are short, and the former only gives rise to the lips; the constrictions of the cæca correspond to the dissepiments.

Priapulus caudatus and Halicryptus spinulosus.*—Dr. W. Apel, after some remarks on methods of preservation, and observations on the living animal, proceeds to describe in detail the structure of these two Gephyrean worms.

As in *P. bicaudatus*, the cuticle consists of two sharply distinguished layers, the outer of which is homogeneous and structureless, while the lower consists of fine lamellæ marked off by two systems of lines. The papillæ of *Priapulus* and those on the proboscis of *Halicryptus* have the same essential structure as, and are doubtless homologous with those of the trunk of the latter; the only difference is that the former have an orifice at their tip. The musculature of *P. caudatus* and *Halicryptus* is similarly arranged as in *P. bicaudatus*, as described by Horst. The wall of the caudal appendage of *Priapulus* has the same structure as the body-wall, save that the circular

* Zeitschr. f. Wiss. Zool., xli. (1885) pp. 459–529 (3 pls.).

muscles here form a continuous layer, and the longitudinal are arranged in fifteen bundles; the whole is to be regarded as an appendage of the body.

The cœlom contains a thick whitish fluid containing a considerable number of large spherical cells; nearly all of these have a large vacuole; they do not, as in *Sipunculus*, coagulate.

In the full description of the digestive tract mention is made of the characteristic dental structures which are developed from the lining cuticle; they are to be regarded as the homologues of the various elevations which are found on the surface of the body; they are filled internally by a process of the subcuticular layer, the cells of which are considerably elongated. The proctodœum appears to be very short.

The nervous system, for a knowledge of the central portion of which we are indebted to Ehlers, is next described; there is considerable difficulty in investigating the arrangement of the peripheral nervous system, and specimens preserved in alcohol are of no use; chromic or picric acids are better. A nerve is given off from the centre of every swelling, and therefore corresponds to the middle of every circular muscular area; these nerves pass off on either side and extend between the cells of the hypodermis; in an animal 43 mm. long the peripheral nerves are ·002 mm. wide; in *Priapulus* the fibres of the hinder end of the body are a little thicker. The nerves given off from the œsophageal ring pass to the body-wall and to the pharynx; of the latter there are only four; they pass between the cells of the subcuticular layer, and extend straight forwards and backwards; these fibres are connected with one another by circular nerves which are set at right angles to them, and in the same superficial plane; the circles are so disposed as to correspond with the rows of teeth. Dr. Apel was able to trace the peripheral nerve-fibres between the cells of the hypodermis, to the limiting membrane between the musculature and the subcuticular layer.

The generative apparatus of the Priapulaceæ is as yet incompletely known; the female organs are found to consist of an efferent duct and a ventral lamellar glandular body; the minute structure of these as of the homologous male organs is described in great detail; the male organ, like the female, is attached to the body-wall by a mesentery, Ehlers' observations to the contrary being probably due to the poor condition of his specimen.

Throughout the essay constant reference is made to the work of Ehlers and of Horst, who have both contributed very largely to our knowledge of these worms.

Pelagic Fauna of the Coast of the Guinea Islands.*—Prof. R. Greef, after a brief general account of the pelagic fauna observed round the Guinea Islands, especially describes the pelagic Annelids. Two new species of *Tomopteris* were observed—*T. rolasi* and *T. mariana;* the rosette-shaped organ in the parapodia appears to be glandular and not optic in nature, and the gland is luminous and under the direct influence of the nervous system; the cephalic seg-

* Zeitschr. f. Wiss. Zool., xli. (1885) pp. 432–58 (5 pls.).

ment and its appendages are described; though the author was able to examine the genital organs, he was not successful in finding fertilized ova. Of the Alciopidæ five species are enumerated, four of which—*Vanadis melanophthalmus, V. setosa, Rhynchonerella fulgens*, and *Alciopa longirhyncha*—are new. The male of *R. fulgens* is remarkable for the arrangement of its generative organs; from the tenth to the thirteenth segments there are a pair of coiled tubes filled with spermatozoa; the orifices at either end are very fine; the tubes communicate with very peculiar conical organs lying under the parapodia of their proper segment, at the end of which they open to the exterior. Unfortunately with the Alciopidæ also Dr. Greef was unable to make any observations on development or on the larvæ.

Development of Nematoids.*—M. P. Hallez has made some further† observations on the development of round worms, which justify him in doubting the correctness of two of the conclusions reached by Davaine. That author stated (1) that the embryo only escaped from the egg after it had been brought into the intestine with food or drink, and (2) that the softening of the egg-shell by the intestinal juices and a temperature of about 40° C. were necessary for the escape of the eggs; but Hallez found that, having placed on the 18th of June a number of eggs of *Ascaris megalocephala* on the surface of the earth of flower-pots, a number of embryos escaped on the succeeding 17th and 18th of August. This and other experiments appear to be conclusive as against the accuracy of Davaine's laws. The young never escape if the eggs are put into water, or are allowed to dry; the young, both before and after their escape, require a supply of oxygen, and this may be the reason why they do not develope under water.

Nervous System of Tæniadæ.‡—The nervous system of Cestodes, first recognized about fifty years ago, but till within the last decennium generally ignored or denied, has recently been the subject of frequent research. The current description, according to which the nervous system consists of spongy lateral cords, has been proved inadequate, but the observations have been hitherto too conflicting and fragmentary to admit of any definite conception of the real state of the case. Through the work of Dr. J. Niemiec, however, the preceding researches have been corrected, completed, and unified, and the *Tæniadæ* have been shown to possess a nervous system of great complexity.

The research is based on sections of the scolices of *T. cœnurus, T. elliptica, T. serrata*, and *T. mediocanellata*. After giving an account of the arrangement and histology of the musculature, he unravels the intricate maze of cords and commissures in the four above-named species. Only a brief account of his summarized results can be given.

(*a*) *The nerve-ring.*—A nerve-ring situated under the hooks, previously observed by Moniez in one species, has been demonstrated in

* Comptes Rendus, ci. (1885) pp. 831–4.
† See this Journal, v. (1885) p. 809.
‡ Recueil Zool. Suisse, ii. (1885) pp. 589–648. See this Journal, v. (1885) p. 244.

several. From this ring filaments run to the hook musculature, while from ganglionic swellings eight branches descend, four going to the two principal lateral ganglia, and four prolonging their course even within the proglottides. The ring ganglia in *T. cœnurus* also give origin to nerves going directly to the suckers.

(*b*) *The central ganglion.*—In the middle of the "principal" commissure joining the two lateral ganglia, there is a large central ganglion, from which a "transverse" commissure passes at right angles to the "principal."

(*c*) *Polygonal commissures.*—In the plane of these two chief commissures there lie nerves, which unite the two lateral ganglia with the branches descending from the nerve-ring and with the "transverse commissure," thus forming a polygonal figure, parallel to which, a little below, there lies an "*inferior* polygonal commissure" of the same nature. Where the different branches join, "secondary ganglia" are situated, and from these, as well as from the principal lateral ganglia, the suckers are supplied with nerves, four to each.

(*d*) *The "spongy cords."*—Nitzsche had previously observed ten "spongy cords," which Niemiec now enables us definitely to localize. Six of them, three on each side, start from the principal lateral ganglia; the remaining four have been already noted as descending from the nerve-ring and passing through the "secondary ganglia."

Dr. Niemiec indicates the interest of his research as a contribution towards the solution of the problem of the phylogeny of the Cestodes. (1) He enumerates the resemblances between the nervous system of *Tæniæ* and that of *Tetrarhynchi*, recently elucidated by Lang. (2) While acknowledging the difficulties of the comparison he regards the nerve-ring of *Tæniæ*—not the commissure—as homologous with the œsophageal ring of Annelids, from which it differs only in its less pronounced development or reversion to a more rudimentary form. (3) Referring to the recent researches of Lang and Gaffron on Trematodes, he indicates how they lessen the difference between the Cestode and Trematode nervous systems, which his own discoveries seem to increase.

Natural History of Rotifers.*—In the first portion of his essay Dr. L. Plate gives a full account of the fresh-water Rotifers examined by him; they are thus arranged:—

Fam. Tubicolarina: *Lacinularia socialis, Conochilus volvox.*
„ Philodinäa: there are here some general notes.
„ Polyarthräa: *Polyarthra platyptera, Triarthra longiseta, T. terminalis* n. sp., and *T. cornuta.*
„ Hydatinäa: *Notommata aurita, N. vermicularis, N. lacinulata, N. tripus, N. hyptopus, Lindia torulosa, Hertwigia volvocicola* n. sp., *Eosphora elongata, Hydatina senta, Synchæta pectinata, S. tremula,* and *Rhinops vitrea.*
„ Macrodactylea: *Scaridium longicaudatum, Monocerca rattus,* and *Diurella tigris.*

* Jenaisch. Zeitschr. f. Naturwiss., xix. (1885) pp. 1–120 (3 pls.).

Fam. Loricata: *Dinocharis pocillum*, *Salpina* spp., *Euchlanis dilatata*, *E. luna*, *Metopidia lepadella*, *Stephanops lamellaris*, *Pompholyx complanata*, *Pterodina* (it is doubtful whether *P. patina* and *P. elliptica* are really distinct from one another), *Anuræa* spp., *Noteus quadricornis*, *Brachionus amphiceros*, *B. urceolaris*, *B. bakeri*, *B. brevispinus*, *B. bidens* n. sp., *B. decipiens* n. sp., and *B. plicatilis*.

„ Asplanchnäa: *Asplanchna myrmeleo*.

In the second division of his essay the author deals in order with the various organs of the body, &c.:—(i.) External integument and form. *Apodoides stygius* appears to be the only exception to the rule that there is no ecdysis during growth; a "carapace" is not really confined to the members of the division of the Loricata, for it is found also in *Notommata lacinulata*, and in some species of *Diurella;* the males of the Euchlanidæ are, exceptionally, provided with a carapace. (ii.) Wheel-organ. Such rotifers as have a double circlet of cilia afford other proofs of a primitive organization, and the "Archirotator" must be supposed to have had a sausage-shaped body, with the hinder end narrower and provided with a circlet of cilia. (iii.) Musculature. Our knowledge of the muscular system is as yet confined to too small a number of forms to enable us to make a comparison; the muscles do not appear to Dr. Plate, as they did to Leydig and Eckstein, to be completely homogeneous, but rather to have a finely granular central protoplasm, while the granules are often somewhat larger and so regularly arranged as to give an appearance of transverse striation. (iv.) Nervous system. The large dorsal central organ cannot be clearly seen to be composed of two lateral halves; a tuft of sensory hairs on the dorsal surface ("dorsal tentacle") is very commonly formed, and in its neighbourhood the hypodermis is thickened and elevated; this is found in many females and in all the males that have been examined; it is sometimes paired, but otherwise is not altered in character, although placed further back on the body; other sensory tufts and the eyes are next described. It is possible that the granular calcareous mass which is found in the brain of some species of *Notommata* represents an otolithic mass; it is not known to be present in the male. After a few observations on (v.) the digestive apparatus, the author passes to (vi.) the excretory organ. It is recognized that Leydig was justified in saying that the excretory tubes were of two forms, for in some they are cylindrical and of about the same width throughout, while in others they are trumpet-shaped. The contractile vesicle appears to have gradually arisen by the fusion of the two vessels, and in the more primitive forms we find that they are not fused into a basal enlargement; in others (e. g. *Conochilus*) the contractile vesicle is formed by the direct conversion of a part of the cloaca. (vii.) The cement-glands are usually paired, but when reduced they may form a single organ. (viii.) The connective tissue is present in the form of filaments and represents the first indications of a mesenchym; in the larger species (*Asplanchna*), the cells from which the filaments arise exhibit amœboid movements, and the tissue has thus a contractile as well as a supporting function; the longer bands,

which are often of great delicacy, are frequently arranged with remarkable symmetry; by some authors they seem to have been mistaken for nerves. (ix.) The female organs exhibit little matter for histological inquiry; the whole yolk-mass is limited externally by a thin structureless membrane, and contains but a small number of large nuclei. They are unpaired except in the Ptilodineæ and in *Seison*, but it is not yet possible to say whether the duplicity is a primitive or an acquired condition; future inquiries will have to settle whether the mass which produces the summer eggs is morphologically different from that which gives rise to the winter ova; the author is inclined to believe that it is not so. (x.) Males; of the seventy-four genera as yet included in the system of the Rotatoria, there are but twenty-four—*Flosculuria*, *Seison*, *Lacinularia*, *Conochilus*, *Triarthra*, *Polyarthra*, *Notommata*, *Synchæta*, *Eosphora*, *Diglena*, *Hydatina*, *Monocerca*, *Monostyla*, *Colurus*, *Salpinx*, *Euchlanis*, *Metopidia*, *Brachionus*, *Apodoides*, *Anuræa*, *Apsilus*, *Ascomorpha*, *Asplanchna*, and *Hertwigia*—in which the males are as yet known. As is well known, the males are of simpler organization than the females. With regard to the method of copulation, the author finds that in Rotifers, as in some Planarians, the penis bores through the body-wall of the female at any point, and is not inserted into the cloaca; under suitable conditions one female may be fertilized by several males. The females of *Hydatina* were observed to live for about fourteen days, but the male could not be kept alive for more than three at the most; the former reach their definite size in about three days, and they then begin to lay their eggs. The common view that males are especially common in spring and autumn is erroneous, for they are just as common in the middle of August as in April or October; the source of error is to be found in the comparative rarity of males.

In conclusion, Dr. Plate has some observations on the stem-form of the Rotatoria; it is clear that sexual dimorphism is an acquired character. The "Archirotator" had a cylindrical body, narrower behind, a ventral mouth and dorsal anus, and an aboral tuft of cilia; the wheel apparatus consisted of two ciliated circlets; the fore-gut had a chitinous masticatory apparatus, and the whole tract was lined by ciliated epithelium; into its hinder portion opened two unbranched excretory canals, and the genital ducts. The nervous system consisted of a dorsal central ganglion, which gave off several anterior and two postero-lateral nerves. As to their systematic position, the Rotifers appear to be of the same stock as the Annelids, but they differ from the Trochophore in wanting a ciliated groove, the hinder circlet of cilia opens into the fore-gut, the aboral tuft does not correspond to the "perianal" circlet, and the brains are not homologous.

Desiccation of Rotifers.—Mr. H. Davis at a recent meeting of the Quekett Microscopical Club, exhibited some strips of note paper on which were several groups of dried Philodines (*P. roseola*), looking like clear red spots. These had been sent to Mr. Davis by the Rev. E. T. Holloway, of Clehanger, who had thus succeeded in obtaining specimens of these dried rotifers quite free from sand or dirt

of any kind, which has been considered by some to be the only protective.

Dr. C. T. Hudson writes us that "Nothing could be more instructive than these curious clusters. In the great majority of cases, each rotifer was seen imbedded in a patch of glutinous secretion, which was divided from the similar patches of the surrounding rotifers by sharp straight lines, so as to give the whole group the appearance of a tesselated pavement. Here and there the Philodines were glued together by long tongues of the same secretion; especially where the fibres of the paper projected above the general surface, and by spoiling the level, prevented the formation of a sharp bounding line. In one case a rotifer had bored its way into the fibres of the paper, and, unable to withdraw or contract itself, had formed the centre of a whole group of others attached to it by radiating bands of glue. In fact these beautifully clean groups gave ocular demonstration of the truth of Mr. Davis's theory that the Philodines resist drought by encasing themselves in a glutinous case of their own secreting: and the efficiency of the protective was at once shown by putting the strips in water, when the buried rotifers soon struggled into life."

Hudson's 'Rotifera.'*—The one thing wanting in a microscopist's library has hitherto been a fairly complete book on Rotifers with a sufficiency of illustrations. The first part of Dr. Hudson's book just published was received at the January meeting with acclamation, not only on account of the publication, so long expected, having been actually commenced, but even more on account of the reality having so much exceeded the expectation. All known British species will be illustrated with original drawings from life, while of those which are not British, descriptions and figures of the most important will be given. Of the drawings (reproduced on coloured folio plates) it is impossible to speak too highly, though they will probably not surprise those who are already familiar with Dr. Hudson's remarkable facility for representing from life the organisms of which he has made himself the leading authority. The instalment of the text, which includes the introduction, history of literature, classification, and haunts and habits, shows that it will not be behind the plates in practical utility to microscopists; while the fact that Messrs. Longman are the publishers is a guarantee that the issue of the remaining five parts, with 25 plates, will not show any falling off from Part I. No microscopist who takes any interest in pond-life can afford to be without this book, which will also fill a gap in zoological literature which has long required filling.

Mr. P. H. Gosse is assisting Dr. Hudson in the production of the book.

Echinodermata.

Hæmoglobin in Echinoderms.†—Dr. W. H. Howell has discovered a Holothurian whose cœlomic fluid contains red, oval, nucleated corpuscles, in addition to the white amœboid ones. The red colour

* Hudson, C. T. (assisted by P. H. Gosse), 'The Rotifera or Wheel Animalcules.' Part I., 40 pp. and 5 pls., large 8vo, London (Longmans) 1886.

† Johns-Hopkins Univ. Circ., v. (1885) p. 5.

is due to hæmoglobin; differing slightly in the "albuminous portion of the molecule" from that of vertebrates.

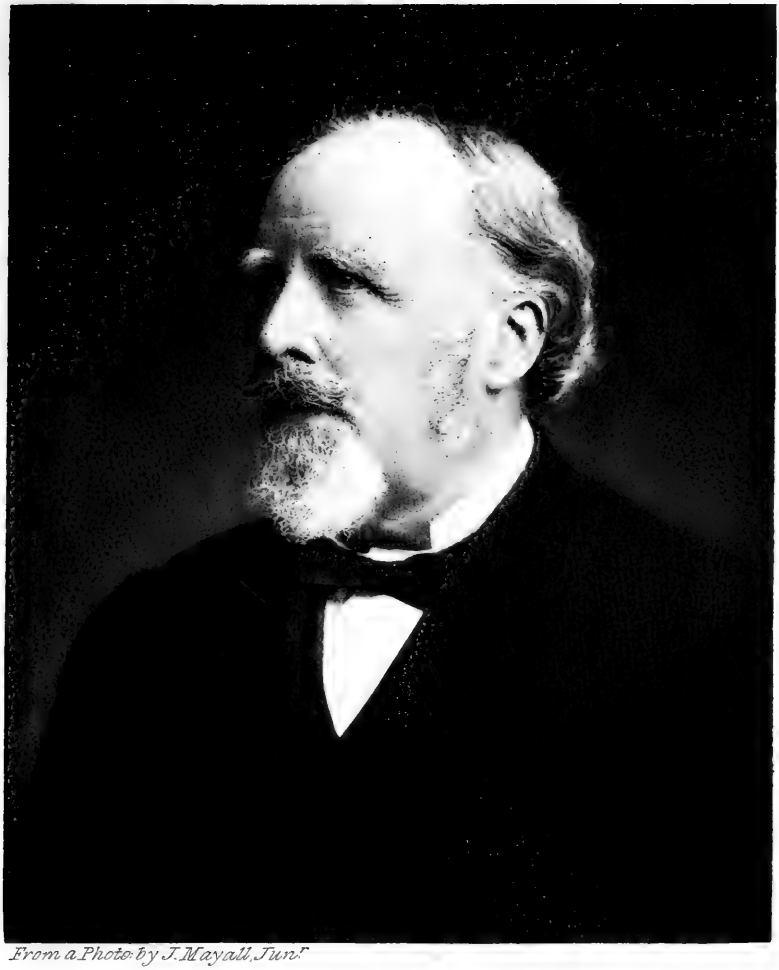
Structure and Function of the Sphæridia of Echinoids.*—Mr. H. Ayers gives a careful description of these sensory organs, the discovery of which we owe to Prof. Lovén; they may be spheroidal or oviform in shape, but there is a typical form for each species; in each sphærid we may distinguish externally a base, which is composed of a mamelon of the test, a joint, which forms the connection between the base and the globule, and chiefly composed of muscle-cells and fibrous tissue, and, lastly, a globule, or body of the sphærid, which consists of head and neck. The calcareous matter of the globule is a hard, very brittle, vitreous carbonate of lime, deposited in more or less concentric layers; it is deposited or inclosed between organic layers. The canal system is best studied after the slow removal of the calcareous matter by dilute acid, and treatment with hard Canada balsam, or by staining; the reticulated tissue of Lovén is then seen to be a system of canals, which is but a modified form of the canalicular spaces of the spines; within the canals are found nerve-cells, and in some cases (e. g. *Echinus melo*) a chlorophyll-green fluid. There is an epithelial covering, the cells of which are known to have cilia only by the currents caused by their motion; when dead they may be seen to be not scattered over the entire surface of the sphærid, but confined to patches of various size on the sides of the neck and globule. The nerve-supply comes from the tentacular nerve-trunk, and the cells form a network of filaments with here and there irregular knots—the nucleated portions of the cells. The ends of the filaments are club-shaped or pyramidal, with the larger part directed outwards.

Mr. Ayers points out that these organs are more highly specialized than Lovén's description would lead us to think, and they are much more so than similar organs among the Medusæ. As to their function it was observed that on the addition of a drop of dilute acetic acid to the sea-water in which the urchin is living, there is a sudden stimulation and increased activity of all the external organs, the sphæridia being the first to recognize the presence of the acid, and giving one or two quick short jerks, followed by a swaying or rotating movement. They seem to have the function of perceiving chemical changes in the surrounding water and reporting the same to the nervous centres of the animal; they do not seem to be affected in the least by sounds.

Ambulacra of Diadematidæ.†—Prof. P. M. Duncan describes the anatomy of the ambulacra of recent Diadematidæ, in the genera *Diadema*, *Echinothrix*, *Centrostephanus*, *Astropyga*, *Micropyga*, and *Aspidodiadema*. The research is of classificatory importance.

Star-fishes of the 'Talisman.'‡—Prof. E. Perrier states that fifty-four species, represented by nearly two hundred examples, of star-

* Quart. Journ. Micr. Sci., xxvi. (1885) pp. 39–52 (1 pl.).
† Journ. Linn. Soc. Lond., xix. (1885) pp. 95–114 (1 pl.).
‡ Comptes Rendus, ci. pp. 884–7.



From a Photo by J. Mayall, Jun.r

P. MARTIN DUNCAN,

M.B. (Lond.), F.R.S., F.G.S.,

Professor of Geology in King's College, London, &c.

President of the Royal Microscopical Society, 1881-2-3.

fishes were collected during the scientific voyage of the 'Talisman'; thirty-five of these are new, and are instructive from the combination of characters which they present. A new genus—*Odinia*—is established for such Brisingidæ as have tentacular tubes. *Zoroaster longicauda* is a new species in which the ambulacral tubes are quadriserial at the base of the arms only. The family Stichasteridæ is formed for *Zoroaster* and *Stichaster*. Four families—Linckiidæ, Pentacerotidæ, Asterinidæ, and Astropectinidæ—are completely absent below 200 metres. *Stephanaster bourgeti* n. sp. has its analogues in the Australian seas. There are nine new Porcellanasteridæ, belonging to various genera; *Styracaster spinosus* has a dorsal peduncle. The most remarkable Pterasterid is *Myxaster sol*, which has a large flattened disc, around which radiate nine or ten delicate, elongated, and flexible arms; there is the usual marsupial pouch; the two specimens were dredged at depths of 1405 and 1550 metres respectively.

Cœlenterata.

Development of Aurelia aurita and Cotylorhiza borbonica.*—Dr. A. Goette states as a result of his studies on these types: (*a*) that the cœlogastrula is a secondary embryonic form in which the gastrulation is completed by an inwandering of the endoderm into the cavity of the cœloblastula; (*b*) Scyphistoma is a perfect Anthozoon; the invagination of the ectodermal œsophagus and the gastral pouches and septa which surround it sufficiently prove the correctness of this view; (*c*) since the Strobila is produced by simple division, and the Ephyra may arise without division directly from the Scyphistoma, there is no reason for asserting an alternation of generations in *Aurelia* and *Cotylorhiza*. The Ephyra and consequently the Scyphomedusa, is a metamorphosed Scyphistoma or Anthozoon, just as the Hydromedusa is a metamorphosed Hydroid polyp.

New Japanese Pennatulid.†—Prof. A. A. W. Hubrecht describes a new Pennatulid (*Echinoptilum macintoshii*) from Japan, which belongs to the section Spicatæ and subsection Junciformes in Kölliker's classification; it forms the type of a new family—*Echinoptilidæ*—characterized by the total absence of anything like an axis, which is present in all Pennatulids except some of the primitive *Veretilleæ* and the divergent *Renilleæ*.

The colony is dense and rigid from the presence of calcareous needles, which, on the rachis, unite to form projecting polyp-cells; the structure of the polyparium is alone described, as the polyps have undergone desiccation; the polyps could be seen to be bilaterally arranged, the general form is short and club-like, the needles are formed in the internal framework, as well as in the investment; the polyp-cells are arranged in less distinct rows than, and the ventral is not wholly devoid of polyps, as in *Stachyptilum*. On the whole, the new form is intermediate in character between groups already known; and this must be recognized in assigning it a systematic position.

* Zool. Anzeig., viii. (1885) pp. 554–6.

† Proc. Zool. Soc. Lond., 1885, pp. 512–8 (2 pls.).

Porifera.

Australian Homocœla and the Homodermidæ.*—Dr. R. v. Lendenfeld, recognizing that the sponge-nature of the Physemarina is not sufficiently proved, regards the Asconidæ as the simplest of all sponges. They form the first family of Poléjaeff's suborder Homocœla, in which there is no differentiation of the endodermal epithelium.† The second family is a new one, and is called Homodermidæ, the new genus *Homoderma* combining the characters of the Syconidæ with those of the Asconidæ; the inner surface is complicated, so as to form radial sack-shaped excrescences similar to the radial tubes of the Syconidæ. The two sponges *Ascaltis canariensis* and *A. lamarckii*, described by Prof. Häckel, have a similar structure of the body-wall. The author gives a detailed description of *H. sycandra*, together with some notes on its postembryonal development or metamorphosis; at first its inner surface is perfectly simple, and chambers appear as the sponge grows; when adult, it is 2 mm. high, and has been found at Port Phillip, Victoria.

Spongilla fragilis.‡—Herr Frant Petr describes the anatomy of a *Spongilla fragilis* (Leidy) found in Bohemia, and compares it with that of other forms. He maintains the identity of the characteristic air-chamber envelope of the gemmulæ with the parenchyma sheath of *Euspongilla* and *Ephydatia* species, and regards its occurrence as probably constant in all fresh-water sponges.

Fresh-water Sponges from Mexico.§—Mr. E. Potts describes a new variety (*Palmeri*) of Carter's sponge *Meyenia plumosa*. It has the same general characters and the various spicules seen in the type: it was found on the banks of the Colorado river: the only other locality is Bombay, where Carter's specimen was found. The lower reaches of the Colorado are exceedingly hot and dry, and the chief vegetation consists in cacti, &c., and *Strombocarpus pubescens*; on the branches of the latter the sponge is found, and since the floods are only out about six weeks in the year, the sponge must be dry for the rest of the year. Reproduction can only take place during the wet season. This variety differs from Carter's in the presence of complicated subdermal spicules.

Vosmaer's Sponges.‖—Parts 8–11 of Dr. G. C. J. Vosmaer's 'Porifera' have been published, with plates 19–25.

The account of earlier classifications is continued, that of Dr. Gray being first taken up. The Porifera are defined as: "Very variable in form, different between the limits of one single species. The body consists principally of a connective-tissue-like substance,

* Proc. Linn. Soc. N.S. Wales, ix. (1885) pp. 896–907.

† The awkward wording of a sentence on p. 1014 of vol. v. of this Journal causes the non-differentiated character of the endoderm to be ascribed to the Heterocœla instead of the Homocœla.

‡ SB. K. Böhm. Gesellsch. Wiss., 1885, pp. 99–111.

§ Proc. U.S. Nation. Mus., viii. (1885) pp. 587–9 (1 fig.).

‖ Bronn's 'Klassen u. Ordnungen d. Thierreiches,' 8vo, Leipzig and Heidelberg, 1885.

and is invested by an epithelium or cuticle. It is traversed by a system of canals or lacunæ which are lined with epithelium; this "canal-system" usually begins by numerous fine pores and terminates in one or more so-called "oscula." Almost without exception the body is supported by a skeleton of calcareous or siliceous spicules, or by horny fibres, or by a combination of the two latter. Reproduction is sexual or by budding. The majority are marine; a few live in fresh water. Fossil and recent."

The Porifera are divided into P. non-calcarea and P. calcarea. The first order of the former is that of the Hyalospongiæ (Hexactinellidæ), the suborders of which are Dictyonina (with the families Euretidæ, Coscinoporidæ, Mellitionidæ, Ventriculitidæ, Staurodermidæ, Mæondrospongidæ, Callodictyonidæ, and Cœloptychidæ); the second suborder is that of the Lyssakina (with the families Receptaculitidæ, Monakidæ, Pleionakidæ, and Pollakidæ). The second order is that of the Spiculispongiæ; its first suborder the Lithistina (families, Rhizomorinidæ, Megamorinidæ, Anomocladinidæ, and Tetraclidinidæ); the second suborder, Tetractina, contains the families Geodidæ, Ancorinidæ, Plakinidæ, and Corticidæ; the third suborder, or that of the Oligosilicina, has in it the Chondrosidæ and Halisarcidæ; the fourth, or Pseudotetraonina, contains only the Tethyadæ; the fifth, Clavulina, the Polymastidæ and Suberitidæ. The third order is that of the Cornacuspongiæ, with the Halichondrina (families, Halichondridæ, Spongillidæ, Desmacidonidæ, and Ectyonidæ), and as a second suborder the Ceratina, in which are found the Spongelidæ, Spongidæ, Aplysinidæ, and Darwinellidæ.

Protozoa.

Glycogen in the Protozoa.*—Prof. O. Bütschli has undertaken experiments as a confirmation of previous investigations in regard to the composition of the granules of the endoplasm of Gregarinæ, which have been recently criticized by Frenzel.† From a number of qualitative results (of somewhat indefinite character), the author concludes that the substance composing these granules is glycogen, or a compound of similar nature ("paraglycogen"), and he has identified such a substance also in the Infusoria *Nyctotherus ovalis*, and *Strombidium*, confirming therefore the observations of Certes.‡

Reproduction of Infusoria.§—Miss S. G. Foulke describes the interesting phenomena of germ-formation in *Chilomonas paramæcium*, one of the Flagellata Eustomata of Kent.

The long oval infusor with its two flagella assumes a spherical or amœboid form, the refractive corpuscles round its cell-wall move actively about in the now more fluid endoplasm, and finally the mass liberates the spores by bursting like a bubble, or by gradually disintegrating, or by extruding a small vesicle enclosing the spores and then disintegrating. The meaning of the breaking-up recorded by

* Zeitschr. f. Biol., xxi. (1885) pp. 603–12.
† Arch. f. Mikr. Anat., xxiv. (1885) p. 545. See this Journal, v. (1885) p. 471.
‡ See this Journal, iii. (1880) p. 285.
§ Ann. and Mag. Nat. Hist., xvi. (1885) pp. 260–1 (1 pl.).

Bütschli is thus recognized, as also the nature of the belt of corpuscles which appears in the mature forms. This observation is of general interest, as illustrating a change from a more to a less active cell-phase at the period of reproduction, and also as indicating the exhaustion of the mother protoplasm in the production of the spores.

The Tintinnodea.*—Prof. G. Entz commences with an account of *Tintinnidium fluviatile*, in which especial attention is given to the peristomial disc and to the characters of the ciliation; the ecto- and endoplasm are not sharply distinguished, and the cuticle is nothing more than a limiting layer, somewhat more resistant than the rest of the protoplasm, and is not to be demonstrated by reagents; the nucleus is frequently elongated in form, and has a cleft-like cavity which divides it into two, often unequal, halves; the addition of acetic acid reveals the presence of clearly defined internal corpuscles. The process of division is effected in much the same way as in *Stentor*, commencing with the formation of a fresh peristome and contractile vacuole. Attention is directed to the great similarity which obtains between free-swimming Tintinnods and the larva of the sponge *Reniera filigrana* described by W. Marshall in 1882, and the various attempts (the last of which was that of Mr. S. Kent) to derive the various phyla of the Metazoa from the Ciliata; Prof. Entz thinks that till the gulf between the Protozoa and the Metazoa has been bridged over we must be content to look upon such resemblances as being merely interesting phenomena of convergence.

The second form described is a new species of *Codonella—C. lacustris*—the test of which is like that of the *Difflugiæ* in that it is beset with angular pieces of silex. The third chapter deals with the tests of some pelagic Tintinnodea; these, which are rare in the intestine of *Antedon rosaceus*, are always found in Salpæ; the commonest are those of *Codonella beroidea* and *C. lagenula*, hundreds of which may be found in the intestine of one *Salpa;* the new species described are *Tintinnus lusus undæ*, *T. claparedii*, *Dictyocysta polymorpha* (which the author had previously called *Codonella perforata*), *D. millepora*, and *Cyttarocylis euplectella;* the last is perhaps identical with Fol's *C. cystellula*, from which it is distinguished by the greater diameter of its alveoli, by the absence of larger cilia below the equatorial zone, and by the absence of the inwardly directed membrane which characterizes the mouth of Fol's species; the author allows that all these differences may be due to individual variation.

New Symbiotic Infusorian.†—Dr. A. C. Stokes describes *Leucophrys emarginata* n. sp., in which the chlorophyll corpuscles lie so close as almost to form a continuous subcuticular layer; the author doubts whether these are, as Brandt thinks, symbiotic algæ, for though they are sufficiently multiplied, the infusorian is voracious. Similarly he hesitates to accept the doctrine that the green colouring matter is in all low animal forms symbiotic; in several Infusoria the coloration is diffused, and not collected into granules, discs, or spherules.

* MT. Zool. Stat. Neapel, vi. (1885) pp. 185–216 (2 pls.).
† Journ. New York Micr. Soc., i. (1885) pp. 152–4.

New Fresh-water Infusoria.*—Dr. A. C. Stokes describes the following new species:—

Phacus acuminatus differs from its nearest ally, *P. triquetra*, in having a concave lower surface and a short caudal prolongation: the protoplasm contains chlorophyll-grains and two "amylaceous corpuscles."

Ophryoglena ovata has a somewhat changeable body, whose anterior extremity is slightly broader than the posterior; the oral aperture is placed obliquely; no nucleus was observed; the contractile vacuoles are stellate on diastole.

Dexiotricha centralis is readily distinguished from *D. plagia* (Stokes) by the much greater length of the "caudal setæ"; by the nearly equatorial position of the ring of cilia, and by the posterior position of the contractile vacuole.

Stentor globator is chiefly characterized by the ability to protrude a soft, attenuate, tail-like prolongation of the body, by means of which it can fix itself. There are several stiff setæ posteriorly.

Strombidinopsis setigera differs from the only other species, *S. gyrans*, in the shortness of the peristomial cilia, and in the presence of long fine setæ on the anterior surface.

Scyphidia constricta is distinguished from *S. inclinans* by a slight anterior constriction; when contracted, a projection appears from the frontal border.

Uroleptus limnetis differs from *U. longicaudatus* in being shorter, in the absence of a caudal prolongation, and in the undulating peristomial membrane.

Stylonychia putrina differs from all other species of this genus in its elongate elliptical form. *S. vorax* is the smallest species described; all the anal styles project beyond the posterior margin of the body; the caudal setæ spring from the margin; the left marginal setæ are remote from the edge of the body.

Acineta fluviatilis has a subtriangular lorica, quadrangular in section; lives in a tide-water creek; has short pedicel; single contractile vacuole. *A. lappacea:* subspherical lorica; non-adherent body; lorica produced into points where the tentacles protrude; multiple contractile vacuole; tentacles very fine, with thickenings upon them. *A. alata:* lorica irregularly ovate, with six or eight longitudinal "wings," each of which is pierced longitudinally by four pores for the tentacles; pedicel long; body apparently not attached to lorica.

Critical Observations on Leidy's 'Fresh-water Rhizopods of North America,' and Classification of the Rhizopods in general.†—Dr. G. C. Wallich closely criticizes Prof. Leidy's work, directing especial attention to *Difflugia*, and taking the opportunity of referring to observations of his own published a long time since which do not appear to have been sufficiently noticed by the American naturalist.

* Amer. Mon. Micr. Journ., vi. (1885) pp. 183–90 (14 figs.).
† Ann. and Mag. Nat. Hist., xvi. (1885) pp. 317–34, 453–73.

Abnormal Amœba.*—Mr. E. B. Brayley describes an *Amœba* of extraordinary dimensions. In length it was within a very small fraction of 1/5 in., breadth about 1/15 in. This is ten times larger than any mentioned in Leidy's monograph. It is suggested to be a very abnormal form of *A. proteus*.

Endoparasite of Noteus.†—Miss Sara G. Foulke describes certain ciliated bodies found in a crushed rotifer, a species of *Noteus*. These were very transparent, and showed no "endoplast": some were ovate, some globular, completely surrounded by long cilia; some contained refractive bodies—"germs"—which escaped from the parent's body. The name *Anoplophrya notei* is given to them; they appear allied to *A. socialis*, but are only 1/6 the size of this, being 1/600 in. in diameter; their cilia are longer, and the cuticle is unstriated.

Bütschli's 'Protozoa.' ‡—Parts 29, 30, and 31 of Prof. O. Bütschli's 'Protozoa' were published in November 1885, with plates 51 to 54.

Forty-eight papers on the literature of the Dinoflagellata are enumerated. The Dinoflagellata are divided into the Prorocentrina or Adinida, the Dinifera, and the Polydinida. The structure of the test is discussed, and its morphology elucidated by the aid of woodcuts; the motor phenomena are said to be very like those of the Flagellata, being almost always connected with locomotion around the longitudinal axis; within the protoplasm are chromatophores, which appear to be endogenous; starch is found in some, even if not in all, of the uncoloured forms; fat, red pigment, and eye-spots are also found; the last have as yet been seen only in the Dinifera, where they occupy a definite position in the body, being placed at about the middle of the longitudinal groove; they are oval, elongated, or (*Glenodinium cinctum*) horse-shoe shaped in form, and are coloured a bright red. Among the organisms here figured are *Glenodinium*, *Peridinium*, and *Ceratium*.

BOTANY.

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

a. Anatomy.§

New Organ in Protoplasm.‖—M. H. de Vries has examined a number of plants, in order to determine the question whether the vacuoles which always appear after a time in the protoplasm of the living cell (and ultimately either coalesce into one, or give place to one

* Sci.-Gossip, 1886, p. 19. † Amer. Journ. Sci., xxx. (1885) pp. 377-8.

‡ Bronn's 'Klassen u. Ordnungen d. Thierreiches,' 8vo, Leipzig and Heidelberg, 1885.

§ This subdivision contains (1) Cell-structure and Protoplasm (including the Nucleus and Cell-division; (2) Other Cell-contents (including the Cell-sap and Chlorophyll); (3) Secretions; (4) Structure of Tissues; and (5) Structure of Organs.

‖ Maandblad voor Natuurwetenschappen, 1884. See Bot. Centralbl., xxiii. (1885) p. 182.

only), are or are not inclosed by a distinct membrane. He claims to be able to answer this question definitely in the affirmative, the best results having been obtained from *Spirogyra nitida*.

The method employed was by the action of a 10 per cent. solution of potassium nitrate, which absorbs water very rapidly from the cell-sap, or plasmolyses the cell. When the parts begin to become disorganized in this solution, the vacuole-membrane remains the longest, the vacuole lying like a ball in the cell, the membrane retaining its tension, and being especially well seen if the potassium nitrate is first coloured by eosin. The author regards the vacuole-membrane as a special organ present in all cells, at least during a certain period of their existence, which has for its function the production of turgidity in the cell; and for this organ he proposes the term Tonoplast.

Distribution of Protoplasm in the Curved Parts of Plants.*—Herr F. G. Kohl has observed that in curved parts of plants the protoplasm behaves differently in different organs, with respect to its sensitiveness to light. In the root-hairs of *Trianea bogotensis*, which are very transparent, and the protoplasm of which is in active motion, this substance always accumulates at those spots only which are exposed to the most intense light. On the other hand, in the hairs on the tigellum of seedlings of *Sinapis alba*, the protoplasm moves from the walls which are directly illuminated to those in the dark. In curved organs like climbing stems, tendrils, &c., the protoplasm accumulates most on the concave side.

Structure of the Cell-nucleus.†—M. C. van Bambeke gives a useful *résumé* of the present state of our knowledge of the structure of the cell-nucleus when in a state of rest, as derived from the observations of the most recent investigators.

Division of the Cell-nucleus in Tradescantia.‡—In the epidermal cells and those of the hairs on the stamens of *Tradescantia virginica*, and in the mother-cells of the pollen, M. E. Bernimoulin finds the nucleus at first granular, and inclosing a large number of chromatic rods, which then coalesce so as to form one or more knotted threads. The contour of the nucleus then disappears, the chromatic thread unrolls, spreads through the protoplasm of the cell, assumes the form of a nuclear plate, and divides into a certain number of segments, which curve and separate into two groups to form the new nuclei.

Chemistry of the Cell-nucleus.§—Herr A. Kossel has carefully investigated the chemical composition and properties of the chromatin of the nucleus of animal and vegetable cells, and finds it to be identical with nuclein. If nuclein is heated with dilute sulphuric

* Wigand's Bot. Hefte, i. (1885) p. 161. See Naturforscher, xviii. (1885) p. 337.

† Bambeke, C. van, 'État actuel de nos connaissances sur la structure du noyau cellulaire à l'état de repos,' 34 pp., 8vo, Ghent, 1885.

‡ Bernimoulin, E., 'Note sur la division des noyaux de *Tradescantia virginica*,' 10 pp. (2 pls.), Gand, 1884. See Bull. Soc. Bot. France, xxxii. (1885). Rev. Bibl., p. 102.

§ Ber. Deutsch. Chem. Gesell., xviii. (1885) p. 1920. See Naturforscher, xviii. (1885) p. 376.

acid, along with other substances, a nitrogenous base is produced, identical with the adenin of the larger glandular organs. This substance may be obtained pure in crystals of the composition $C_5H_5N_5$, capable of forming various compounds with acids. Adenin belongs to the group of xanthins. The primary products of decomposition of nuclein are probably adenin and guanin, xanthin and hypoxanthin being only secondary products. In conjunction with nuclein adenin appears to play an important part in the physiology of animal and vegetable tissues.

Chemistry of Chlorophyll.*—Mr. E. Schunck, after separating the phyllocyanin and phylloxanthin of chlorophyll by Frémy's method, investigates the properties of the former substance. It is obtained as a dark-blue crystalline mass resembling indigo. It is decomposed between 160° and 180°. It contains nitrogen, but no sulphur. It is insoluble in water, petroleum-ether, and ligroin, but soluble in alcohol, ether, chloroform, glacial acetic acid, benzol, anilin, and carbon disulphide. The best solvent is chloroform, a minute quantity imparting an intense colour to the solvents. Oxidizing agents decompose it easily, yielding yellow amorphous products, the solutions of which show no absorption-bands. It dissolves easily in concentrated sulphuric, hydrochloric, and hydrobromic acids, yielding dark-blue solutions, which show spectra differing from that of phyllocyanin. They are unstable, and water precipitates from them phyllocyanin unchanged. It dissolves readily in dilute caustic potash or soda lye; phyllocyanates are precipitated from these solutions by earthy or metallic salts. Phyllocyanin acts the part of a weak base, forming metallic compounds with strong acids. Chlorophyllan is probably an impure substance containing some fatty acid along with phyllocyanin.

Colourless Chlorophyll.†—M. C. Timiriazeff states that when a chlorophyll solution is treated with metallic zinc and an organic acid, it is reduced through the agency of the nascent hydrogen generated in the reaction, the resulting substance being perfectly colourless, and presenting no traces of fluorescence or of the characteristic spectrum of chlorophyll. In contact with air this substance gradually acquires the green colour and optical properties of chlorophyll. M. Timiriazeff considers this to be a confirmation of his previous hypothesis that the green colour of chlorophyll is due to the presence of iron in the state of an $FeOFe_2O_3$ compound.

Researches on Chlorophyll.‡—Herr A. Tschirch gives the following as the properties and appearances of the derivatives of chlorophyll.

I. Soluble in alcohol.

1. Bodies which show the chlorophyllan spectrum; solution brown.

a. Chlorophyllan, black rosettes of crystals.

b. Phyllocyaninic acid, black lamellæ with superficial blue colour.

* Proc. Roy. Soc., xxxviii. (1885) pp. 336–40. † Nature, xxxii. (1885) p. 342.
‡ Ber. Deutsch. Bot. Gesell. Generalversammlung, 1885, pp. xliii.-liv.

2. Bodies which show the spectrum of living leaves (with exception of xanthophyll bands); solution emerald-green.

a. Pure chlorophyll, by reduction from chlorophyllan.

b. β-chlorophyll, by reduction from phyllocyaninic acid; black lamellæ with superficial blue colour.

II. Soluble in water.

3. Alkali-chlorophyll; solution emerald-green, black lamellæ without superficial colour.

III. Soluble in ether.

4. Cyanophyllin-barium; emerald-green in solution, black lamellæ without superficial colour, no trace of iron, suitable for quantitative determination of the green colouring matter of leaves.

Further communications are made on the extinction-coefficient of the absorption-bands of a pure chlorophyll solution. From this it seems that the end-absorption of the blue is weaker in all parts than the absorption of the fixed band between B and C; whence it follows that the second maximum observed in the leaf and in an alcoholic extract of chlorophyll is to be traced to a superposing of the spectra of pure chlorophyll and xanthophyll. Further examination of the spectrum of xanthophyll solution confirmed the earlier view that xanthophyll shows only two bands in the blue, and end-absorption of the violet.

Crystallizability of Xanthophyll.*—According to Herr J. Reinke, the crystallized chlorophyll-yellow of Hanstein is nothing but cholesterin with admixture of chlorophyll-yellow. The orange-red colour of dead leaves of *Delesseria sanguinea* he found to be due to fluorescence; and the same was the case also with other Florideæ.

"Soluble Starch." †—The so-called "soluble starch" which Sanio and Schenk found in the epidermal cells of *Ornithogalum* and *Gagea*, has already been shown by Nägeli not to be starch. Herr J. Kraus gives reasons for regarding it as a substance belonging to the class of tannins; he finds a similar substance in the epidermal cells of some species of *Arum*.

Proteinaceous Bodies in Epiphyllum.‡—Herr H. Molisch describes proteinaceous bodies of peculiar form found in the branches of several species of *Epiphyllum*. They are of three kinds:—(1) fusiform, and then either straight, crescent-shaped, or sickle-shaped, from 0·013 to 0·014 mm. long, and either homogeneous or distinctly striated; (2) annular, either circular or elliptical, and homogeneous or laminated; and (3) threads, curved in various ways. The author believes that they are mainly formed by a process of intussusception. The chemical and physical properties of these bodies are described in detail, and lead to the conclusion that they are of the nature of crystalloids, and that they serve as reserve-materials.

* Ber. Deutsch. Bot. Gesell. Generalversammlung, 1885, pp. lv.-lviii.

† Abhandl. Naturf. Gesell. Halle, xvi. (1885). See Bot. Centralbl., xxiii. (1885) p. 133.

‡ Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 195–202 (1 pl.).

Formation of Gum-arabic.*—Herr G. Kraus has determined, by observations on the exudation of gum from *Acacia melanoxylon*, that it is formed only in the bark, and not in the wood, and only in the bast-layer, never in the parenchyma nor in any more external portion; that the bast-fibres have no share in its formation; that it flows from the cells of the soft bast, and especially from the sieve-tubes; and that it is not a product of degradation of the cellulose, but is a true cell-content, flowing out unchanged through the unchanged cell-walls.

Oxalic Acid in Plants.†—MM. Berthelot and André, to extract this substance, bruise the plant in a mortar, boil with water for one hour, allow to macerate for twenty-four hours, and decant off and filter the liquid. The residue is again extracted with warm water, and finally pressed. If it is required to extract the insoluble oxalates, the water used for maceration must be mixed with 20–30 c.cm. of strong hydrochloric acid for each 100 grm. of plant. The mixed filtrates are acidified with hydrochloric acid (if this has not been already added), boiled, and again filtered. The filtrate is made alkaline with ammonia, and mixed with an excess of boric acid solution, which, in presence of ammonium chloride, prevents the precipitation of nitrates, racemates, citrates, &c., or redissolves these precipitates if already formed. The liquid is then strongly acidified with acetic acid, mixed with calcium acetate, heated below the boiling point for about an hour, and the impure calcium oxalate collected and washed. The precipitate is redissolved in hydrochloric acid, and again collected. This treatment is repeated if necessary, and the purified precipitate is finally weighed as such, converted into calcium sulphate, or treated with a large excess of sulphuric acid and the evolved carbonic oxide measured.

The paper concludes with some determination of the proportions of soluble and insoluble oxalates in different parts of *Chenopodium quinoa*, *Amaranthus caudatus*, *Mesembryanthemum crystallinum*, and *Rumex Acetosa*.

Growth and Increase of Crystals in Plants.‡ — According to Herr Otto Köpert, who has examined with this view a considerable number of plants, the relative number of crystals of calcium oxalate in different parts of the stem of plants, and in leaves of different ages, varies with the species. With regard to their size the results are more uniform. They are wanting in the youngest rudiments of leaves, but appear in them in the leaf-bud before they are capable of assimilation, immediately beneath the cone of growth, and attain their maximum size as soon as the organ—root, stem, or leaf—has attained is full development.

Sphærocrystals of Calcium Oxalate in the Cactaceæ.§ — In addition to the well-known crystals of calcium oxalate of various

* Ber. Sitz. Naturf. Gesell. Halle, 1884, pp. 19–20.
† Comptes Rendus, ci. (1885) pp. 354–60.
‡ Zeitschr. f. Naturwiss., lviii. (1885) p. 140.
§ Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 178–82 (1 fig.).

forms, Dr. M. Möbius finds, in a number of species of Cactaceæ, aggregations of the same substance closely resembling organic sphærocrystals. Their presence is of no value from a systematic point of view; since in the same genus there are species which contain, and others which do not contain them.

Anatomy of Combretaceæ.* —The order Combretaceæ of Bentham and Hooker consists of the two tribes Combreteæ and Gyrocarpeæ. Herr H. Solereder, as the result of an examination of a large number of species, considers that these groups have but little relationship to one another. The Combreteæ are characterized, with a few exceptions, by the presence of intraxylary soft-bast (within the xylem on the medullary sheath), provided with sieve-tubes. The Gyrocarpeæ, on the contrary, have no bicollateral bundles, and a further distinction from the Combreteæ is furnished by the presence of secreting cells, in the pith, the primary and secondary cortex, and the leaves. This tribe may be again divided into two natural groups, the Gyrocarpeæ in the narrower sense (*Gyrocarpus* and *Sparattanthelium*) and the Illigereæ (*Illigera*), by the presence of cystoliths in the former group, which are absent from the latter.

Comparative Anatomy of the Stem and Rhizome in Herbaceous Plants.†—Herr W. Rothert has made an extended examination of the differences in anatomical structure between the aerial and underground stems of herbaceous flowering plants. After a minute description of the structure of the various elements in a great variety of plants, he sums up the main points of difference under the following heads, viz. (1) Differences regarding the relation of the central cylinder to the cortex. In rhizomes the size of the central cylinder in comparison to that of the cortex is generally less than in underground stems. (2) Differences relating to the mechanical properties of the parts in question. These include differences in the position and development of the sclerenchyma and collenchyma, air-passages and intercellular cavities, and in the development of hairs, which are usually, though not always, absent from roots. (3) Differences in the development of suberous tissue, especially in the protecting sheaths. These protecting sheaths are almost invariably present in the rhizome, but absent from the aerial stem. (4) Differences in the organized cell-contents. Chlorophyll is usually wanting in the rhizome, with the exception of its apex in *Mercurialis;* starch and inulin are often more abundant in the rhizome. (5) Differences in the differentiation of the tissues. This is generally less in rhizomes than in underground stems. (6) Differences in the number, course, arrangement, and structure of the desmom-tissue (vascular bundles). The number of bundles is usually less in the rhizome than in the aerial stem, and their arrangement less regular; in Monocotyledons the xylem and phloëm have often a more or less concentric arrange-

* Bot. Centralbl., xxiii. (1885) pp. 161–6.

† Rothert, W., 'Vergleichend.-anat. Unters. üb. d. Differenzen in primären Bau der Stengel u. Rhizome krautiger Phanerogamen,' Dorpat, 1885. See Bot. Centralbl., xxiii. (1885) p. 71.

ment in the rhizome, when those of the stem are collateral; the predominant character of the vessels is pitted in the former, spiral and reticulate in the latter. As a general *résumé*, the storing-tissue and suberous tissues are usually strongly developed in the rhizome, while the assimilating tissue is wanting, and the mechanical tissue is greatly reduced. While the rhizome retains all the essential anatomical characters of the stem, it yet shows some approximation in many ways to the structure of the root.

Anatomical Structure of the Stem and of Underground Stolons.* According to Herr F. Haupt, the outer walls of the epidermal cells of stolons are thicker than those of stems, although less cuticularized; the lateral and inner walls are also thicker. The stomata are less numerous in stolons; when beneath the soil they are usually larger. Stolons have, as a rule, no trichomes; hairs occur in Labiatæ and in the potato, but are more delicate, and are composed of a smaller number of cells; glandular hairs are found on the stolons of Labiatæ. Cork occurs in both organs. The inner endoderm is usually more strongly developed in stolons. In the vascular bundles the xylem is always reduced in the stolons, and the phloëm, on the other hand, increased. The mechanical tissues, including collenchyma, sclerenchyma, and the interfascicular tissue, are always reduced in stolons. Starch usually occurs abundantly in stolons, especially in those which persist through the winter.

Anatomy of the Stem of Cruciferæ.†—Herr E. Dennert classes the Cruciferæ under seven different types, dependent on the arrangement of the tissues, and especially on the nature of the "strengthening-ring" which incloses the vascular bundle, composed of primary prosenchyma, or of inner cambium and inner bast, or of all these elements, viz.:—

1. *Aubrietia*-type. The prosenchyma is wanting in the strengthening-ring; the bast-fibres unite into a ring.

2. *Teesdalia*-type. The hard-bast and primary prosenchyma unite into a continuous ring, with which the separate bundles are in apposition internally.

3. *Cochlearia*-type. The ring consists of alternate groups of vessels and bridges of primary prosenchyma; it undergoes very little or no change in the isolated cambium-strings.

4. *Sisymbrium-Alliaria* type. The ring is much stronger; but the cambium-strings remain isolated.

5. *Turritis*-type. The continuous cambium produces no medullary rays.

6. *Brassica*-type. When the cambium has become continuous, it produces radiate prosenchyma in addition to vessels and secondary prosenchyma.

7. *Raphanus*-type. The individual bundles are separated by primary medullary rays; secondary rays also appear later.

* Ber. Bot. Sällsk. Stockholm, Dec. 27, 1884. See Bot. Centralbl., xxiii. (1885) p. 234.

† Dennert, E., 'Beitr. zur vergleich. Anat. des Laubstengels der Cruciferen,' 37 pp. (1 pl.), Marburg, 1884.

Anatomy of Ceratophyllum.*—Herr J. E. F. af Klercker gives a more detailed memoir on this subject. Agreeing with Haberlandt, he disputes the statement of Korschelt that the growing point exhibits a single apical cell; he finds, on the contrary, that the dermatogen divides only by anticlinals, and forms a sharply defined cell-layer. The processes in the embryo-sac which precede and follow impregnation were followed out in detail. With the development of the embryo the greater part of the integument disappears; a small residue remaining only at the micropyle and chalaza. The embryo has no suspensor.

Form of the Stem of Dicotyledons and Conifers.†—M. E. Guinier does not consider that the history of annual climatic vicissitudes is recorded in the form of the stem of dicotyledonous and coniferous trees to the extent generally supposed. The areas of the sections of the layer of growth usually increase from the summit towards the base. The thickness of each layer of growth is, to a certain extent, dependent on the preceding layer; and thick or thin layers are disposed in series often corresponding to periods of sixty years or more.

Formation of Cork.‡—Dr. J. E. Weiss classifies the various modes of formation of cork under three different types, all of which occur in the Lythrarieæ, Onagraceæ, Hypericaceæ, Myrtaceæ, Rosaceæ, and other families. The author disputes the statement of Sanio, that cork is sometimes formed in a purely centrifugal way.

Annual Formation of Cork in the Periderm.§—Dr. Gerber has investigated the question whether the formation of cork in the superficial periderm of trees is always renewed every year; and finds that the thirty-one species examined can be classified into the three following groups:—(1) Corks which maintain an annual increase until the cork cambium dies in consequence of the formation of inner periderm, the younger elements differing from the older ones; or corks with a permanent formation of annual rings. (2) Corks the phellogen of which forms cells of different kinds at the commencement and end of the first growing period only; but from the second year only similar cells, alike in all respects to those of the later cork-cells of the first year. (3) Corks which repeat an annual increase, but always composed of similar elements; and therefore not forming annual rings. Numerous examples are given of each kind.

Pith of Woody Plants.‖—Herr G. Kassner gives the following as the main results of his observations on a great number of trees. The pith of most woody plants is lignified; its cells retaining their

* Bih. K. Svenska Vetensk. Akad. Stockholm, ix. (1885) 3 pls. See Bot. Centralbl., xxiii. (1885) p. 345. Cf. this Journal, v. (1885) p. 825.

† Guinier, E., 'Formes des tiges des arbres Dicotyledones et Conifères,' 30 pp. (7 pls.), Gap, 1885. See Bull. Soc. Bot. France, xxxii. (1885). Rev. Bibl., p. 180.

‡ SB. Bot. Verein. München, March 11, 1885. See Bot. Centralbl., xxiii. (1885) p. 367.

§ Ber. Sitz. Naturf. Gesell. Halle, 1884, pp. 3–8.

‖ Kassner, G., 'Ueb. d. Mark einiger Holzpflanzen,' 38 pp. (2 pls.), 8vo, Breslau, 1884.

form, with greatly thickened walls. Crystal-cells (containing calcium oxalate) are frequently found, and are distinguished by peculiar properties. In many plants these crystal-cells are divided by transverse and longitudinal walls into smaller chambers (*Pterocarya*, *Quercus*). As the internodes lengthen they manifest a tendency to become larger than any of the other cells (*Ribes*, *Ledum*). They lose their protoplasmic contents at an earlier period, and die before the other cells of the medullary tissue (*Euonymus*). In many plants, even those in which the pith is lignified, the walls of these crystal-cells consist of cellulose, remaining permanently thin and unlignified; on which account they often collapse and form cavities in the tissue. The pith of some woody plants consists, during its whole existence, of thin soft cellulose. It is then subject to a variety of subsequent changes, from further division or superficial growth, or the collapse of the tissue after vital activity has ceased.

Development of Palm-leaves.*—Prof. A. W. Eichler has investigated, in a large number of species, the origin of the division, whether pinnate or digitate, in palm-leaves, which differs from that in other leaves in being not the result of the growth of segments originally distinct, but of splitting or tearing. He finds the order of development to be this:—First, the rachis with the leaf-sheath; then the lamina in the form of an expansion of the margin of the rachis. Where there is a petiole, it is of intercalary origin as the leaf unfolds. The lamina grows very rapidly in breadth, and thus produces folds lying very close to one another, arranged in a pinnate or digitate manner according to the length of the rachis; and the lamina then becomes split by the decay of certain angles of these folds. Of this there are four cases, according as it is the upper or lower angles, or both, that decay, or the lateral angles also. In *Carludovica*, belonging to the Pandanaceæ, the processes are similar.

Contrivances for Storage of Water in the Leaf.†—Dr. E. Heinricher describes a structure which he has observed especially in the leaves of species of *Centaurea* growing in very dry situations. The delicate cells of the parenchyma-sheaths which inclose the finer veins of the leaves, and which ordinarily serve for the transfer of a portion of the products of assimilation, are not unfrequently transformed into tracheid-like cells, which then perform a different function, and which the author terms "reserve-tracheids." A similar structure is well developed in *Astrolobium repandum*, and is described by the author in detail. This is one of a number of contrivances in the mesophyll of the leaf for the rapid transference, or for the storing up of water, corresponding to the needs of the plant as dependent on climate and habitat. In addition to their usual position running alongside the vascular bundles, these reserve tracheids are also sometimes found dispersed through the parenchyma of the leaf. The

* Abhandl. K. Preuss. Akad. Wiss. Berlin, 1885 (5 pls.). See Naturforscher, xviii. (1885) p. 376.

† Bot. Centralbl., xxiii. (1885) pp. 25–31, 56–61 (1 pl.).

same purpose is also answered in other cases by the greater closeness of the network of the vascular bundles, and by the increase in the diameter of the separate bundles.

Relative Resisting-power of the Upper and Under Surfaces of Leaves.*—Herr L. Kny finds that where the interstices between the finer veins on the upper surface of the leaf are strongly convex, the leaf offers much greater resistance to the tearing force of heavy bodies like shot falling on it, than the lower surface does. But where the upper surface is quite flat, the resisting-power of the two surfaces of the leaf is nearly the same.

Protection of Leaves against the Mechanical Action of Rain and Hail.†—Herr L. Kny considers that a contrivance for this purpose is to be recognized in the rounded swellings of the fundamental tissue of the leaf between the finer veins, such as occurs in *Primula elatior*, *Ballota nigra*, *Mentha piperita*, &c. By this contrivance, the shock of the impact is partially carried from the cells which first receive it to the neighbouring ones, and thence to the fibro-vascular skeleton. This arrangement is not found in leaves which are otherwise protected against this injurious agency, as those which are finely divided, or which are submerged, or have a very thick cuticle, or are sensitive.

Development of the Stomata of the Oat.‡—Miss E. A. Southworth states that the epidermis of the oat is composed, in the young leaf, before the appearance of the stomata, of quadrangular cells which afterwards grow much faster in length; the mother-cell of a stoma being cut off from the end of one of these. On each side of this mother-cell a nearly semicircular accessory cell is cut off out of the adjacent cell, and the mother-cell of the stoma subsequently divides into the two guard-cells. The behaviour of the protoplasm, with which both mother-cell and accessory cells are well filled, is very characteristic. When division takes place, this has condensed in the centre of each cell, so that it appears to be in a continuous band across all four cells. In the immature stoma the protoplasm is very slightly granular, and has a slight green tinge; when the stoma is mature, the protoplasm appears perfectly homogeneous, and small chlorophyll-bodies containing starch occupy the former vacuoles.

Contents of Sieve-tubes.§—Herr G. Kraus finds the composition of the sieve-tubes of *Cucurbita* to differ in different individuals, and even in different parts of the same individual. The proportion of solid contents is always considerable, varying, in small fruits, between 7 and 8 per cent., in larger fruits between 9 and 10, or amounting even to 14 per cent. The sap that flows out first is usually more concentrated than the later. Of the residue which remains on evaporation, about two-thirds is again soluble in water. A large proportion of the insoluble portion consists of albuminoids. There is also a large amount of non-albuminoid soluble nitrogenous constituents, consisting

* Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 258–73. † Ibid., pp. 207–13.
‡ Amer. Naturalist, xix. (1885) pp. 710–1 (1 pl.).
§ Ber. Sitz. Naturf. Gesell. Halle, 1884, pp. 9–14. Cf. this Journal, iv. (1884) p. 586.

of ammonium compounds and nitrates, but chiefly of asparagin and other amides; and a substance of the nature of saccharose. The alkaline reaction of the contents of the sieve-tubes is undoubtedly due to calcium phosphate. As much as 2 to 3 per cent. of phosphoric acid was determined in the aqueous solution. The same is also true of the alkaline reaction of other fluids found in plants, as, for example, that in the glands of the "ice-plant," *Mesembryanthemum crystallinum.*

Heterophylly of Quercus prinoides.* — According to Mr. T. Meehan the leaves of this species of oak vary, from nearly orbicular and obtuse to narrowly lanceolate or saliciform and acute; some are quite entire, while others have lobed and wavy edges. These variations can be due neither to environment nor to mere conditions of growth or sexual peculiarities, but only to an innate and wholly unknown power to vary, which science has been so far unable to reach.

Organs of attachment of Ampelopsis.†—Herr A. V. Lengerken has examined the mode of formation of the structures by means of which several species of *Ampelopsis* (Virginian creeper) attach themselves to their support. The irritation caused by the contact of the apex of the tendril with the foreign substance first excites the epidermis to a characteristic growth; it then extends to the hypodermal layer and subjacent tissues. The discs are found only on those tendrils the apices of which are long in contact with foreign bodies; branches of the same tendrils not in this condition die off. With the increased development of the discs, the tendril loses its power of winding round foreign support. Those species of *Ampelopsis* which produce these attachment discs show indications of similar structures on the apices of still unchanged tendrils. In *A. Veitchii* this can be made out in the meristem of the tendrils at the earliest period. The irritation caused by contact need not be vertical; it may be oblique; in most cases the discs are formed on the convex side of the coiled apex of the tendril. Two results follow from the irritation. A great excretion of mucilage takes place, by means of which the disc can become rapidly attached to the support; and after this excretion has taken place, the cortical tissue and epidermal cells inclose in their growth the least projection on the surface of the support, thus causing an extremely firm attachment of the disc.

Absorbing Hairs of Dipsacus.‡—Sig. G. Archangeli finds, in the receptacles at the base of the leaves of *Dipsacus Fullonum*, no special secretion, but only rain-water. He never found glandular hairs provided with mobile threads of protoplasm, as described by Cohn and F. Darwin. Hairs of a precisely similar character occur outside these reservoirs on other species of Dipsacaceæ which do not form such reservoirs, and on many other plants; he believes them to be concerned simply with the absorption of water, and to have no function connected with the absorption and digestion of nitrogenous substances.

* Proc. Acad. Nat. Sci. Philad., 1885, p. 365.
† Bot. Ztg., xliii. (1885) pp. 337–46, 353–61, 369–79, 385–93, 401–11 (1 pl.).
‡ Atti Soc. Toscana di Sci. Nat., iv. (1885) pp. 178–81.

Oil-receptacles of Hypericum and Ruta.* — Herr H. Kienast considers the term "gland" as incorrectly applied to these organs. In *Hypericum* the receptacles have been determined by several observers to have a schizogenous origin. In older stages of development the membranes of the secreting cells offer great resistance to sulphuric acid; this is due to a formation of cork. The dark dots in the leaves of *Hypericum* are merely aggregations of cells without intercellular spaces. They originate from a cell which divides in the same way as the mother-cell of the oil-receptacles.

The oil-receptacles of *Ruta* are also, like those of *Dictamnus*, of schizogenous origin, originating from a single cell which at first divides regularly into quadrants; afterwards irregularly. The epidermis takes no part in their formation.

Extra-floral Nectaries in Gunnera.†—Sig. J. Danielli describes organs which he regards as of this nature found by Sig. Beccari on the surface of the stem of *Gunnera scabra*, between the leaf-insertions. They have the appearance of round regularly lobed warts, umbonate in the centre, and with a fleshy point. As they grow older the surface becomes more convex, and the umbo and point almost disappear. They have a smooth small-celled epidermis, their substance being composed of a close parenchyma with a central vascular bundle which branches into the lobes. They are of the nature of emergences; the whole tissue contains cane- and grape-sugar.

Morphology of the Calyx.‡—M. D. Clos contests the ordinary view that the so-called "calyx-tube" of "monosepalous" calices is the result of cohesion of the sepals. It is rather an expansion of a part intermediate in character between axis and appendicular organs, and ought rather to be called the "caliciferous tube."

Shimmer of the Petals of Ranunculus.§—According to Dr. M. Möbius, the oily shimmer of the petals of the yellow species of *Ranunculus* differs from that of any other flowers except some species of *Acacia*. In *R. Ficaria* this peculiar appearance extends from the tip of the petals downwards for about two-thirds their length, the lowest third being of a dull yellow colour, and the two parts sharply separated, though not by a straight line. The mesophyll contains but little anthoxanthin in the granular form; the seat of the peculiar colour is the epidermal cells, where it is caused by a highly refractive yellow oil; this appearance is greatly assisted by the fact that the layer of cells of the mesophyll immediately beneath the epidermis is densely filled with minute starch-grains.

Composition of Pollen.‖ — Dr. A. de Planta has studied the chemical composition of the pollen-grains of the hazel. He states

* Kienast, H., 'Ueb. die Entwickelung der Oel-behälter in den Blättern v. Hypericum u. Ruta,' 49 pp. (5 pls.). Elbing, 1885. See Bot. Ztg., xliii. (1885) p. 599.

† Atti della Soc. Toscana di Sci. Nat., vii. (1885) 1 pl. See Bot. Centralbl., xxiii. (1885) p. 303.

‡ Mém. Acad. Sci. Toulouse, vi. (1884) pp. 190–206 (1 pl.).

§ Bot. Centralbl., xxiii. (1885) pp. 115–9.

‖ Landwirthschaftliche Versuchsstationen, 1884, pp. 97–114. See Bull. Soc. Bot. France, xxxii. (1885). Rev. Bibl., p. 131.

that, when fresh-gathered, they contain about 9 per cent. of water, 5 per cent. of nitrogen, and 4 per cent. of ash; or more exactly, after drying, 31·63 per cent. of nitrogenous substances, 64·36 of non-nitrogenous substances, and 4·01 per cent. of ash. Among nitrogenous substances, Dr. de Planta has determined the presence of globulin, peptones, hypoxanthin, and amides. The presence of saccharose was also ascertained, while glucose is absent. The sugar contained in pollen-grains is therefore not directly capable of assimilation; the proportion of cane-sugar is as much as from 7 to 8 per cent. Starch is also present to the extent of more than 5 per cent.

In the pollen of the hazel the author found in addition colouring matters of two kinds, one easily soluble in water, the other only with difficulty; cuticule, about 3 per cent.; waxy substances not definitely identified; fatty acids, about 4 per cent.; cholesterin; and a bitter resinous substance.

Ovum-cells and Antherozoids.*—By the examination of the ovum-cells and antherozoids of *Chara*, mosses, and ferns, spermatozoids of frogs, and the ovum-cells and pollen-tubes of flowering plants, Herr E. Zacharias has satisfied himself that the male sexual cells are distinguished by the small size or entire absence of nucleoli, and the abundant nuclein; the nuclei of the female cells containing but very little nuclein, abundance of albuminoids, and one or more nucleoli, often of great size. These nucleoli are not distinguishable in their chemical properties from those of other nuclei; the cell-protoplasm contains no nuclein. It follows that the fertilized ovum-cell must contain more nuclein in proportion to its other constituents than before fertilization.

"Luminous Line" in the Seed of Malpighiaceæ.†—Sig. O. Mattirolo attributes to the presence of lignose the peculiar appearance known as the "luminous line" in the sclerenchymatous layer of the integument of the seed of Malpighiaceæ, the phenomenon corresponding, therefore, to that in other nearly allied orders, as the Tiliaceæ.

Seminal Integuments of Tiliaceæ.‡—Sig. O. Mattirolo describes in detail the structure of the seed in several species of *Tilia* and *Corchorus*, and in *Sparmannia africana*. In the course of development of the seed, the integument becomes differentiated into two well-defined layers, the outer layer being composed of what the author terms "Malpighian cells." Through this layer runs the peculiar "luminous line" characteristic of the seeds of Tiliaceæ, and which Sig. Mattirolo determines, by the application of a great variety of reagents, to be due to the peculiar modification of cellulose known as lignin.

Suberification in the Seminal Integument of Tilia.§—Sig. O. Mattirolo describes the following processes as taking place in the development of the seeds of *Tilia*:—A gradual transformation by which the cells full of protoplasm lose their power of division; their

* Ber. Deutsch. Bot. Gesell. Generalversammlung, 1885, p. lxv.
† Mem. R. Accad. Sci. Torino, xxxvii. (1885) (1 col. pl.).
‡ Nuov. Giorn. Bot. Ital., xvii. (1885) pp. 289–319 (3 pls.).
§ Atti R. Accad. Sci. Torino, xx. (1885) pp. 1166–72.

contents diminish; their walls thicken, and a deposition takes place of crystals of calcium oxalate. A branching of the internal surface of the cell-wall, by which the whole cell-cavity becomes filled up by the confluence of the branches. A suberous tissue is thus formed differing from any hitherto observed, in the presence of large intercellular cavities which are usually entirely wanting in suberous tissues.

Lignification of the Testa of Seeds.*—Herr C. O. Harz discusses the value of the various tests for lignin in vegetable tissues. Wiesner discovered that all lignified membranes are stained yellow by anilin sulphate; but a still better test is moistening the object by an aqueous or alcoholic solution of phloroglucin with addition of hydrochloric acid, when a very beautiful red colour is obtained. This test is an extremely delicate one for the least trace of lignification.

In the case of seeds, lignification occurs in certain cases in the hairs, as in those of some Bombaceæ and Asclepiadeæ. The nucellus very rarely exhibits the presence of lignin, nor does the embryo, endosperm, or perisperm, even in the case of the horny endosperm of Rubiaceæ, Colchicaceæ, and palms, or the comparatively hard nucellus of many Leguminosæ. The testa, on the contrary, is very commonly more or less lignified.

The author then enters into considerable detail with regard to the presence or absence of lignin in a large number of seeds. In Coniferæ the testa is almost always more or less lignified. In Gramineæ this was never found to be the case, though lignin occurs in the paleæ.

Strobili of Walchia piniformis.†—According to M. J. Bergeron a large number of the cones described in various works as belonging to this species are so described erroneously. He gives the characters by which the undoubted cones of this plant may be known.

Sexual Differentiation in the Fig.‡—Graf zu Solms-Laubach discusses the different varieties of the common cultivated fig, and accepts the view of Fritz Müller that both the cultivated form and the Caprificus or wild fig probably existed in the wild state, the latter being the female and the former the male form. The ancestor of both forms he considers to have been probably *Ficus elastica*, in which the two kinds of flowers are irregularly intermixed.

β. Physiology. §

Evolution of Phanerogams.‖—MM. Marion and de Saporta continue their researches into the genesis of the various forms of vegetable

* SB. Bot. Verein. München, May 13, 1885. See Bot. Centralbl., xxiv. (1885) pp. 21, 59, 88.

† Bull. Soc. Géol. France, xii. (1884) pp. 533–8 (2 pls.). See Bull. Soc. Bot. France, xxxii. (1885). Rev. Bibl., p. 171.

‡ Bot. Ztg., xliii. (1885) pp. 513–22, 529–40, 545–52, 561–72 (1 pl.).

§ This subdivision contains (1) Reproduction (including the formation of the Embryo and accompanying processes); (2) Germination; (3) Nutrition; (4) Growth; (5) Respiration; (6) Movement; and (7) Chemical processes (including Fermentation).

‖ Marion et Saporta, 'L'Évolution du Règne Végétal,' Paris, 1885. See Nature, xxxii. (1885) p. 289.

life from the Cryptogams to the Phanerogams. The latter they consider to have sprung directly, by imperceptible gradations, from the Heterosporous Vascular Cryptogams. One of these latter, in which the microspores penetrate to a solitary macrospore in order to effect fertilization, and in which the prothallus is inclosed, and germination takes place *in situ*, is already on the road to become a phanerogam, and a gymnosperm if the macrosporangium is not protected by a modified leaf. In the course of this transformation the authors trace three distinct stages, the Progymnosperms, the Gymnosperms, and the Metagymnosperms. The Progymnosperms occupied an important position in the carboniferous flora; at the present time they are, to a certain extent, represented by the Cycadeæ.

The authors then discuss the position of various fossil cryptogamous forms which they place among the Progymnosperms:—*Lepidodendron*, *Sigillaria*, with distinct radiating vascular cylinder and exogenous growth, and *Calamodendron*.

Fertilization of Goodenia.*—Mr. A. G. Hamilton describes the mode of fertilization in several species of this genus. He regards *Goodenia hederacea* as exhibiting an elaborate and beautiful series of contrivances for ensuring self-fertilization; while in *G. ovata* and other species the very same contrivances have for their object to prevent self-fertilization.

Mr. E. Haviland,† on the contrary, regards all the Australian species of *Goodenia* as cross-fertilized. He points out that the fact of the stigma being densely covered with pollen from the same flower is not necessarily an evidence of self-fertilization; since it is often placed there for the convenience of being carried away by insects to other flowers for their fertilization.

Endosperm of Grasses.‡—Prof. E. Tangl finds that the contents of the aleurone and starch-cells in the endosperm of grasses are in mutual connection by means of very fine threads passing through the cell-walls which are not pitted. At all events in the walls of the aleurone-cells these threads are of protoplasmic nature. In the aleurone cells the primary membrane of the inner and lateral walls, and the cellulose of the thickening mass, must be regarded as reserve-food-material. In germination, the first function of the aleurone layer is to act as a peripheral layer of cells for the conduction of the ferment-substances separated from the scutellum. In the later stages of germination the reserve-materials present in the aleurone are absorbed along with the soluble products from the amylaceous portion of the endosperm, through the epithelium on the dorsal surface of the scutellum.

Distribution of Reserve-material of Plants in Relation to Disease.§—Prof. D. P. Penhallow draws the following results from several thousand experiments made on a great variety of trees:—

* Proc. Linn. Soc. N. S. Wales, x. (1885) pp. 157–61 (1 pl.).

† Ibid., pp. 237–40.

‡ SB. K. Akad. Wiss. Wien, July 2, 1885. See Bot. Centralbl., xxiii. (1885) p. 169.

§ Canadian Record of Science, i. (1885) pp. 193–202.

(1) In the normal plant the full exercise of its functions of growth and a normal histological condition occur when potash and chlorine are relatively in excess, and lime is relatively wanting. (2) In the diseased plant the imperfect nutrition and distribution of the reserve-products, as also modifications of the cellular structure, are associated with deficiency of potash and chlorine, and excess of lime. Chemical analyses show that when the restoration from abnormal to normal functional activity occurs, the chemical constituents change their relations to those observed in healthy trees, i. e. the potash increases in proportion to the lime.

Food-material of the Ling.*—The ling, *Calluna vulgaris*, being a plant remarkable for its indifference to condition of climate, altitude, and soil, MM. P. Fliche and L. Grandeau have made a series of observations on the composition of the ash, which they found remarkably constant under varying conditions of soil. It is essentially a calcifugal plant, but is indifferent to the chemical composition of the soil, provided it does not contain too much lime. Requiring a very small quantity of matter derived from the soil, it will flourish on poor land, where scarcely anything else will thrive.

Products of Assimilation of the Leaves of Angiosperms.†—Herr A. Meyer has carried on a series of experiments for the purpose of determining the question: In what chemical form is the assimilated carbon chiefly stored up in the assimilating cells? Although undoubtedly far the larger part is in the form of carbohydrates, yet there is nothing in the results obtained to show that a portion of it may not be transitorily stored up in the form of proteids. It may also occur in the form of fatty oils, though this is not very common, as these substances are not as such capable of carriage from cell to cell.

Herr Meyer demonstrated by experiment the power of leaves to form starch out of sugar, even in absolute darkness, and of the non-assimilating cells in young leaves to receive starch from the other organs. As to the particular carbohydrate present in the leaves, he found that, as a general rule, dicotyledons store up a large quantity of starch, monocotyledons much less.

He then enters into a very interesting discussion as to the relative size of the molecules of the different carbohydrates. Of the glucoses he concludes that dextrose or grape-sugar, levulose or fruit-sugar, and lactose or galactose, have the smallest molecules of all the carbohydrates; probably they have all the same formula, $C_6H_{12}O_6$. Cane-sugar must have a molecule about twice as large as that of glucose, probably $C_{12}H_{22}O_{11}$, since it can be split up by invertin or by dilute acids into dextrose and levulose. Of nearly the same composition as cane-sugar are gentianose and the rare melezitose and melitose, less certainly also levulin. Lactosin and inulin form a group which must have a molecule at least six times the weight, viz. $6C_6H_{10}O_5$. To the same group probably belong also triticin and galactin, if these are

* Ann. Sci. Agronomiques, 1885. See Bull. Soc. Bot. France, xxxii. (1885). Rev. Bibl., p. 78.

† Bot. Ztg., xliii. (1885) pp. 417–23, 433–40, 449–57, 465–72, 481–91 497–507.

not identical with sinistrin and lactosin. Of all the carbohydrates starch must have the largest molecular weight, probably $6C_6H_{10}O_5 + H_2O$; but it may be considerably higher even than this. It was further determined that the diffusibility of the various carbohydrates is in inverse proportion to their molecular weight. In the spring-sap of many trees, cane-sugar is present to the extent of 2·5 per cent.; while the carbohydrates chiefly employed for the storage of food-material are those with a high molecular weight—starch, inulin, lactosin, and sinistrin.

Function of Tannin.*—Herr G. Kraus argues that tannin is not, as is generally thought, simply a waste product of excretion in the plant, but that it plays an important part in the formation of food-material, that it is, in fact, of the nature of a reserve-substance. This is shown by the parts of the plant in which it is very frequently found, as for example, in the growing point of the stem, in the inter-fascicular cambium, and especially in the phellogen. In leaves it occurs especially in the palisade-tissue; it is also found in those tissues which serve for the conduction of formative substances, as in the soft-bast and in the starch-sheath. Not unfrequently also it is met with in true receptacles for reserve-material. Its distribution can best be compared with that of starch or sugar. It can be transformed in quantities from place to place; and its production is closely connected with light. Its quantity diminishes rapidly in leaves or shoots placed for any time in the dark. In etiolated plants it is altogether wanting. It is formed in the organs exposed to strong light, as the leaves, and from there readily transferred to other parts of the plant.

Physiological Functions of the Starch-sheath.†—Herr H. Heine calls attention to the fact, already described by Sachs and others, of the invariable occurrence of a single row of cells—denominated by Sachs the starch-sheath—in immediate apposition to the vascular bundles, and, with their sieve-tube portion, accompanying these tubes throughout their whole length. These cells are always strongly charged with starch-grains, or occasionally with glucose. A careful examination of the facts connected with the appearance and disappearance of the starch from this layer of cells has led the author to the conclusion that the starch contained in the starch-sheath must be regarded as a store of reserve-substance, furnishing the material for the thickening, which is often very considerable and rapid, of the young bast-cells in their immediate proximity. This conclusion is favoured by the anatomical structure of the starch-cells, and especially by the close way in which they fit to one another, and to the adjoining phloëm-cells, without any intercellular spaces.

Growth of Leaves.‡—According to Herr J. Kraus, the leaves of the Scotch fir are larger in their second and third than in their first

* Ber. Sitz. Naturf. Gesell. Halle, 1884, pp. 46–57.

† Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 189–94.

‡ Abhandl. Naturf. Gesell. Halle, xvi. (1884) pp. 46–57. See Bot. Centralbl., xxiii. (1885) p. 132.

year; and the same is true of all those Conifers in which the leaves are in clusters of twos or threes, but not of those in which the leaves are solitary. A secondary growth appears to take place in the second year, which is repeated in the third; the increase in length being due chiefly to a growth of the cells in the leaf-sheath. In other trees, the mode of growth of the leaves is of two different kinds. Either the increase in size takes place from below upwards, so that the uppermost leaves are the largest, as in the lime, birch, and elm, or the size of the leaves at first increases upwards, but again decreases rapidly towards the apex of the branch, as in the maple and horse-chestnut. In the beech both modes occur. The leaves on the main branches of *Pinus excelsa* are larger than those on the lateral branches.

Influence of Electricity on Growth.*—The object of Dr. Holdefleiss's researches was to determine what influence, if any, was exerted on a crop of roots and potatoes by a weak galvanic current passing through the soil. In the field, copper plates, 50 by 80 cm. square, were sunk vertically, so that one plate covered two drills; the plates were 56 m. distant, and were connected with 14 Meidinger elements. In a further experiment there was a combination of zinc and copper plates without a battery, placed at a distance of 33 m. apart, and a third experiment was made with another arrangement of pairs of plates, whereby a stronger current was produced.

As the result, a constant current was observed, but no influence appeared to be exerted on the growth of the crop as regards quality or quantity, when under the influence of the first arrangement; under the second set of conditions, the crop at first was forwarded, but not later on; and an increase in yield amounting to 15–24 per cent. was remarked in the third case.

Influence of Calcium Sulphide on Barley.† — The material employed by Herr J. Fittbogen to ascertain the effect of calcium sulphide on the growth of barley was the ash of two sorts of brown coal, containing 3·85 and 2·74 per cent. respectively of the compound. A known quantity of artificially prepared sulphide was also used, mixed with the usual mixture of plant-food, together with sand. In the earliest stages of growth, the harmful action was perceptible, and as growth proceeded the poisonous action showed itself by producing white and brown markings on the leaves, which markings gradually spread over the whole leaf. These spots, when microscopically examined, were found to indicate the cells which were empty and destitute of chlorophyll; moreover, the presence of calcium sulphide seemed to retard growth. This action seems to be due to the formation of sulphuretted hydrogen, produced by the medium of water, the oxygen of the soil also being removed from the service of the plants. It was thought probable that the calcium hydroxide formed by the decomposition of the sulphide might also prove detrimental;

* Journ. Chem. Soc.—Abstr., xlviii. (1885) pp. 1152–3, from Bied. Centr., 1885, pp. 392–3.

† Journ. Chem. Soc.—Abstr., xlviii. (1885) p. 1154, from Bied. Centr., 1885, pp. 385–92.

yet no harm seemed to arise from this compound when added within certain limits; consequently, as the hydroxide formed by double decomposition lies within these limits, it is concluded that it exercises no influence.

Movement of Water in Plants.*—To determine the relative influence of transpiration and of "root-pressure" (osmosis from cell to cell) in causing the ascent of sap, Miss G. E. Cooley made a number of experiments with the manometer on *Robinia pseudacacia*, with the following results:—The influence of transpiration is felt in very remote parts of the plant; and, in this case at least, root-pressure has but little influence in supplying the wants created by transpiration.

Conduction of Water.†—Dr. F. G. Kohl describes an apparatus by which he claims to have proved, as the result of a number of experiments, that (1) The bending of a shoot causes the cell-cavities to become less, but does not completely close them for the passage of water; (2) The continuity of the current of water is not interrupted by the bending of a shoot; and (3) It is possible by alternate increase and diminution of the diameter of the vessels or tracheids of a shoot, to increase or diminish the current of water, the conditions of transpiration remaining the same; and that a complete closing of the cell-cavities altogether suppresses the transpiration-current.

Conduction of Sap through the Roots.‡—As the result of the present state of our knowledge, Herr C. Kraus states that it is most probable that in all plants, even woody plants, the water absorbed from without is forced up a certain height in the wood by pressure. There is very often no bleeding from the woody portion of a cauline organ which does not root, although this might be expected from the structure and arrangement of the parenchyma. The normal sap which exudes from the root when wounded is very thin, while that which exudes from the stem contains a relatively much larger quantity of substances in solution.

Galvanotropism. §—Herr J. Brunchorst contests that theory of Rischawi ‖ that galvanotropic curvatures depend only on a direct cataphoric current; he considers, on the other hand, that at all events positive curvatures depend to a large extent on the substance eliminated at the positive electrode; negative curvatures are possibly not to be regarded as truly galvanotropic.

Variations of Transpiration.¶—By a series of experiments on the seeds of peas and haricots, M. J. Vesque has come to the conclusion that, while nocturnal transpiration is at first less than diurnal,

* Canadian Record of Science, i. (1885) pp. 202–7.

† Bot. Ztg., xliii. (1885) pp. 522–6.

‡ Forsch. a. d. Geb. der Agriculturphysik, viii. (1885) pp. 33–50. See Bot. Centralbl., xxiii. (1885) p. 69. See this Journal, iv. (1884) p. 591, v. (1885) p. 837.

§ Bot. Centralbl., xxiii. (1885) pp. 192–8.

‖ See this Journal, v. (1885) p. 1032.

¶ Ann. Agronomiques, x. (1884) pp. 113–25. See Bull. Soc. Bot. France, xxxii. (1885). Rev. Bibl., p. 101.

it gradually increases and at length surpasses the latter. In proportion as the plant grows older, the quantity of water in it increases. The quantity of water transpired during twenty-four hours reaches its maximum in the 15th day after germination.

Nitrates in Plants.*—According to experiments made by MM. Berthelot and André on a large number of plants, the formation of nitrates at certain spots of the tissue, and at certain periods of growth, is a vital function of plants, dependent on the work of particular cells, and is in close connection with the processes of oxidation and reduction. They occur in all parts of the plant, but most abundantly in the stem.

Composition of the Gases in Floating and Submerged Leaves.†—MM. N. Gréhant and J. Peyrou find, as the result of a number of experiments on plants with floating or submerged leaves, that the gases exhaled by the same plant differ to a marked extent according to whether the sky is cloudy or the leaves exposed to bright sunlight; those of *Potamogeton lucens* gave, in the former case, 3·6 per cent., in the latter case 6·9 per cent. of oxygen.

Amphid-Substances in the Sap of Plants.‡—According to Herr C. Kraus, there are in the sap of plants, in addition to acid and alkaline, a number with amphid-reaction. This he has determined by experiment on the sap of the medullary parenchyma of more than 20 species.

Elimination of Oxygen from Plants.§—Prof. N. Pringsheim describes a series of experiments with the micro-spectrum on a number of different plants, both green, brown, and red, which tend to show that there is no invariable coincidence between the maximum of absorption of carbon dioxide and the maximum of elimination of oxygen.

New Alcoholic Ferment which does not Invert Sugar.‖—Signor J. F. Teixeira found that brews were gradually losing their character, and the yeast, on examination, contained a special ferment, which it was possible to isolate. The cells are globular, 0·2–0·33 μ broad, and do not invert saccharose.

Fermentation in the Living Sugar-cane.¶—Sigg. Palmeri and Comes have observed that a process of true fermentation goes on in the sap of the sugar-cane, the fermentation following the course of the vascular bundles and being indicated by the dark-red colour of the stem. They state that the organized ferments found in the fermenting tissues are *Hormiscium sacchari* Bonord., which they

* Journ. Pharm. et Chim., 1884. See Bot. Centralbl., xxiii. (1885) pp. 274 and 275.

† Comptes Rendus, ci. (1885) pp. 485–6.

‡ Ber. Deutsch. Bot. Gesell. Generalversammlung, 1885, pp. xx.-xxvi.

§ Ibid., pp. lxxii.-lxxx.

‖ Journ. Chem. Soc.—Abstr., xlviii. (1885) p. 1168, from Bied. Centr., 1885, pp. 416–7.

¶ Rend. R. Accad. Sci. Fis. e Mat. Napoli, 1883. See Bot. Centralbl., xxiii. 1885) p. 19.

identify with *Saccharomyces ellipsoideus* Rees, and *Bacterium Termo*, the latter, however, appearing to be connected with the decay of the tissue rather than with the fermentation of the sap. These organisms appear to enter the plant through the stomata.

Gum-ferment, a new diastatic Enzyma.* — According to Prof. J. Wiesner, the transformation of cellulose into gum or mucilage is the result of the action of a diastatic ferment. It is distinguished from other diastatic ferments in being able to transform starch into dextrin, but not into any copper-reducing sugar. Gum-ferment is known by a very characteristic and sensitive reaction; orcin and hydrochloric acid produce, after boiling for a short time, a red, and then a violet colour, with separation of a blue precipitate. It can be shown by this reaction that the gum-ferment arises in the protoplasm, passes into the cell-walls, and then brings about the transformation of cellulose into gum or mucilage. It appears to have the power of preventing the formation of sugar. It occurs in gum-arabic, the gum of the Drupaceæ and Pomaceæ, and in other kinds. Herr Wiesner has not been able to obtain the ferment in a pure condition.

Haberlandt's 'Physiological Anatomy of Plants.'†—This exhaustive work of Professor G. Haberlandt divides the subject treated into nine sections. The 1st section treats of the Cell; the 2nd, of the formation of Tissues; and the 3rd, of the Tegumentary system, including the Epidermis. The 4th, 5th, and 6th sections are devoted to the Mechanical and Absorptive systems, and the 7th to the Assimilative. In the 8th section, treating of the Vascular Bundles, a special terminology is adopted, the whole bundle being called the Mestom, the xylem the Hadrom, and the phloëm the Leptom. The fibrous tissue or Stereom consists chiefly of lignified prosenchymatous cells, the Stereïdes. The 9th section treats of the Intercellular space system.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Development of the Prothallia of Ferns.‡—Mr. D. H. Campbell finds that spores of many ferns germinate much more easily than is generally supposed, if sown on fine moist soil, namely, under favourable conditions, in from 3 to 5 days. The species chiefly experimented on were *Onoclea Struthiopteris* and *sensibilis*. In the genus *Onoclea* the exospore is frequently thrown off on germination, and between it and the endospore is another coat which the latter must rupture. The spore, on germinating, lengthens, and divides transversely into two cells, a smaller transparent one, which becomes the first root-hair, and a larger one containing abundance of chlorophyll. The larger cell then usually divides by other transverse septa into a row of cells; and, if grown in water, frequently does not go beyond this

* Bot. Ztg., xliii. (1885) pp. 577–83.

† Haberlandt, G., 'Physiologische Pflanzenanatomie im Grundrisse dargestellt,' 8vo, Leipzig, 1884.

‡ Bot. Gazette, x.(1885) pp. 355–69 (1 pl.). Cf. this Journal, v. (1885) p. 493.

condition, and develops no sexual organs. The terminal cell then divides longitudinally; and, after a number of divisions in both directions, one of the terminal cells takes the lead and becomes a triangular apical cell, which again becomes obliterated towards the close of the growth of the prothallium. The above process is subject to variations.

In the two species above named, and in *Asplenium filix-fœmina*, it was exceptional to find both kinds of sexual organ on the same prothallium; while *Aspidium spinulosum* is generally monœcious. In *Cystopteris fragilis* two forms of prothallium were found, smaller male, and larger hermaphrodite. The male prothallium is, as a rule, much smaller than the female, and of very irregular shape. Either no definite apical cell is formed, or it is early lost; not unfrequently the prothallium is reduced to a single row of cells, terminating in an antheridium: and in *Asplenium filix-fœmina* even to a single cell, besides the root-hair, which produced an antheridium with perfect antherozoids. In this same species, on one occasion, the prothallia produced in the summer large numbers of antheridia; growth ceased entirely in the winter, but was resumed in the spring, when archegonia were produced in large numbers, and subsequently young plants.

Budding on Apogamous Prothallia of Ferns.*—Dr. H. Leitgeb has studied especially two of the five cases described by De Bary of the apogamous development of shoots on fern-prothallia. One of these is when a shoot appears in the normal position, and a second shoot opposite to it on the dorsal side of the prothallium. This results, according to the author, from alternations in the degree of illumination. In the second case, the primary members of a single shoot distribute themselves over both surfaces of the prothallium. This is also the result of varying degrees of relative illumination on the two sides of the prothallium, combined with the fact that the roots of fern-embryos are always strongly negatively heliotropic.

Carboniferous Lycopods.†—Mr. R. Kidston describes three new species of *Sigillaria* (*S. McMurtriei*, *S. coriacea*, and *S. Walchii*), and one of *Lepidodendron* (*L. Peachii*).

Muscineæ.

Section Harpidium of Hypnum.‡—Sig. G. Venturi publishes a monograph of the Mosses coming under this subgenus, which he describes as, with but few exceptions, growing in watery places, ditches, and ponds, where they form dense tufts, the green extremities of the branches alone emerging from the water. They have also the power of creeping over moist soil, and produce their fructification especially in such situations. The species comprised by the author in this section are *Hypnum fluitans*, *intermedium*, *verrucosum*, *aduncum*, *Kneiffii*, *Sendtneri*, *capillifolium*, *Hausmanni*, and *riparium*, which are described in detail, with their numerous varieties.

* Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 169–76.
† Proc. R. Phys. Soc. Edin., viii. (1885) pp. 415–24 (1 pl.).
‡ Nuov. Giorn. Bot. Ital., xvii. (1885) pp. 161–84.

New Aquatic Moss.*—Prof. J. B. Schnetzler describes a Moss attached to pieces of limestone found by fishermen in their nets when fishing at a depth of 200 m. at a particular spot in the Lake of Geneva. No fructification has yet been found on it, but the author considers it as probably allied to *Hypnum* (*Thamnium*) *alopecurum*, which it resembles in its mode of branching and in the form of its cells. It is multiplied by green shoots; and the leaves contain abundance of chlorophyll and starch. Assimilation and the formation of chlorophyll therefore take place at a depth which marks the extreme limit of the sun's rays.

Hepaticæ of Terra-del-Fuego.†—The Hepaticæ brought from Terra-del-Fuego, in 1882, by Dr. C. Spegazzini, have been examined by Signor C. Massalongo, who finds and describes a very large number of species new to science, about one-fourth of the whole collection. He also establishes a new genus of Jungermannieæ, *Pigafettoa*, with the following characters:—Perichætium few-leaved, or pseudo-lateral from subfloral innovations; cauline and perichætial leaves subsimilar; colesula subovate, large-mouthed, 3–4 lobed above, lobes irregularly inciso-dentate or subcristate; calyptra pear-shaped, with 3–4 sterile pistillidia near the base; cauline leaves subtransversely subsuccubous, bifid, areolation made up of pachydermal cells; amphigastria smaller than the leaves, bidentate.

Classification of Sphagnaceæ.‡— Dr. Röll points out the very great diversity displayed by different sphagnologists in the limitation of species; and insists on the remarkable variability within the limits of the various alleged species of all the characters derived from external characteristics: the size, form, and colour, the number, size, and direction of the branches. The fruit, on the other hand, offers no difference from which specific characters can be drawn throughout the genus, with the exception of the few exotic forms of the sections *Hemitheca* and *Isocladus*. There are, in fact, among the Sphagnaceæ neither constant species nor typical forms. The characters that are of practical convenience in the arrangement of the Sphagnaceæ under so-called species must not be regarded as natural or of any genealogical value; they indicate rather stages in the history of development than distinct species. Dr. Röll illustrates the above conclusions by the comparison, in their various features, of a very large number of forms of *Sphagnum*, and supports Warnstoff's proposal for a congress of bryologists to determine what variations of structure are of genetic value.

Rabenhorst's 'Cryptogamic Flora of Germany.'—The fourth volume of this work treats of the Mosses; and of this volume three parts are now published, including a general introduction, and an account of the Sphagnaceæ, Andreæaceæ, and Archidiaceæ. In the

* Bot. Centralbl., xxiii. (1885) pp. 330–1.

† Nuov. Giorn. Bot. Ital., xvii. (1885) pp. 201–77 (17 pls.). Cf. this Journal v. (1885) p. 1030.

‡ Flora, lxviii. (1885) pp. 569–80, 585–98.

introduction, the structure of Mosses in general is described under seven heads, viz. (1) the protonema, (2) the stem, (3) the leaf, (4) the sexual organs, (5) the inflorescence, (6) the sporogonium, and (7) the vegetative mode of reproduction. The Musci are divided, in the first place, into four orders: Sphagnaceæ, Andreæaceæ, Archidiaceæ, and Bryineæ; the last again into two tribes, Cleistocarpæ and Stegocarpæ, and the latter of these into two sub-tribes, Acrocarpæ and Pleurocarpæ. Of *Sphagnum*, the sole genus of Sphagnaceæ, twenty-three species are described. In the Andreæaceæ are comprised nine species of *Andreæa;* in the Archidiaceæ the single species *Archidium phascoides.*

Algæ.

Assimilating System of Algæ.*—Although in even the higher algæ (sea-weeds) there is no distinct differentiation of the structure into epidermal, assimilating, and conducting tissues, still, according to Herr N. Wille, there are cells which are especially concerned in assimilation, and which may be either iso-diametrical or elongated in a direction either parallel to or at right-angles with the axis. Such an assimilating-system he classes under three heads, and eighteen types, viz.—(1) An assimilating-system which acts also as a conducting system; to this belong three types; viz. those of *Ulva*, *Polysiphonia*, and *Lithoderma;* (2) An assimilating distinct from a conducting system: either *a*, conducting system imperfectly developed, including seven types, viz. those of *Rhodomela*, *Dictyota*, *Ceramium*, *Corallina*, *Ahnfeltia*, and a type with organs which, from a physiological point of view, are leaves, viz. *Myriactis* and *Batrachospermum;* *b*, conducting system well developed, with four types, viz. *Desmarestia*, *Chorda*, *Chordaria*, and *Furcellaria;* and (3) in addition to an assimilating system, there is both a primary and a secondary conducting (Leitungs and Zuleitungssystem) system:—four types, viz. those of *Nothogenia*, *Rhodophyllis*, *Cryptosiphonia*, and *Halimeda.*

Algæ from Madagascar.†—In a collection of algæ made by M. Ch. Thiébaut from Majunga in the north-east of Madagascar, Tamatave, and the coast of the same island opposite Réunion, and described by M. E. Bornet, he records a new species of Florideæ, *Constantinea? Thiébautii.*

Fresh-water Algæ of Rome.‡—Sig. E. Martel enumerates the fresh-water algæ of Rome and the Campagna. Of Florideæ only one species is described—*Hildebrandtia rivularis.* Of Chlorosporeæ there are fifty-five, including a new genus of Palmellaceæ, *Chlorothecium* Borzì, belonging to the Sciadiaceæ, but distinguished from all the other genera of the family by its dimorphic cells. The purely vegetative cells of the first generation are ovoid; those destined to produce 1, 2, or 4

* Bot. Sällsk. Stockholm, April 22, 1885. See Bot. Centralbl., xxiii. (1885) pp. 264, 296.

† Bull. Soc. Bot. France, xxxii. (1885) pp. 16–19 (2 figs.)

‡ Ann. Istit. Bot. Roma, i. (1884) pp. 182–204.

zoospores are rounded and collected into palmelloid groups. Thirty-nine species of Nostochineæ are described, and ten of Chroococcaceæ.

Algæ of the Indian Ocean.*—Herr F. Hauck describes *Dictyota atomaria* obtained from Bombay at a depth of from two to four metres. The frond is capable of forming, by proliferation, a new stalked branch. The tetrasporangia and antheridia are found on different individuals; the latter form elongated or oval whitish spots, not exceeding 1 mm. in breadth.

Marchesettia spongioides, belonging to the Areschougiaceæ, has a remarkable resemblance to a sponge; it is found at Singapore, in New Caledonia, and in Madagascar. The tetrasporangia and cystocarps develope at the summit of peripheral branches. The cystocarps belong to one of the most complex types; the sporiferous nucleus has in its centre a large placental cell.

Phæothamnion, a new Genus of Fresh-water Algæ.†—Under the name *Phæothamnion confervicola*, Herr G. Lagerheim describes a freshwater alga forming brownish-yellow tufts on *Vaucheria*, *Cladophora*, &c. Each tuft consists of a relatively small filament with monopodial branching, which takes place in the same way as in *Cladophora*. The cells are cylindrical or ovoid, with a parietal ribbon-shaped brownish-green chromatophore. No nucleus, pyrenoids, or starch, could be detected in them. The lower cells of the primary axis and the basal cells of the older branches become sporangia, swelling up, and forming two zoospores by bipartition, which then escape through an opening in the cell-wall. The zoospores are roundish, and have two equal cilia. They do not conjugate, but attach themselves directly to an algal filament, and surround themselves with cell-walls. The germinating cell divides into two, the upper one of which produces the filament by further growth and division. A palmella-condition was also observed, in which the cells divide in two directions, and become invested in a common gelatinous envelope.

Notwithstanding its brown pigment, Lagerheim refers *Phæothamnion* to the Chlorophyceæ, chiefly on account of the structure of the zoospores, constituting a new family, Phæothamnieæ, near to Chroolepideæ and Chætophoreæ.

Chlorochytrium Cohnii.‡—Herr G. Lagerheim has had the opportunity of further examining this parasitic alga, discovered by Wright.§ It is interesting as being parasitic on animals, *Campanularia*, *Vaginicola*, &c., as well as upon algæ,—*Schizonema*, *Urospora*, *Enteromorpha*, &c. The separate cells vary in form:—spherical, elliptical, flask-shaped, or quite irregular; the chromatophore forms

* Hauck, F, 'Cenni sopra alcune Alghe dell' oceano Indiano,' 4 pp. (3 pls.). See Bull. Soc. Bot. France, xxxii. (1885). Rev. Bibl., p. 181.

† Bih. K. Svenska Vet. Akad. Handl., ix. 14 pp. (1 pl.). See Bot. Ztg., xliii. (1885) p. 604.

‡ Ofvers. K. Vet. Akad. Förhandl., 1884, 7 pp. (1 pl.). See Bot. Ztg., xliii. (1885) p. 605.

§ See this Journal, i. (1881) pp. 801, 931.

a parietal disc with a starch-grain. The zoospores are formed by repeated bipartition, and escape through an opening in the outgrowth by which the parasite is attached to the host; they are pear-shaped and biciliated. Larger zoospores, with four cilia, have also been observed by Lagerheim, but no conjugation of these with the micro-zoospores has yet been detected, as in the case of *C. Lemnæ*. Both kinds appear to be capable of direct germination.

Fronds of Laminariaceæ.*—In the 4th part of his 'Observationes Phycologicæ,' Prof. J. E. Areschoug describes the 11 species of Scandinavian Laminariaceæ. *Nereocystis Luetkeana* and *Pelagophycus giganteus* are annual, the plant dying entirely every year. In the perennial species the new fronds begin to show themselves in January, and attain their complete development towards April. In *Laminaria flexicaulis* the old frond begins to bear spores at the moment when the new frond appears, and dies in the middle of the summer when the new frond has become large. In *Alaria esculenta* all the fronds disappear in the autumn before the new fronds have made their appearance, but the stem is perennial, and produces new fronds in the spring.

Motion of Diatoms.†—Mr. C. Ouderdonk, having studied the Diatomaceæ for some time, mainly in regard to a discovery of their mode of motion, has come to the conclusion that there is a fluid in motion on the outer surface of the valves, no other supposition accounting for the observed phenomena. He therefore endeavoured to find the fluid, or semi-fluid, and thus describes his results:—

"I turned my attention to the Palmellaceæ. Here I had an invisible frond, firm enough to be lifted out of the water and hold the green globular masses contained in it. I began to search for stains to make this invisible matter visible. I found that methyl-anilin-green stained the *Palmella* a clear blue, while it also hardened it. I found that this stain also stained the living diatoms blue; more than this, my success was far beyond what I had hoped, for I saw in many cases a blue mantle slowly unfold and detach itself from the now white denuded frustule. Subsequently, by many observations, I found that all diatoms which have come under my notice are encased in a gelatinous pallium; that this pallium is most manifest under the action of the stain in the case of the diatoms with strong motion, and least manifest in the case of fixed diatoms like those with a stipes; that the Diatomaceæ have not internal motion analogous to the motion called cyclosis in the Desmidieæ; that the motion on the outside of the outer covering of the Diatomaceæ is strongly analogous to the motion on the inside of the outer covering of the Desmidieæ.

"From the above-mentioned facts, and others which time forbids to mention, I offer as a theory that the motion of the Diatomaceæ is caused by what I will call *external cyclosis*. I do not court credence

* Acta Reg. Soc. Scient. Upsalensis, iii. (1884) 16 pp. See Bull. Soc. Bot. France, xxxii. (1885). Rev. Bibl., p. 180.

† The Microscope, v. (1885) pp. 205–6.

(an editor of a journal in the cause of Microscopy objected to my papers on the ground that I could not expect to gain credence), I only trust microscopists will investigate; if my theory is false, let it fall."

Lichenes.

Lichen-studies.*—In the course of a reply to Herr Forssell's criticism on his "Lichen-studies," Herr H. Zukal repeats the main points in which he dissents from Minks's interpretation of the development of lichens.

The structures described by Minks as "gonocysts" actually occur, but are only gonidia which, by a peculiar process of growth, have got extruded on to the superficial crust, where they acquire an appearance so peculiar that they are with difficulty recognized as metamorphosed gonidia. Zukal proposes for them the term *Exogonidia*. These may, in certain circumstances, develope into a new lichen-crust. In this whole process there is nothing very strange; it may be regarded as simply a modified formation of soredia.

"Minks's gonangia" are spherical colonies of *Palmella* or *Glœocystis*, overgrown and inclosed by thick-walled brown lichen-hyphæ. His "microgonidia" are moniliform rows of spherical strongly refractive and greenish particles of protoplasm, which fill up the hyphæ of many lichens, and sometimes give them a peculiar appearance.

Lichens of Scandinavia.†—In reviewing the genera of Scandinavian lichens, Herr K. B. J. Forssell proposes a general classification, the main feature of which is a division into five primary groups dependent on the structure of the spores, viz. (1) unicellular, and not muriform; (2) bicellular, and not muriform; (3) quadricellular, and not muriform; (4) multicellular, and not muriform; and (5) multicellular and muriform. The lichens with unicellular spores are again classified as follows:—

A. Spores coloured.
  (1) Discocarpi (*Alectoria, Buellia muriopsis*).
  (2) Coniocarpi.
    a. Thallus fruticose (*Sphærophorus*).
    b. Thallus crustaceous (*Calicium, Chænotheca*).

B. Spores hyaline.
  (1) Asci with few (not 8) but large spores.
    a. Thallus fruticose (*Alectoria*, &c.).
    b. Thallus crustaceous (*Lecidia sanguinaria, Pertusaria*).
  (2) Asci with 8–∞ usually small spores.
    a. With chroococcus-gonidia (*Omphalaria, Synalissa*).
    b. With palmella-gonidia.
      α. Pyrenocarpi (*Thelocarpon, Trimmatothele*).
      β. Discocarpi.
        * Spores very numerous (*Acarospora, Biatorella*).
        ** Asci with at most 24–32 spores.
          † Apothecia lecanora-like (*Lecanora*, &c.).
          †† Apothecia lecidea-like (*Lecidea*, &c.).

* Bot. Centralbl., xxiii. (1885) pp. 292–6.

† Bot. Notiser, 1885, pp. 33–57. See Bot. Centralbl., xxiii. (1885) p. 37.

(3) Asci with eight spores of medium size.
a. With palmella-gonidia.
α. Pyrenocarpi.
β. Coniocarpi.
γ. Discocarpi.
b. With trentepohlia-gonidia (*Ionaspis*, *Glomerilla*?).

Fungi.

Mycorhiza.*—In a further communication on this subject, Herr B. Frank states his opinion that the symbiosis is probably one to which all trees are subject under certain conditions; but that the mycorhiza is probably formed only on soils which contain a large amount of humus or of undecomposed remains of plants; and its apparent limitation at present to the Cupuliferæ and a few other trees is probably due to their partiality for soil of this character. Through the mycorhiza the tree absorbs not only water and mineral constituents, but organic substances also derived from the humus, the humus having no power of supplying these substances directly to the tree. Of especial value is the mycorhiza in the case of those plants which, like *Monotropa*, do not form chlorophyll.

A discussion followed the reading of the paper, in which a general agreement with the conclusions of the author was declared by Woronin, Reess, De Bary, and others.

Fungi of Cellars.†—Dr. J. Schröter describes the fungi found in the cellars which undermine Breslau, where the external conditions are great moisture, a nearly uniform temperature, and almost complete darkness. The walls are covered with a mucilaginous slime, 1–1½ cm. thick, of a light flesh-colour due to the presence of oxide of iron. This slime consists to a very large extent of various micrococci, the most abundant of which is a peculiar hitherto undescribed species, which the author calls *Leucocystis cellaris*, resembling, in its simplest stage of development, Friedländer's micrococcus of pneumonia, *Leucocystis pneumoniæ*. It is composed of colourless strongly-refractive cells 1·5–2 μ long, and 1–1·5 μ broad, inclosed in a gelatinous envelope as much as 5–8 μ in thickness, and forming large lumps. The cocci multiply by dividing in all three directions, the products remaining, up to a certain point, inclosed in the original envelope. Both cocci and envelope are strongly stained by anilin pigments; careful treatment shows the envelope to be composed of a number of layers.

In addition to this there are found in the slime many other Schizomycetes: large bacilli in various stages of division, a very long bacterium with distinct coils, imbedded in a small amount of slime, a *Myconostoc*, and a strongly refractive micrococcus in moniliform chains.

In all the older cellars is found also the tinder-fungus, *Rhacodium*

* Ber. Deutsch. Bot. Gesell. Generalversammlung, 1885, pp. xxvii.–xxxiii. Cf. this Journal, v. (1885) pp. 844, 1025.

† JB. Schles. Gesell. Vaterl. Kultur, lxi. (1884) p. 193, and lxii. (1885) p. 290. See Bot. Centralbl., xxiii. (1885) pp. 174, 333.

cellare, covering everything with dense masses of felt, several metres in length, and as much as 2 cm. in thickness. Its power of attaining such vigorous development on a substratum which does not afford the least nourishment distinguishes this fungus from all others at present known; and indicates that it must obtain its sustenance from the particles suspended in the air of the cellar. It consists of a loose tissue of branched hyphæ from 2·5 to 3 μ in diameter, with occasional irregular swellings. The filaments are provided with irregularly placed indistinct septa, and a thick olive-brown membrane with hooked or annular unevennesses, and strongly refractive contents. The author found among the hyphæ large masses of isolated spores, of a narrow elliptical or almost club-shaped form, 6–13 μ long and 3–3·5 μ broad, of an olive-brown colour, simple or divided by a single septum, and resembling the spores of *Cladosporium*. These spores are formed on the apices of the young branches, and can be made to germinate in water or solution of sugar. The author considers it probable that *Rhacodium* is a stage of development of an Ascomycete; but the asci and ascospores have not yet been detected.

The effect of the exclusion of light on fungi which ordinarily grow above ground is shown in the lengthening of the stipes and the partial or complete abortion of the pileus; many forms found in dark places, and described by writers as distinct species, are modifications of this nature of *Lentinus lepideus* and other species. To the same category belong the various forms of Rhizomorph, which are modifications of *Armillaria melleus* and of other Hymenomycetous fungi; those formed on dead willows and poplars, which are often much branched, are usually derived from a species of *Mycena*. The black-brown, horse-hair-like threads which frequently proceed from pine-leaves, known as *Rhizomorpha setiformis*, are the degraded fructification of *Marasmius androsaceus*. Of the same nature are the malformations known as Oozonium, many of which belong to the cycle of development of *Merulius lacrymans*.

The author then describes in detail the remarkable fungus-vegetation of the Hoymgrube near Czernitz, and concludes with a description of *Agaricus acheruntius*, a species rarely found in woods, and attaining its most luxuriant development in the uniform moisture and temperature of underground passages.

Development of Merulius lacrymans.*—Prof. R. Hartig has carefully investigated the development of the fungus which produces dry-rot in timber, and has been able to fill up several gaps in our knowledge of it. It is exceedingly sensitive to cold, and is hence never found on living trees, but only in human dwellings. The spores are so minute that about four million occupy a cubic mm.; in large quantities they form a light-brown powder; they contain a drop of oil, and a small sharply-defined colourless spot, possibly a nucleus. The germinating filaments are readily formed in nutrient solutions, but do not undergo great development unless in contact

* Hartig, R., 'Der ächte Hausschwamm,' Heft i. 82 pp. (2 col. pls.), Berlin, 1885. Bot. Centralbl., xxiii. (1885) p. 123. Cf. this Journal, v. (1885) p. 845.

with wood, when they branch freely and penetrate readily from cell to cell and vessel to vessel. The perforation of the cell-wall takes place by chemical means; ferments being formed in the protoplasm of the fungus, which disintegrate the part of the cell-wall with which they come into contact. The larger hyphæ are often covered by numerous granules or crystals of calcium oxalate, which remain after the hyphæ have disappeared. Development outside the wood takes place only in moist air.

The fructification of *Merulius lacrymans* is very irregular in size and form; it makes its appearance in places where the mycelium receives a small amount of light. It changes in colour, from white on its first appearance to reddish and finally brownish-yellow; the margin always remains white, and exudes drops of fluid into moist air, like the mycelium. As soon as the chalky character of the dense cushion of mycelium indicates the commencement of the development of the fructification, the ends of the hyphæ which lie on the surface swell into a club-shape and become basidia, which place themselves at right angles to the surface, and develope the spores at their apices. The spores are developed in the same way as in other Hymenomycetes.

The author enters into considerable detail respecting the chemical constitution of the fungus. The spores will not germinate in water, the juice of fruits, or gelatin, except after the addition of urine, depending on the presence of ammonia. The fungus has the property of transporting water from one part of its mycelium to another, which greatly adds to its destructive properties. It derives its nourishment entirely from the wood among which the mycelium penetrates, depriving it of its nitrogenous ingredients, which it finds especially in the living cells of the medullary rays; but its chief food-material is cellulose. It takes up the ash-constituents of its host directly by contact, while the organic nutrient substances are absorbed by the help of a ferment.

Polyporus Schweinitzii as a Parasitic Fungus.* — Herr P. Magnus records an instance of the Weymouth pine, *Pinus Strobus*, killed by the mycelium of this fungus, the large fructification of which had appeared for many years on the root and base of the stem. The mode of action of the mycelium is the same as that of the nearly allied *P. annosus*. *P. Schweinitzii* is not uncommon on Conifers, but always on the root or base of the stem.

Sour-Rot of Grapes.†—M. K. Portele, in reference to the caterpillar of the *Tortrix uvana*, which does much damage to grapes, finds that if it attacks the hard berry, the berry becomes acid and harder; if, however, sugar has formed in the berry, then many ferments are introduced into the mash, and the wine is deteriorated. If the worm attacks ripe berries, then *Penicillium glaucum* and *Aspergillus glaucus* form in the wound; the growth of this mildew may close up the entrance, when the whole contents of the berry rot, and quantities of bacteria are produced, which destroy the mycelium. If the opening

* Verhandl. Bot. Ver. Proc. Brandenburg, xxv. (1884) pp. viii.–x.

† Journ. Chem. Soc.—Abstr., xlviii. (1885) pp. 1153–4. From Bied. Centr., 1885, pp. 403–4.

remains open, the contents also decomposed, *Saccharomyces ellipsoideus* and *S. apiculatus* are produced, then alcohol is formed, which is again changed into carbonic anhydride and water, but more frequently into acetic acid. Should heavy rain fall, these affected grapes will do no harm to the must, as they will be washed clean, and only the husks remain.

Disappearance of Insects in consequence of the appearance of Puccinia malvacearum.*—According to Dr. F. Ludwig, this parasitic fungus first made its appearance in the neighbourhood of Greiz, in 1875, since which time its ravages have nearly destroyed all the wild and cultivated Malvaceæ. There are many insects the larva of which feed exclusively on various species of the order; these must either disappear or find some other food-plant.

New Ustilagineæ.†—Herr E. Ule records the following new species of Ustilagineæ found on grasses or sedges in Brandenburg:—*Tilletia aculeata* on *Agropyrum repens*, *T. Brizæ* on *Briza media*, *T. alopecurivora* on *Alopecurus pratensis*, *T. Avenæ* on *Avena pratensis*, *T. sterilis* on *Festuca ovina* and *Kœleria cristata*, *Urocystis Festucæ* on *Festuca ovina*, and *U. Caricis* on a species of *Carex*.

New Chytridiacea.‡—Herr P. Magnus records the discovery of a new species of parasitic fungi belonging to the Chytridiaceæ, *Olpidium zygnemicolum*, in the cells of a *Zygnema*, not attacking either a *Spirogyra* or *Mesocarpus* growing along with it. Swarm-cells were observed piercing the cells of the host, from which zoosporangia and resting-cells were developed. It is distinguished from other species of *Olpidium* by the absence of a long neck to the zoosporangium.

Rabenhorst's Cryptogamic Flora of Germany (Fungi).—The last three parts (19–21) of this section of Rabenhorst's great work are still occupied with the Sphæriaceæ, and chiefly with the families Sphærelloideæ and Pleosporeæ. Of *Sphærella* 120 species are described, of *Leptosphæria* 139, and of *Pleospora* 63.

Protophyta.

Movements of Oscillaria.§—Prof. J. B. Schnetzler, from observations of a large species of *Oscillaria*, *O. ærugineo-cærulea*, describes the movements as of six different kinds, viz. (1) Rotation round the axis of the filament or of its segments; (2) creeping or gliding over a solid substratum; (3) a free movement of translation in the fluid; (4) rotation or flexion of the filament; (5) sharp tremblings or concussions; and (6) radiating arrangement of the entangled filaments. The author considers that simple osmose is insufficient to explain these various movements; but that they must be due, in some way at present unexplained, to the protoplasm. Everything which increases or retards the vital energy of the protoplasm, increases or retards respectively the intensity of the movements of the filaments.

* Hedwigia, xxiv. (1885) pp. 219–20.
† Verhandl. Bot. Ver. Prov. Brandenburg, xxv. (1884) pp. 212–7.
‡ Ibid., xxvi. (1885) pp. 79–80.
§ Arch. Sci. Phys. et Nat., xiv. (1885) pp. 160–71.

Floating Rivularia.*—Professor F. Cohn describes a floating *Rivularia* forming a "flos aquæ" on the surface of a marsh. He gives it the specific name *Rivularia fluitans*, and considers it identical with Rabenhorst's *Glœotrichia pygmæa*.

Glycogen in Beer Yeast.†—Dr. L. Errera finds that the cells of *Saccharomyces cerevisiæ* in active growth contain glycogen in considerable proportion. Sometimes the entire cell-contents consist of this substance, which doubtless plays the same part as starch in the higher plants. The presence of glycogen explains many earlier observations respecting yeast, for instance, that it yields sugar when boiled with dilute acids.

Rise of Micro-organisms in Damp Soil.‡—Herr J. Soyka has determined, by experiment, the possibility of micro-organisms rising in a capillary tube of water, and hence concludes that they may be carried up to the surface of the soil by capillary attraction.

Ætiology and Pathology of Gonorrhœa of the Urethra.§—Dr. Bockhart has cultivated by inoculation the gonococci obtained from gonorrhœa patients. They soon produced suppuration, and in the matter were found large numbers of gonococci, collected mostly in larger or smaller groups, and having often the form of diplococci. Further investigation showed that these gonococci were the pathogenous bacteria of gonorrhœic affections. When brought into contact with the mucous membrane of the urethra, they make their way, probably between the epithelial cells, into the lymph-passages of the fossa navicularis, where they increase and produce violent inflammation. Thence they penetrate into the blood-vessels and upwards towards the bladder. Finally they destroy the colourless blood-corpuscles which they have attacked, either in the tissue itself, or in passing through the epithelial layer, or in the gonorrhœa secretion. Those that remain in the tissues perish either there or in the blood.

Micrococci of Erysipelas.‖ — Dr. Fehleisen has observed the uniform presence of micrococci in the lymph-glands of the parts of patients affected with erysipelas; and by culture on pepton-gelatin infusion of flesh, and infection in rabbits, has proved the cocci to be the cause of the disease.

Zoogloœæ and Related Forms.¶—Dr. W. Trelease describes several new species of chromogenous bacteria, as well as a new variety of *Saccharomyces*. Slices of boiled potato answered best for their culture, though other substances were previously tried. The cultures were

* Ber. Schles. Gesell., 1884, pp. 273–5. See Bull. Soc. Bot. France, xxxii. (1885). Rev. Bibl., p. 110.

† Comptes Rendus, ci. (1885) pp. 253–5. Cf. this Journal, iii. (1883) p. 397.

‡ Prag. Medicin. Wochenschr., 1885. See Naturforscher, xviii. (1885) p. 434.

§ SB. Phys.-Med. Gesell. Würzburg, 1883, pp. 13–9. See Bot. Centralbl., xxiii. (1885) p. 143.

‖ SB. Phys.-Med. Gesell. Würzburg, 1883, pp. 9–13. See Bot. Centralbl., xxiii. (1885) p. 142.

¶ Studies Biol. Laborat. Johns-Hopkins Univ., iii. (1885) pp. 194–216 (1 pl.).

started by rubbing the potato on the floor, sink, &c., and then separating from the mass of zooglœæ the ones he wished to study. Methyl-violet was found to be the best staining agent, and Dr. Trelease contradicts Rasmussen's assertion that preparations with this reagent undergo alteration.

The new forms described are the following:—a *Micrococcus* which formed spots of magenta colour, which is doubtfully identified with *M. prodigiosus*, but it never gives the characteristic blood-red colour of this latter species.

Bacterium candidum (Trel.) grows best on wet potato. The zooglœa, at first moist, dries later on and looks powdery, becoming wrinkled, till ultimately it assumes a yellow colour. The constituent cells are ellipsoidal, and usually in chains up to six; when in water the cells move about, but no flagellum could be distinguished. When sown on beetroot the zooglœa was red, but a new culture on potato showed the characteristic white colour. *B. aurantiacum* (Trel.) forms at first a pale yellow semi-fluid zooglœa, which later on becomes waxy and orange-coloured. Cells smaller than preceding, and show central spores. (In each case he refers to similar forms previously described.) *B. luteum* (Trel.) is at first nearly fluid and colourless, it soon becomes waxy, and as it dries, becomes wrinkled and of a lemon-yellow colour. After two or three days it dries up and becomes a brownish-maroon. The cells are short ellipsoids, or rod-like, and spores were noticed. *B. chlorinum* (Trel.) has a greenish-yellow zooglœa, and on drying shows no wrinkling. *B. incarnatum* (Trel.) is somewhat like the preceding, but varies in colour from a "dirty flesh-colour" to deep red brown; cells ellipsoidal, or more elongated unsegmented rods.

He also describes *Micrococcus candidus* (Cohn), *B. tumescens* (Zopf), *B. violaceum* (Bergonzini), *B. hyalinum* (Ktz.), *Cladothrix dichotoma* (Cohn), and *Leptothrix buccalis* (Robin), with a new *Saccharomyces*, *S. glutinis* (Cohn) var. *candidus* (Trel.) which resembles Cohn's claret-coloured form, except that its colour is white; it pullulates as yeast does, but never forms strings of more than three cells.

Bacilli of Syphilis.*—Prof. Doutrelepont and Dr. J. Schütz have succeeded in detecting by staining the bacilli of syphilis by a complicated and tedious process. They are nearly straight or slightly curved or coiled or bent long rods. Here and there are light-coloured spots, possibly spores, rarely swellings at the extremities. They are formed singly, or in pairs like crossed swords, or in large irregular groups. They are usually found in pale inflated cells, often without any discernible cell-boundary. They are not usually numerous; only fresh products of syphilis yielded them in large quantities. Cultivation has at present been without result.

Oxidation and Reduction under the Influence of Microscopic Organisms in the Soil.†—M. A. Müntz has already shown that in

* Deutsch. Med. Wochenschr., 1885, p. 320. See Bot. Centralbl., xxiii. (1885) p. 145.

† Comptes Rendus, ci. (1885) pp. 248–50.

presence of air and the nitric ferment in soils, iodides are converted into iodates. He now finds that alkaline bromides are converted into bromates under the same conditions, but similar experiments with chlorides gave no definite results. In presence of the nitric ferment, but out of contact with air, alkaline iodates, bromates, and chlorates are completely and somewhat rapidly reduced to iodides, bromides, and chlorides respectively.

Etiology of Asiatic Cholera.*—The report of Drs. E. Klein and H. Gibbes, together with the transactions of a committee convened to consider it, on which there were, among others, Sir W. Jenner, Sir W. Gull, Sir J. Fayrer, Prof. Burdon-Sanderson, Dr. Aitken, and Dr. Timothy Lewis, has been published by the India Office.

Drs. Klein and Gibbes traverse directly several of Dr. Koch's statements; for example, the German observer stated that the number of comma-shaped organisms in the intestinal tissues and contents is in proportion to the acuteness of the attack, and that these organisms generate within the body a ferment by which the system is poisoned; the delegates of the India Office find, on the other hand, that the number of comma-bacilli in the stools of choleraic patients varies very greatly; they did not find that Peyer's patches or the solitary glands of the ileum were enlarged, while they explain the occasional abundance of the bacilli by the supposition that they here find the most suitable conditions for growth. Fine sections of the mucous membrane stained in various anilin dyes revealed the total absence of comma-bacilli from the mucous membrane itself, from the tissue of the villi, and the adjoining tissues. Blood of choleraic patients obtained according to the usual approved method from patients in various stages of the disease was not in one instance found to contain any kind of bacterium, and similar results were obtained by cultivation experiments.

With regard to Dr. Koch's proposition that comma-bacilli are not found under any conditions other than cholera, it is remarked that this bacillus, or at any rate one that appears to be morphologically identical with it, occurs also in the stools of diarrhœa, and has been met with in cases of dysentery, enteric catarrh, chronic phthisis, and chronic peritonitis. With regard to the causal connection between the comma-shaped organisms in cholera, a belief which Dr. Koch based on the examination of a certain village tank, Drs. Klein and Gibbes write that a sample of the water from the same tank was examined by them, and was found to contain undoubted comma-bacilli; nevertheless, there was no case of cholera among the 200 families that used the tank. "We have in this instance an experiment performed by nature on a scale large enough to serve as an absolute and exact one. The water had been contaminated with choleraic evacuations, and of course with the comma-bacilli, and it was used extensively by many human beings for several weeks." It is clear, then, that this water did not contain the cholera virus, and that the latter has nothing to do with the comma-bacilli.

* Folio, London, 1885, 44 and 30 pp.

The delegates conclude that—

1. Comma-shaped organisms are ordinarily present in the dejections of persons suffering from cholera.

2. They are not to be found in the blood nor in any of the tissues, including the mucosa of the small intestine when the latter is examined in a fresh condition.

3. Comma-shaped organisms of closely allied morphological appearance are ordinarily present in different parts of the alimentary tract in health; are developed to an unusual extent in some of the diseases characterized by hyper-secretion of the intestine; and there are grounds for assuming that when any predominant form is observed it is in great measure attributable to the nature of such secretion.

4. The comma-shaped bacilli ordinarily found in cholera do not induce that disease in the lower animals, and there are no real grounds for assuming that they do so in man; while the circumstance that they have been found in tanks which constituted the ordinary water-supply of adjacent villages unassociated with the presence of the disease, goes to negative any such assumption.

Dr. Lewis states that, where comparable, his own observations were wholly in accord with those of Drs. Klein and Gibbes; he has been able to satisfy himself that the alimentary tract in health may even harbour not one only, but certainly two or three comma-shaped organisms; one of these has been cultivated by Dr. Miller of Berlin, and another, also from the mouth, had been cultivated by Dr. Klein; the latter seems to have the closest possible resemblance, physiological as well as morphological, to the "choleraic commas." He does not doubt but that, sooner or later, means will be devised by which an abundance of the self-same commas would be obtainable from ordinary alvine secretions; in the case of the monkey this has, indeed, been already effected by Dr. Klein, after ligaturing the ileum and injecting sulphate of magnesia. What is really new about this bacillus is its name and some phases of its natural history; if a wet and a dry cover specimen of a pure cultivation be made, the former will be found to have its field covered with minute vibrios in a state of great activity, while that of the dry preparation will be characterized by the presence of comma-shaped organisms. The "comma," as ordinarily understood, is but a segment of this vibrio, detached by the drying process.

In appended memoranda Dr. Aitken remarks that we require a fuller knowledge of microbes—their life-history, their variations under altered surroundings, the biological relations (if any) between pathogenic and septic or infective forms; are the changes brought out by multiplied cultures, biological or chemical, or both? how far are pathogenic forms variable, and is specific functional activity a more or less rapidly acquired variation than morphological modifications? Prof. Burdon-Sanderson remarks that the existence of comma-bacillus in the intestine does not bear on any practical question relating to the prevention of cholera. Dr. N. Chevers disbelieves in sanitary cordons, and in systems of quarantine, as means of defence from cholera invasions. Dr. Marston thinks that any action based

on Koch's view will be futile. Sir W. Smart, who had much experience of cholera during the Crimean war, remains under the impression that some such organism, if not the comma-bacillus, may yet be discovered, and proved by experiment to be the specific cause of cholera in man, but the present evidence is insufficient. Dr. Sutherland insists on the necessity of sanitary improvement, if cholera is to be successfully fought against.

Crookshank's 'Practical Bacteriology.'*—Dr. E. M. Crookshank has produced a most excellent book on Bacteria, which notwithstanding the number of works dealing with the subject, will occupy a distinct place of its own in regard especially to the practical side of bacteriology, to which the bulk of the book is devoted. We know of no book which any one desiring to appreciate the present position of bacteriology could more usefully study, whether he intends to follow up the subject by practical demonstrations of his own or otherwise. The coloured plates, of which there are twenty-seven, add largely to the comprehension of both the methods and their results.† There are also numerous woodcuts.

The book is divided into the following principal heads:—(1) Apparatus, material, and reagents employed in a bacteriological laboratory. (2) Microscopical examination of bacteria in liquids, in cultivations on solid media, and in tissues. (3) Preparation and staining of tissue secretions. (4) Preparation of nutrient media and methods of cultivation. (5) Experiments upon the living animal and examination of animals experimented upon. The preceding forms Part I., while Part II. is systematic and descriptive, with special microscopical methods.

* Crookshank, E. M., 'An Introduction to Practical Bacteriology, based upon the methods of Koch,' xxii. and 249 pp., 42 figs. and 30 pls., 8vo, London, 1886.

† Plates III., IV., and V., *supra*, p. 25, are taken from this book.

MICROSCOPY.

a. Instruments, Accessories, &c.*

Bulloch's Lithological Microscope.—The general construction of this instrument (fig. 5), is similar to the Professional stand of Mr. W. H. Bulloch except in the following details:—

There are two stages, each is graduated to 15′ reading by a vernier to 20″, and can either be revolved by hand or by tangent screw which also acts as a slow motion. The worm cut on the periphery of the stage has 360 teeth (equal to single degrees), and the tangent screw head is graduated to 6°, so that each division reads to 1′. The tangent screw can be thrown in or out of connection as required. Each stage has stops for Maltwood finder, and also stops for the small lithological slides. The above arrangement is common to both stages. One of the stages has a plain sliding object-carrier. The second is also furnished with a sliding object-carrier, and with micrometer screws in two directions "for the direct measurement of objects without any reference to magnification." The screw threads are 0·5 mm., the heads being graduated to 250, so that each division reads to 2 μ and by vernier to tenths equal to 0·2 μ.

At the side of the limb there is a scale reading to 0·5 mm., and the slow motion screw-head is graduated to 500, each division equalling 1 μ. The polarizing prism fitting in the substage has a graduated circle, and a spring catch at each 90°. The analysing prism at the lower end of the body-tube has a revolving movement by a lever of 90° and can be removed to the side by a slide similar to the Wenham binocular prism. At the lower end of the tube is a Klein's quartz-plate, and a centering nose-piece. A goniometer eye-piece is used with crossed spider lines, a Nicol prism, and a calc-spar plate. The fitting is made adjustable, for if the calc-spar is not cut in the proper direction the cross cannot be placed in the centre of the field without slightly tilting the crystal.

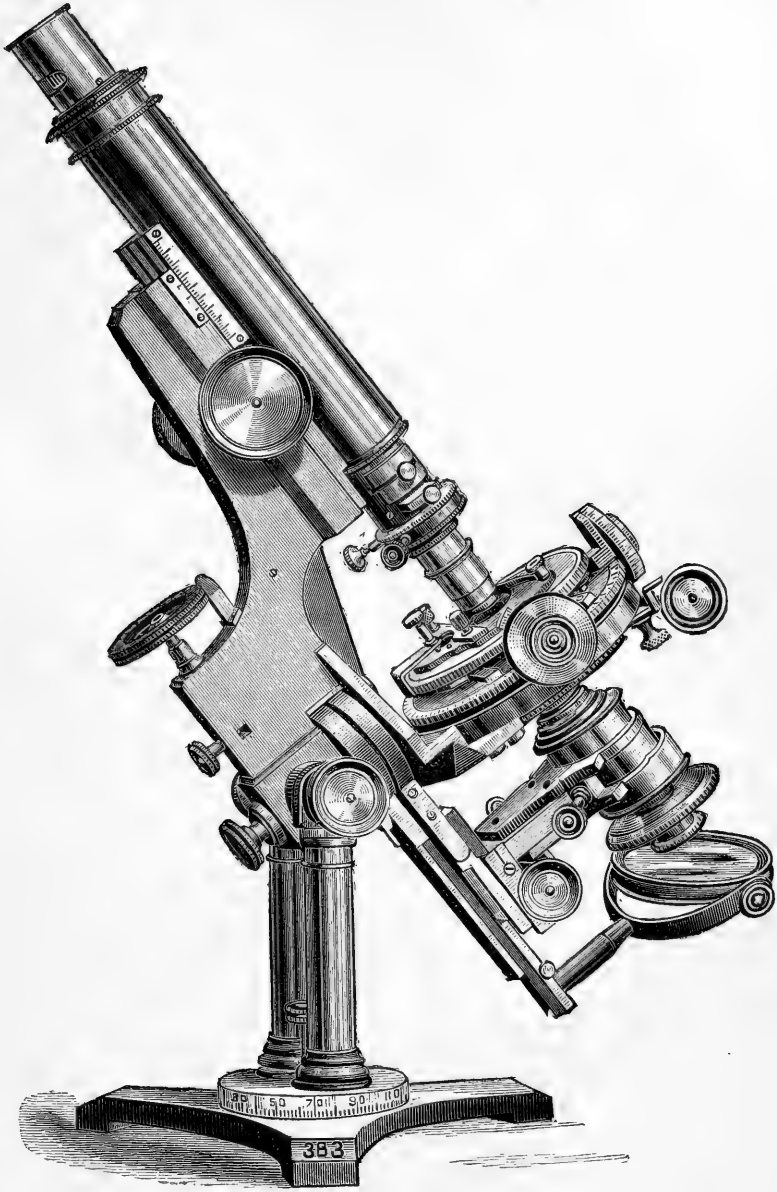
In working; to change from polarized to ordinary illumination, the prism below the stage can be turned aside, leaving the wide angle condenser in position; or the whole substage can be turned aside, a movement which is supplementary to swinging on the axis in the centre with the object on the stage. When the condenser is not required there is a supplementary substage for the lower prism, so that the prism can be used close to the object, and no light admitted, except that which has passed through the prism.

Chevalier's Portable Microscope.—An ingenious method of providing a solid and steady base for a portable Microscope was devised by M. C. Chevalier, and is shown in figs. 6 and 7.

The tripod feet of the instrument fit into three notches in the

* This subdivision is arranged in the following order:—(1) Stands; (2) Eyepieces and Objectives; (3) Illuminating Apparatus; (4) Other Accessories; (5) Photo-micrography; (6) Manipulation; (7) Microscopical Optics, Books, and Miscellaneous matters.

FIG. 5.



BULLOCH'S LITHOLOGICAL MICROSCOPE.

circumference of a heavy brass disc. Over the disc fits a ring (shown separated in the fig.), which when screwed down fixes the feet

Fig. 6.

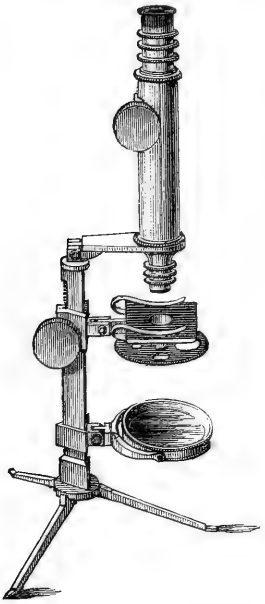
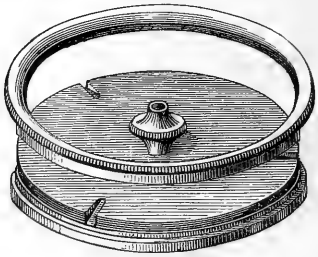


Fig. 7.



of the tripod immovably. In the centre of the disc is a support for the end of the standard to rest on.

The feet fold together, and the mirror and stage can be turned up against the standard, whilst the horizontal arm can be set vertical. When the body-tube is unscrewed, the whole instrument is reduced to very small dimensions. For a coarse adjustment the stage is moved, and for a fine adjustment the draw-tube, in which the eye-piece slides. Both movements are by rack and pinion.

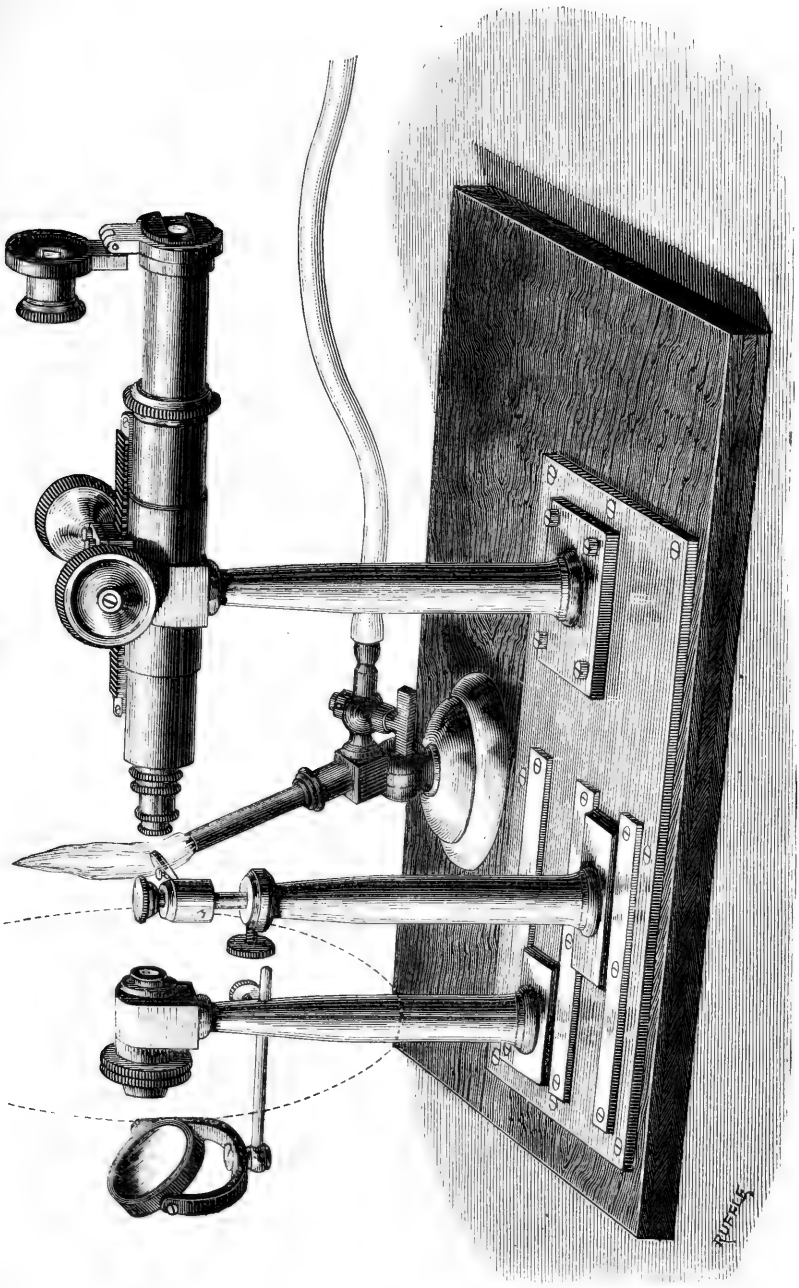
Klein's Horizontal Heating Microscope.* — This (fig. 8) was devised by Prof. C. Klein for the purpose of observing minerals with the Microscope under high temperatures.

The body-tube is mounted horizontally on a brass standard screwed to a metal plate, with which the wooden base is strengthened. Opposite to it is a second standard, which slides in grooves and carries the lower part of the Microscope—mirror, condenser of long focus, and polarizer. In another groove at the side of, and parallel to the former, is a third standard, with an extending rod, which supports a pair of forceps with platinum points to hold the mineral to be examined, which can be placed at any convenient point between the condenser and the low-power objective. An analyser is attached by a hinge-joint to the front of the eye-piece, so that it can be turned up out of the way when not required, as shown in the fig. A selenite plate can be interposed between the analyser and the eye-piece. A screen (shown by dotted lines) can be placed on the lower tube to shut off extraneous light.

Heat is applied to the object by a Bunsen burner, which is movable on a hinge, so that the flame can be quickly applied to a given point and as quickly removed again.

* Nachr. K. Gesell. Wiss. Göttingen, 1884, pp. 133–5.

Fig. 8.

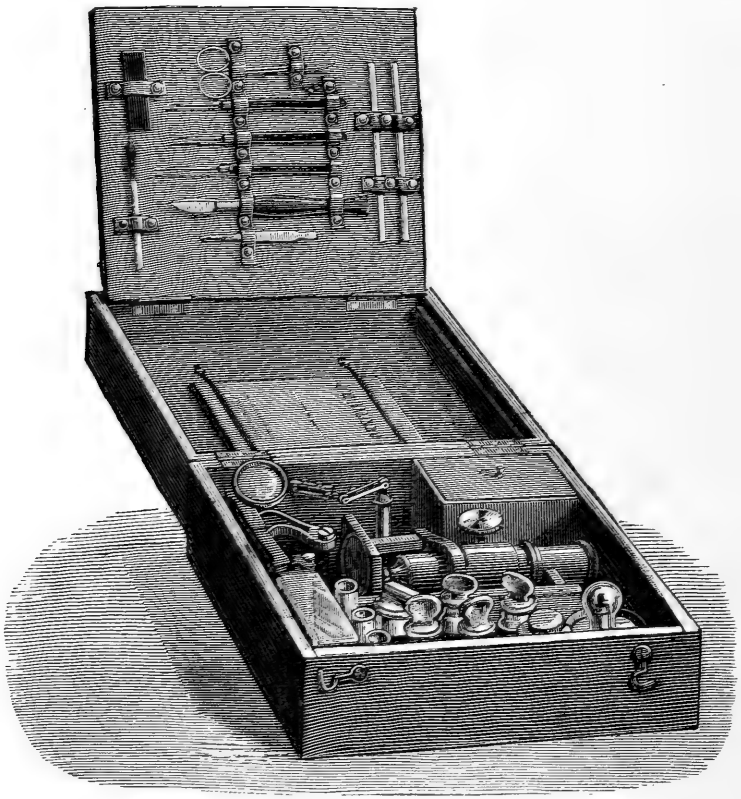


KLEIN'S HORIZONTAL HEATING MICROSCOPE.

Prof. Klein thus describes his observations on some crystals of leucite which will illustrate the application of the Microscope:—Sections parallel to the faces of the cube, octahedron, dodecahedron, and icositetrahedron (regarding the crystals as cubic for the sake of simplicity), all behaved in the same way when heated. Darkness spread over them, the characteristic twin lamellæ disappeared, and the sections remained dark between crossed Nicols until the flame was withdrawn, when they transmitted light as before (beginning with the coolest side), and the lamellæ returned. The same section could be repeatedly heated with the same results. It follows from these experiments that leucite becomes isotropic when heated, and Prof. Klein draws the conclusion that it originally crystallized at a high temperature as a cubic mineral, and became rhombic (as he shows elsewhere) on cooling.

French Dissecting Microscope.—This instrument (fig. 9), though called a "dissecting" Microscope, is in the ordinary form of a small student's compound Microscope. Its special feature is not so much the stand itself as the case in which it is packed, which has a

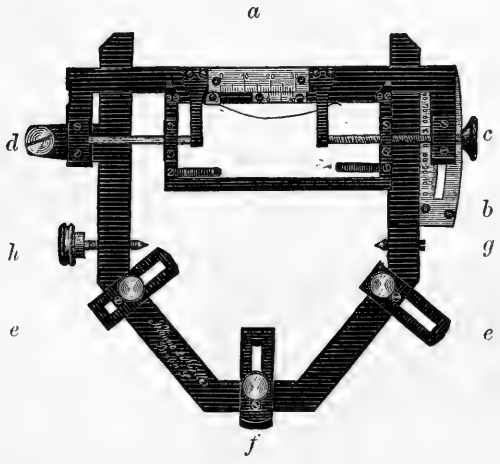
FIG. 9.



very convenient arrangement of mounting apparatus, including trays, reagents, and instruments. The knives, scissors, &c., are, as will be seen, arranged on a hinged cover to the inside of the lid, which is of extra depth.

Klönne and Müller's Pendulum Object-frame or Bacteria-finder.—Messrs. Klönne and Müller have devised this apparatus (figs. 10 and 11) for readily finding small objects. It may be fitted to any Microscope, and can be traversed over the whole of an object

FIG. 10.



by means of two graduated motions, so that the position of any point may be marked and recovered without difficulty. The frame (fig. 10) which holds the slide, is moved backwards and forwards by a swinging motion about the fixed point *d*, and from side to side by the traversing screw *c*. These motions are measured by the graduations on the circular slot at *b*, and by the millimetre scale and vernier at *a*.

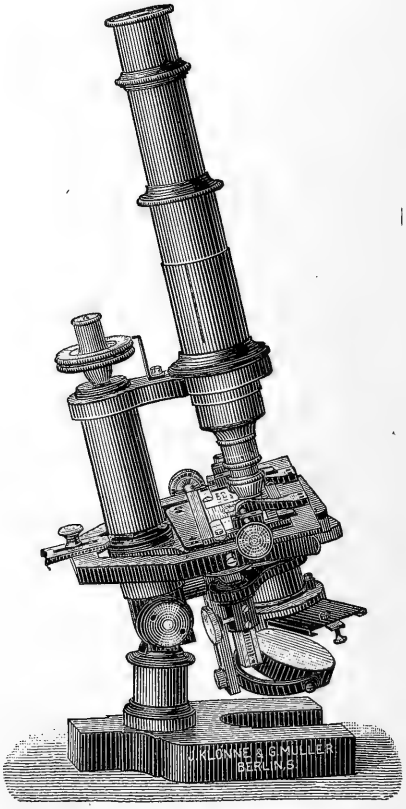
To fit the frame to the Microscope, the piece *a* is swung out of the slot *b* and brought round to the left of *d*; the framework *h f g* is pushed forward over the stage from behind until the rests *e e* lie upon the stage, and *f* upon a projection at the back of the pillar. The screw *g* presses against one side of the stage, and *h* is screwed up to the other. *f* and *g* are adjusted by the makers so that the line *d c* (*c* being near the centre of the slot) passes through the centre of the stage. The object is then inserted into the frame *a* from below; it is held in position by the spring shown at the upper side, and is pressed against the stage by the two springs below when the frame has been swung back into the position shown in the figure.

The object having been placed by means of *c* so that its edge is at one side of the field of view, is searched from top to bottom by the motion about *d*; it is then shifted by means of *c* through a distance equal to the width of the field and a second vertical strip of this width is traversed by the pendulum motion; the process is repeated

until the whole object has been searched. The exact position of any point may then be noted by the readings of *b* and *a*. If the frame is transferred from one Microscope to another, the exact points at which the screws *g* and *h* indent the sides of the stage, and the exact extent to which *g* is screwed into its bearings must be noted. To facilitate the latter adjustment, a small slit is cut across the threads of *g*.

Professor Arendt, of Leipzig, writes to express his satisfaction with the apparatus, which works extremely well in practice. The

FIG. 11.



slide can be inserted into the frame quite as easily as under the ordinary springs, and marked points in an object are rapidly recovered. He says, "For example, I have to-day searched a Bacteria-slide which I had prepared, and found in it thirty-seven points of particular interest. This was the work of about an hour. To find *all* these points again occupied me only *four minutes*, and the adjustment is so accurate that they were in every case brought back into the centre of the field."

Fig. 11 shows the apparatus in place on the Microscope.

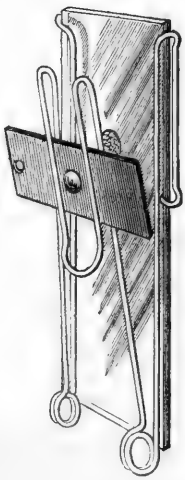
Microscopes at the Antwerp Exhibition.*—Dr. H. van Heurck reports upon the Microscopes exhibited at the recent Universal Exhibition at Antwerp. "The Microscope," he says, "is generally very imperfectly represented in universal exhibitions, and the Antwerp exhibition was no exception, only six firms being represented, Hartnack, Nachet, Prazmowski (Bezu, Hausser and Co.), Reichert, Ross, and Zeiss.

Of Hartnack's instruments Dr. van Heurck describes Bacterial, Mineralogical, and Photographic Microscopes, also his Cupro-ammonia Cell (*post*). M. Nachet's instruments are the Large Model, Petrographical, Chemical, Travelling, Demonstration, Dissecting, and Double body Microscopes. Also his "Loupe-chambre-claire" (*post*). Of Bézu's, the Mineralogical, and Large and Second Hartnack Models. In each case the objectives exhibited are also reported on, and the special fluid for homogeneous immersion used by Dr. Hartnack described (*infra*, p. 133).

Hippisley's Lens- and Slide-Holder.—Fig. 12 shows the ingeniously simple mounting adopted by Mr. J. Hippisley for the lenses made of globules of glass described Vol. V. p. 890.

The lenses are secured between two pieces of thin brass, one of which has its two ends turned up over those of the other, and hammered down. The lens thus mounted is slipped into a holder of brass wire in the manner shown in the figure, the slide being similarly held by another part of the holder. The focusing adjustment is made by pressing together the two parts of the holder which are normally kept apart by the "spring" of the wire caused by the turns which are made in it at the bottom. Mr. Hippisley describes its use thus:—

FIG. 12.



"It is intended to be held horizontally, when the focal adjustment will be found to be well under command of the thumb and finger of one hand. The spring of the wire allows ample traverse of the lens over the field; and by judicious application of the other thumb and finger the slide may be shifted longitudinally, so that any part of the field can be examined without removing the instrument from the eye. The other hand makes a convenient screen for the eye not in use.

This is only one of many variations of contrivances for utilizing these lenses. 'Thumb-screws' are an abomination for slowness of action and other inconveniences. A wedge I have found much more useful for fine adjustment, as its operation is equally fine, and it may be *suddenly* thrust in or withdrawn for the beginning (or coarse part) of the adjustment. But I do not think, unless it is wanted to

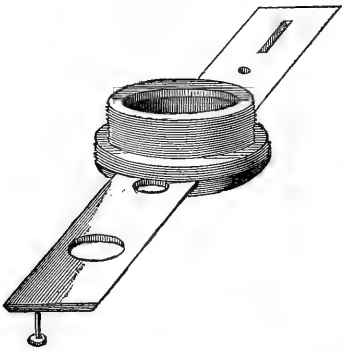
* Journ. de Microgr., ix. (1885) pp. 364–75 (6 figs.).

transfer the instrument *with focus adjustment* to the hands of some one unused to a lens, that even that provision is necessary practically, for anything not exceeding 150 or 200 diameters."

Mr. Hippisley also says that he makes "Coddington" lenses by melting pear-shaped pieces of glass until the ends in advancing towards a spherical form have approached to the right distance, which is ascertained by repeated trials. As the two ends cannot, except by chance, be exactly of the same curvature, one end has to be selected and marked, as that to which the eye is to be applied.

Griffith's Substage Diaphragm.—Mr. E. H. Griffith's substage diaphragm is intended as a substitute for the cheaper kind. The principal claims for it are that it will do the work well that is required of much more expensive ones, and as it is placed in the centre of the substage fitting, and so constructed that it may be turned in any direction, many effects may be secured by simply moving the slide. Being central it is not so much in the way as some other forms.

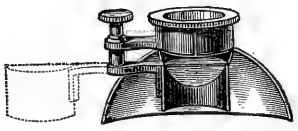
Fig. 13.



It is simply a perforated metal button fitting the Society screw of the substage. Through the head is a groove, cut with a milling-machine, which is provided with a diaphragm slide which has different sized and shaped apertures which can be placed exactly central by means of stops, or out of centre if desired. The slit can be made to be perpendicular, diagonal, or longitudinal to the slide, as desired, by turning the button.

Sorby's Direct Illuminator.—In some recent discussions on the microscopical structure of metals, Dr. H. C. Sorby has recalled attention to the illuminator devised by him many years ago for the examination of minerals. It consists (fig. 14) of the "Parabolic Reflector," in the centre of which, in a semi-cylindrical tube, open in front, is placed a small plane reflector which covers half of the objective, and throws the light directly down upon the object, and back through the other half. This allows of two kinds of illumination, oblique and direct, to be readily used, as the plane reflector is attached to an arm so that it can be swung out of the way when not required, as shown by the dotted lines in the fig.

Fig. 14.



Dr. Sorby writes:—"I may say that for the study of polished and etched sections of iron and steel, it is almost indispensable. In

examining other objects, especially if they have glass covers, the direct illumination of course causes much reflection from the glass, and makes the object look milky. The reflection from iron and steel, however, entirely overpowers this light from the cover, so that it does not interfere with the use of the illuminator." (See also *infra*, p. 175, for Dr. Sorby's paper on the preparation and illumination of iron and steel for microscopical examination.)

Equalizing the Thickness of Slips with Oil-Immersion Condensers.*—It is necessary that an oil-immersion condenser should have a fairly long focus; otherwise it would be of no use if the slip happened to be rather thick. If the slide is thin, it will be found impossible to keep the oil contact when the condenser is in focus, unless you increase the thickness of the slide, by uniting a thick cover-glass to the back by oil. It will be found very difficult to do this without oiling the stage when the Microscope is inclined. The oil between the condenser and the cover-glass is sure to unite with that between the cover-glass and slide, and then the cover-glass falls, upsetting the whole arrangement. To obviate this Mr. E. M. Nelson has found the following plan to answer admirably. A piece of glass 1 in. square, upon one side of which, close to one edge, a strip 1/8 in. broad is fastened by shellac, is oiled to the back of the slide; the ledge hooking over the edge of the slide prevents it slipping down.

FIG. 15.

FIG. 16.

Coxeter's Silico-Carbon Battery and Electric Lamp. — Messrs. Coxeter and Nehmer exhibited at the January meeting the battery and illuminator, figs. 17 and 18.

The battery has in each of the four cells two large silico-carbons, with platinum clamp connections, and one zinc rod with screw terminal. It is charged with chloride of ammonium. No chemical action takes place except when it is actually in use; and once charged it needs no further attention, but is always ready when required. There is a shunt on the lid to connect the cells consecutively, and thus illuminate the object with the varied requirements of high and low power. The current passes through a rheostat before it reaches the incandescence lamp, to prevent its being spoiled; the electrical resistance should be afterwards lessened or taken out of the circuit by moving the sliding button A, and thus the battery is economized. The lamp-holder is jointed, and can be moved into any position, either above or below the stage, or to any part of it, and the position of the light is not altered by any movement of the Microscope. The light can be turned on and off at the lamp when desired. It is

* Engl. Mech., xlii. (1885) p. 280 (3 figs.).

claimed that the lamp "is the only one with practically no heat; it gives a delightfully soft and steady light, capable of great variation

FIG. 17.

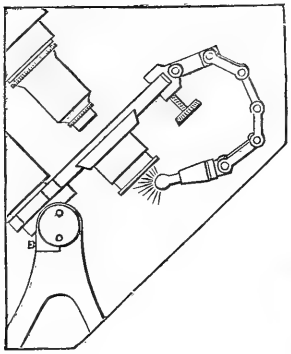
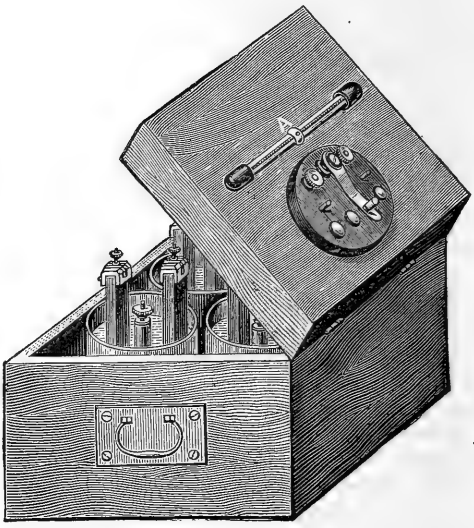


FIG. 18.



in intensity, and far less tiring to the eyes than ordinary reflected light."

The lamp can also be carried on a swinging tail-piece, after the plan introduced by Mr. E. Bausch.*

Bulloch's Cobweb Micrometer.†—A form of cobweb micrometer has been introduced by Mr. W. H. Bulloch, in which in addition to the movement of one set of lines with the micrometer screw, another screw, worked with a milled head on the other side of the instrument, moves both sets of lines together, so that it is possible to set the graduated screw-head at zero for any particular measurement. This is a very convenient as well as useful feature.

Jung's Nose-piece Adapter.—Herr R. Jung has further improved the Nachet-Thury form of adapter.‡

Fig. 19 is the adapter, and fig. 20 the ring which is screwed to each objective. The adapter consists of a fixed inner cylinder which screws into the body-tube, and a movable outer cylinder which is kept pressed up towards the lower end of the body-tube by a strong spiral spring. The bottom of the outer cylinder ends in a shoulder which is cut away for about a third of its circumference, so as to allow a ring and its objective to be slipped in when the cylinders

* Appleton's Annual Cyclopedia for 1884 (1885) p. 515 (1 fig.).
† Amer. Mon. Micr. Journ., vi. (1885) pp. 239–40.
‡ See this Journal, i. (1881) p. 661.

are separated. The spring, by drawing the outer cylinder back again, keeps the objective firmly in place. So far, the arrangement is similar to the Nachet-Thury form.

To draw down the outer cylinder against the strong spring, in order to release the objective, requires some force, and if it is allowed to slip, the fingers are apt to be nipped, apart from the injury to the fine adjustment, while if the spring is weak and so easily extended, the objective is only loosely held. To avoid these difficulties the upper margin of the outer cylinder has two notches cut in it, one of which is shown in fig. 19 (the other being opposite to it), whilst the inner cylinder has two pins with projecting heads. When a notch is opposite a pin, the outer cylinder is close home, but on rotating it, so that the pins do not fall in the notches, as shown in the fig., the outer cylinder is forced down.

Fig. 19.

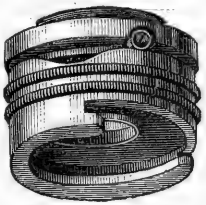
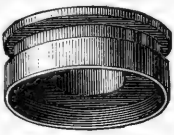


Fig. 20.



In order to release the objective, therefore, no force is required; all that is necessary being a slight rotation of the outer cylinder, so as to take the pins out of the notches. To ease the rotation, the pins have each a loose collar, which revolves as the outer cylinder is turned.

Hartnack's Fluid for Homogeneous Immersion.*—Dr. E. Hartnack supplies, in place of cedar-oil, vaseline oils—the white oil for axial illumination and the yellow oil for the oblique.

Rotary Object-carrier.†—Mr. J. M. Flint describes a device for exhibiting a series of mounted objects, without a change of slides. As described it is arranged for Foraminifera, viewed as opaque objects, with a low power. They are mounted on small brass discs furnished with a stem, by means of which they may be carried in a "Beck's disc-holder" when it is desired to make a thorough study of the specimens. Ordinarily these discs are inserted in thin wooden slides of regulation size and kept in boxes, until the series is complete. In order to protect the specimens from dust or injury, and at the same time maintain their accessibility, movable covers are constructed as follows:—A score or more of curtain rings, not flattened, are slipped upon a squared rod of wood, and brushed over freely with thick shellac. On the following day, before the shellac has become hard, the rings are slightly separated in pairs. When the pairs are firmly united, a thin glass cover is secured to the upper surface of each pair, and thus a little box cover is formed, deep enough to inclose disc and specimen. Now, by driving two small gimp-tacks into the wooden slide, at the proper distance apart, and deep enough so that the heads of the tacks will just enter the groove between the

* Journ. de Microgr., ix. (1885) p. 367.
† Amer. Mon. Micr. Journ., vi. (1885) pp. 204-5.

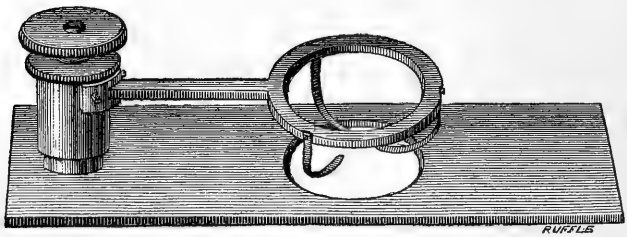
rings, a simple catch is formed, by means of which the cover may be secured, and also be removable at pleasure.

For exhibition, these discs are transferred to a thin circular plate 6 in. in diameter, made of three or four sheets of cardboard glued one upon the other. This makes a firm plate, not liable to warp, and in which holes may be readily bored for the insertion of the discs, and the tacks driven to secure the covers. By inserting the discs as near the edge of the plate as possible, a line 15 or more in. in length is obtained on which to display the objects. The circular plate bearing the specimens as above is made to rotate upon a pivot passing through its centre in such a way that the objects are brought successively into the field.

The manner of support of this pivot and its attachment to the stage must depend upon the instrument used, which, however, should have a stage with mechanical movements, and the attachment be made to the upper stage-plate, thus giving control of each object when brought into the field in the same manner as if it were mounted upon the ordinary slide. The author constructed a pivot support out of a piece of thin board (cigar-box), 2 in. wide and 3 in. long, the pivot being a common wood-screw inserted near one end, and carrying a wooden nut to steady the revolving plate, and the attachment to the stage-plate being effected by means of four small screws driven nearly home on the under side of the thin strip bearing the pivot, the heads of the screws being so arranged that they slide into grooves on the stage-plate, which ordinarily carry one of the clamps for securing the object slip. Shallow notches on the edge of the revolving plate, into which drops the curved end of a light spring, serve to inform the observer when the object is in the proper position. Transparent objects might be mounted on small squares of glass, made transferable from wooden or glass slips to the revolving plate as above, the necessary holes being made in the plate to allow the passage of light from below.

Kunckel d'Herculais' Compressor.—This (fig. 21), the design of M. Kunckel d'Herculais, is intended for the "gradual compression

Fig. 21.



of living organisms, and it has the advantage of allowing paraffin to be used for sealing the preparation." The apparatus has a micrometer screw to insure gradual compression.

Not being clear as to the mode in which the designer intended his apparatus to be used, we applied to him on the subject, but without receiving any reply. Mr. G. C. Karop has, however, kindly furnished us with the following note:—

"I do not think the use of this compressor necessarily refers to a *temporary* closure only. You have a specimen which cannot be satisfactorily examined except under pressure; the effect of pressure you may wish to keep and exhibit. A specimen is placed on a slip with, say, a drop of glycerin or other preservative; a cover-glass is placed on this, and the whole is transferred to the compressor-plate, the three curved springs being in position on the cover. The whole is then put on the stage of the Microscope, and the construction allows of the objective working down through the ring, whilst sufficient pressure is obtained by the micrometer screw to show the desired points. This being done, the apparatus is removed from the stage, any surplus glycerin, &c., wiped off, and the preparation sealed by paraffin with a hot wire, according to the well-known method. When dry it is put on a turntable and permanently sealed by a ring of Paris glue or white cement, &c."

Martius' Method of Determining the Absolute Rate of Ciliary Vibration by the Stroboscope.*—By the stroboscope, as is well known, a vibrating body is instantaneously illuminated or is viewed at successive intervals through a revolving or vibrating aperture.

A familiar instance of this is the "wheel of life" toy sold in the streets a few years ago. The wheels of a carriage, or a moving animal, seen by the light of a flash of lightning, appear perfectly stationary, the duration of the light being so brief as to admit of only an inappreciable movement of the body while illumination lasts. If a regular succession of light flashes is produced, the moving body will be seen in as many different positions as there are flashes of light. If a body rotating rapidly on a fixed axis be viewed by light flashes occurring once during each revolution of the body, only one image will be observed, and this will result from a succession of impressions upon the retina, which by the persistence of vision become blended into one continuous image. In this case no movement of the body will be apparent; but if the flashes of light succeed each other ever so little slower than the rotatory period of the revolving body, the body will appear to move slowly forward, while in reality it is moving rapidly; and should the light flashes succeed each other more rapidly than the revolutions of the revolving body, the body will appear to move slowly backward, or in a direction opposite to that in which it is really turning. These curious effects are also produced when the number of the light flashes is a multiple of the number of revolutions, or *vice versâ*.†

* Arch. f. Anat. u. Physiol. (Physiol. Abtheil.) 1884, pp. 456-60.

† The preceding paragraph is interpolated from an article by Mr. G. M. Hopkins ('Scientific American') in which he describes the method he used for applying intermittent light to a microscopical examination of ciliated organisms by an electrically rotated aperture disc, arranged to interrupt the beam of light employed in illuminating the object to be examined.

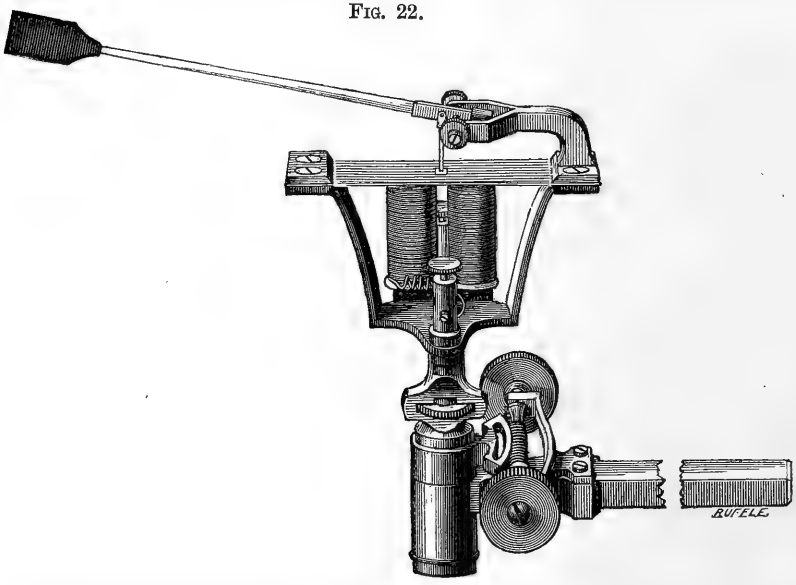
The instrument consists of a single electric motor mounted on a plate having

In the same way if a vibrating rod is viewed through a hole in a revolving disc, and the rate of revolution is varied until the period coincides with that of the rod, the latter will always be seen in the same phase and will appear stationary.

The method may be applied to the analysis of many kinds of periodic vibration, and to the examination of objects in motion. Dr. A. van Beek used a revolving screen perforated with holes, by means of which the object under the Microscope is periodically illuminated, to estimate the rate of ciliary vibration in the cells of a frog's tongue.

With such an apparatus it is not found possible to vary the rate and constancy of the revolutions with sufficient delicacy, and Herr Martius has consequently applied the electro-magnetic stroboscope, as used by Kronecker, to the same purpose. A strip of paper (fig. 22) is made to vibrate between the source of light and the

Fig. 22.



diaphragm of the Microscope so that at each vibration the object is illuminated by a flash of light. A great advantage is gained by using a plain strip in place of a perforated screen; for if the instrument is so arranged that the strip while moving in one direction

---

a collar fitted to the substage. The shaft, which carries a simple bar armature, also carries upon its upper extremity a disc having two or four apertures, which coincide with the apertures of the stage and substage two or four times during the revolutions of the disc. The course of the current from the battery through the instrument is through the spring touching the commutator, through the shaft and frame of the instrument to the magnet. The speed of rotation can be varied, experiment showing that the period of darkness should be to the period of illumination about as three to one for the best effects.

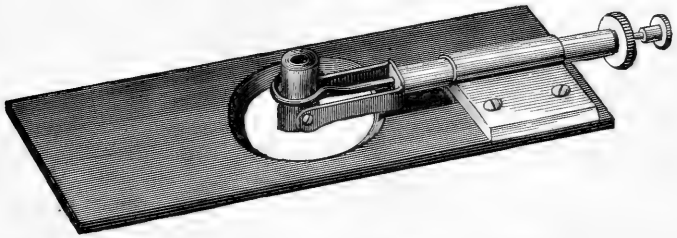
completely obscures the light, and only admits the flash when it retreats far enough in the other direction to uncover the side of the diaphragm, then a slight shifting of the whole stroboscope will lengthen the duration of the flashes without affecting their rate; while the rate can be varied by adjusting Bernstein's acoustic contact-breaker, which regulates the vibrations. Moreover, by this method the object can only be illuminated once in each complete oscillation of the strip, while with a vibrating slit it may be illuminated either once or twice. A frog's palate examined with this apparatus was found to have a period of ciliary movement varying from ten to fourteen (mostly from eleven to twelve) vibrations in a second.

A second indirect means of measurement may be used as a check upon the direct determination of the period from the phenomenon already mentioned. When the rate of the stroboscope is equal to that of the cilia, they appear as nearly as possible stationary; as the rate is increased waves of motion will be seen to run along them until a point is reached at which they appear to be in uniform motion. It will be found that at this point the rate of the instrument is exactly double that of the cilia.

Various rotifers examined by intermittent light showed the cilia perfectly stationary. The ciliary filaments of some of the Infusoria (*Vorticella* and *Stentor*), when viewed by intermittent light, not only appeared to stand still, but their length seemed much greater than with continuous light. The interrupted light brings out not only the cilia around the oral aperture, but shows to good advantage the cilia disposed along the margin of the body.*

Accessories for Microscopical Drawing.†—G. S. S. writes that it often happens to him, when wishing to draw a mounted object, that it is not placed exactly in the position in which it is wished to draw it, and to so place it, the slide requires raising at one end or side. For this purpose he devised a very simple piece of apparatus.

FIG. 23.



A piece of thin wood a little longer than an ordinary slide is cut, and a hole 3/4 in. square made in the middle. About 1/2 in. from either end, and on the lower side, cut a narrower transverse groove, and slip an india-rubber band over each end until it reaches the groove. The slide to be examined is placed on the wooden one

* Loc. cit. † Sci.-Gossip, 1886, p. 8 (2 figs.).

under the elastic rings, and then, by inserting a wedge between the wooden and other slide the object can be placed as desired.

Another very simple contrivance for placing an unmounted object in any desired position is shown in fig. 23. By turning the milled head the object can be moved in a direction transverse to the apparatus, and by moving the other in or out, the object can be moved in a longitudinal direction. The hole in the vertical tube can be fitted with a cork to hold pins; a small pair of forceps or a piece of wax can be used to hold a geological specimen.

Dunning's Zoophyte-Cell. — All who work with the ordinary zoophyte troughs know the difficulty there is in cleaning them, also the risk of breakage in doing so, more especially with the very shallow troughs. Mr. C. G. Dunning has designed the apparatus shown in figs. 24–26 to overcome this difficulty.

Fig. 24.

Fig. 25.

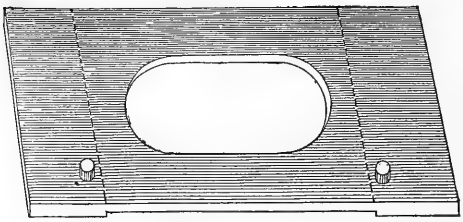
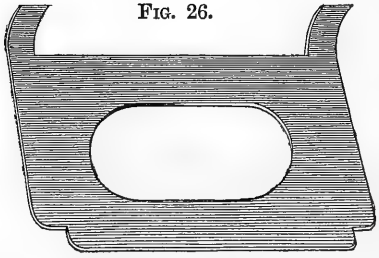


Fig. 26.



The lower plate (fig. 25) is of metal, 3 in. long, 1½ in. wide, and about 1/10 in. thick, with an oval perforation, the under side being sunk out as shown in the section (fig. 24). In this sinking is fixed, by means of Canada balsam, a piece of stout cover-glass, which forms the bottom of the cell, the sinking being sufficiently deep to prevent the thin glass from actually bearing on the stage when in use, or on a table, or when laid down. The cover (fig. 26) consists of a thinner plate of metal rather shorter than the lower plate, and having a corresponding aperture. To the under side of this plate is also fixed a piece of cover-glass.

To use the apparatus it is only necessary to lay it flat and well fill the cell with water, arranging the object if necessary; then put the cover on from the bottom edge by placing the notches over the two pins which are inserted in the bottom plate, and gradually lowering it, the superfluous water will then be got rid of, and the whole should be wiped. The capillary attraction assisted by the weight of the cover is sufficient to prevent any leakage, while the pins prevent it from sliding down when inclined. Although, of course, there is no supply of air, *Vorticellæ*, zoophytes, &c., can be kept under exhibition for more than two hours without change of water,

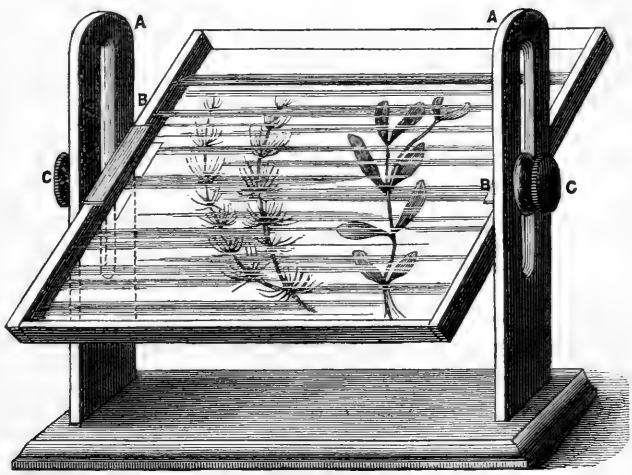
but should that be found necessary it is easily done by lifting the cover carefully by means of the projecting horns on the top edge and adding fresh water with a dipping tube. The apparatus is intended more particularly for use as a shallow cell, so that moderately high powers can be applied, yet the depth can readily be increased by means of an intermediate plate the same size as the cover and with a corresponding aperture; this plate may either be of metal or ebonite, and with this inserted between the lower plate and the cover the cell is as free from leakage as before.

The area of the cell is purposely rather large, as being more convenient for zoophytes, &c., but should it be desired to restrict the movements of a lively object, it is only necessary to select a glass ring rather thinner than the depth of the cell, place it in the middle, fill the whole cell with water and place the object within the ring and cover as before.

Hardy's Examining Tank for Pond-Life, &c.—Mr. J. D. Hardy exhibited at the last Conversazione a very convenient tank for showing aquatic organisms.

A A (fig. 27) are two uprights, each having a slot in which the

FIG. 27.



holders B B can be raised or lowered. The screw nuts C C keep the holders in place, at the same time allowing the tank to be inclined at any angle. The holders are not fastened to the tank, but clamp it so as to leave it free to be moved through them, for the purpose of bringing the tank more forward for examination with the Microscope or otherwise. A piece of cork cut to fit loosely and float on the water stops the water running out when the tank is tilted.

The stand is weighted with lead at the bottom, and the tank,

which is 6 in. square, is made of the best thin white glass in the same manner as Mr. Hardy's "flat bottle."

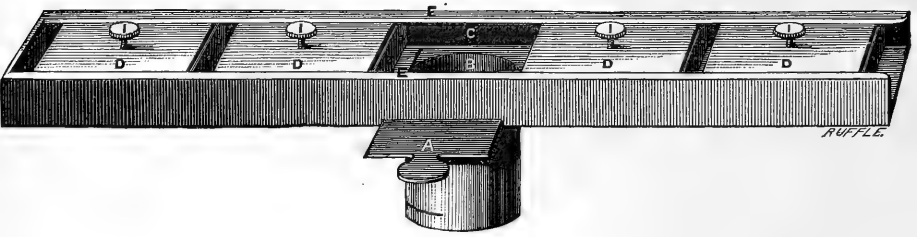
In using the Microscope, the mirror and carrier are unscrewed and placed on the opposite side of the tank from the Microscope, the light being reflected in a line with the body-tube. The objective was also screwed in the substage by an adapter and focused by the substage pinion.

Bostwick's Absorption Cell.*—Mr. A. E. Bostwick has devised a cell for obtaining the absorption spectra of liquids which have but little selective absorption, and which would therefore have to be used ordinarily in large quantities.

The cell is a rectangular box, 6 in. by 3 in. by 3 in. The bottom and the two ends are of wood, covered with shellac, and the two sides of looking-glass, cemented to the wood, so that the box is water-tight. The reflecting surface of the glass is turned inward, and at each of two diagonally opposite corners the amalgam is scraped away so as to make a vertical slit about 2 mm. in width. One of these is placed close to the spectroscope slit, and through the other a parallel beam of light is admitted. It is evident that the box may be so placed that the beam will be internally reflected in it a number of times, depending upon the angle between the two, and will finally pass through the second slit into the spectroscope. The length of its path through the cell may therefore be varied indefinitely by turning the latter, and is limited only by the decrease in intensity caused by general absorption —not only in the liquid, but also at each reflection. With mirrors of polished metal the result might be even better, since the absorption in the glass would be eliminated. In this case, however, the number of liquids which could be used in the cell would be somewhat limited.

Vérick's, Benecke's, and Moitessier's Photo-micrographic Cameras.—The first of these cameras by MM. Vérick (fig. 28) allows

Fig. 28.



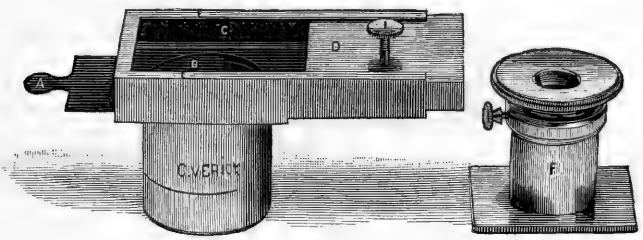
of four negatives being taken successively. It consists of a tube fitting over the body-tube after the eye-piece is removed, carrying a box C, with a central opening B, closed by a movable shutter A.

* Amer. Journ. Sci., xxx. (1885) p. 452.

In the box slide four carriers D, for the sensitive plates, and these can be placed in position over the central opening one after another and a negative taken.* The special advantage of the apparatus is that it enables different degrees of exposure to be tested, or different portions of an object to be rapidly photographed in succession.

A simpler form of camera is shown in fig. 29, on the same principle as the preceding, but for one plate only.

Fig. 29.



For focusing it is necessary first to regulate the focusing lens F, which is a single lens in an adjustable screw mounting. For this purpose a square of glass is placed in the box C, on the lower face of which some scales have been fastened. The lens is then placed so that the base-plate is applied exactly to the upper edge E of the box C. It is then focused on the scales by screwing the lens in or out, and is then clamped by the set-screw. The lens, when thus regulated, will of course only serve for the particular person to whose sight it has been adjusted.

The sensitive plate is placed in the carrier D, and its contact with the guides on the bottom of the box assured by turning the screw I gently. The image of the object is then focused by the adjustments of the Microscope, again applying the lens F upon E and using it as an eye-piece.

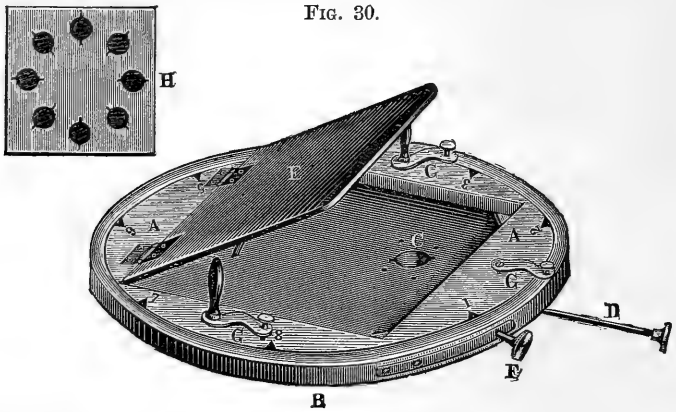
Dr. B. Benecke † devised the camera, fig. 30, for taking eight photo-micrographs. In a circular camera B, rotates a disc A having a square aperture 12 cm. wide in the centre. The bottom of the camera has an opening at C, 2 cm. in diameter, communicating with a tube which fits into the body-tube of the Microscope; it can be closed by a slider, the handle at which is at D. A plate H, for eight photographs, fits into the aperture in the disc, and can be rotated over C, a spring clip F indicating the eight equidistant positions. The shutter E of the camera is secured by the three catches G, and on the under side it has a spring which presses on the back of the plate. In order to mark the corresponding positions of the different photo-

* The drawing has been reduced in width. The box of the original apparatus is about a fifth wider so as to leave more space for the carriers.

† 'Die Photographie als Hülfsmittel Mikroskopischer Forschung,' 1868, pp. 54–6 (1 fig.).

graphs on paper copies or glass positives (which is important in the case of stereographs), the opening at C has two cuts in its margin

Fig. 30.



which show on the plate as two small black lines (see H) and so enable the image to be easily oriented.

Dr. A. Moitessier's camera,* B, fig. 31, is intended for taking six

Fig. 31.

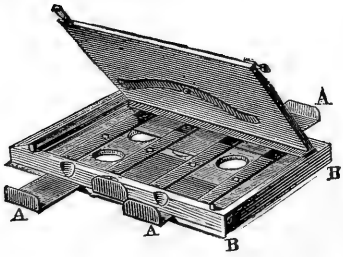
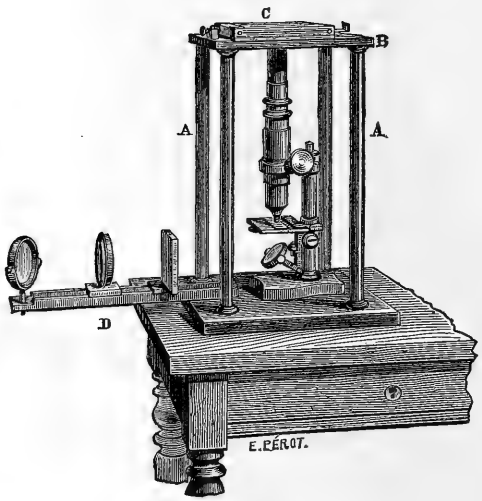


Fig. 32.



micro-photographs, each aperture having a sliding shutter A. Being too heavy to be supported on the Microscope, a special support for it is necessary, fig. 32. The camera C is placed on the wooden plate B,

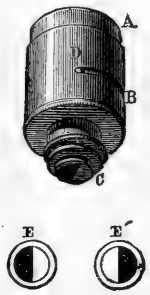
* 'La Photographie appliquée aux recherches micrographiques,' 1866, p. 121.

which is supported over the Microscope by the pillars, A. A tube inserted in an opening in B forms the connection with the Microscope, and the camera can be brought by a sliding arrangement into six different positions, corresponding with the photographic plate. D is the illuminating apparatus, consisting of mirror, condensing lens, and movable screen to shut off the light as required.

Apparatus for taking Stereoscopic Photo-Micrographs.—Stereoscopic photo-micrographs could of course be obtained by applying a camera to each end of the tubes of a binocular Microscope, and taking two photographs simultaneously, or as suggested by Babo, by slightly raising either end of the slide alternately, or again by taking a second photograph with the objective focused to a lower plane of the object than that to which it was focused when the first was taken. A combination of these two methods is said by Dr. S. T. Stein * to give excellent effects.

Dr. A. Moitessier suggested † the apparatus, fig. 33. The fixed tube A, attached to the body-tube, has a second external tube B, which rotates upon it, a pin working in a semicircular slot D stopping the rotation beyond 180°. At the end of B is attached a half-diaphragm C, and the objective is screwed over the diaphragm. On rotating the tube in opposite directions, the diaphragm takes the positions E and E′, so that opposite halves of the objective are alternately made use of and different images obtained. Photo-micrographs thus taken will give stereoscopic or pseudoscopic effect, according as they are mounted, The apparatus will only act effectively with low powers and opaque, not transparent, objects.

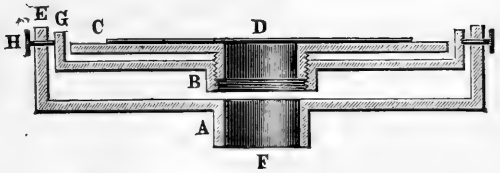
Fig. 33.



In order to alter readily the inclination of the object to the axis of the Microscope, Dr. B. Benecke ‡ devised the apparatus shown in figs. 34 and 35.

A circular plate A, fig. 34, with a central opening, is fixed by the

Fig. 34.



tube F in the aperture of the stage. The vertical pieces E support a similar plate B G, which swings on a horizontal axis passing through

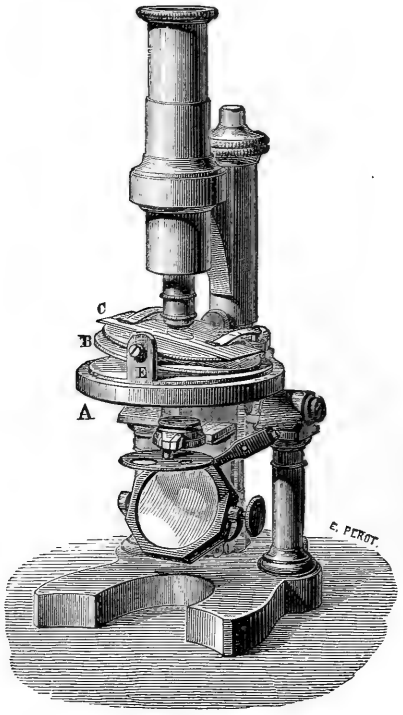
* 'Das Licht im Dienste Wiss. Forschung,' 1884, p. 197.

† 'La Photographie appliquée aux recherches micrographiques,' 1866, p. 148.

‡ 'Die Photographie als Hülfsmittel Mikroskopischer Forschung,' 1868, p. 81 (2 figs.).

H. A third disc C is supported by B and moves with it. It carries the slide D. A photograph having been taken, with the object inclined in one direction, the carrier is tilted in the opposite direction, and a second one taken. As it is indispensable that the object should be exactly in the plane of the axis of rotation, the disc C is connected with B by a piece of tubing having a thread so that it can be raised or lowered. A wedge slipped under one end of the plate B is the most convenient mode of inclining it, a spring being inserted under the other end. Screws are not so good. According to the objective used the angle of inclination for the best effects varies from 4° with high powers to 12° with low powers. The wedge can be marked at different points, so as to show the angle of inclination.

Fig. 35.



In focusing the two wedges, care must be taken that exactly the same details of the object are focused in each case, otherwise the photographs will not combine in the stereoscope.

(Fig. 35 shows the apparatus in place on the Microscope.)

Another form was devised by Prof. G. Fritsch, a description of which, for want of the woodcut illustrating it, must be deferred.

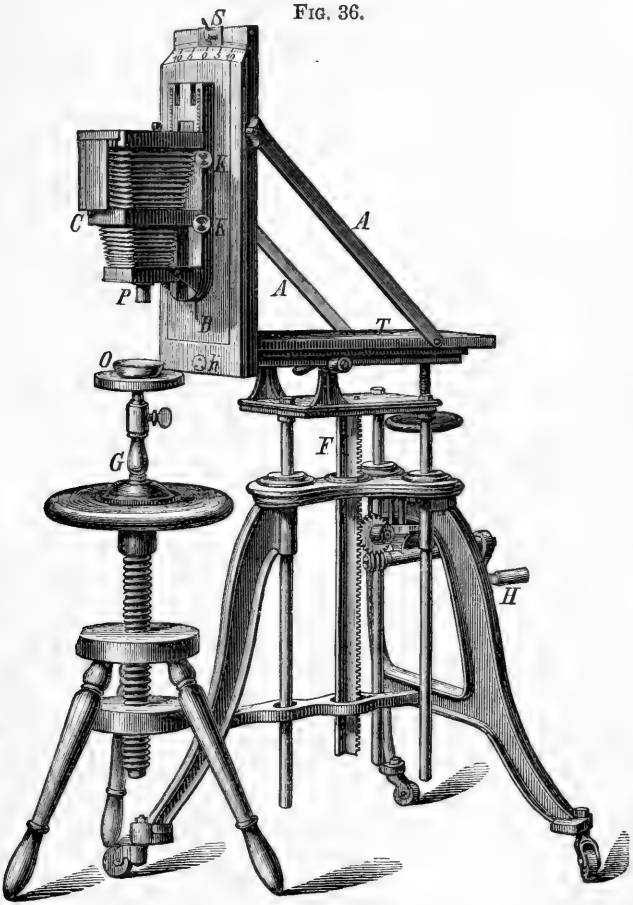
Dr. H. Fol has devised * an apparatus (fig. 36) for photographing microscopic objects under small magnifying powers. He considers that such photographs are undoubtedly of much greater value when observed under the stereoscope.

The table T carries at one end the board B and camera C P, with the supports A. The table is raised and lowered on the tripod by the rack and pinion F H, or moved horizontally by a second one on the further side. The board B turns on a pivot *k* and the extent of the motion is shown on a graduated scale at the top. It is fixed in any position by S. The camera is double, each bellows being adjustable by the milled heads K K. The object lies in a black cup O in water

* Fol, H., Lehrb. d. Vergl. Mikr. Anat., 1884, p. 79 (1 fig.).

or weak alcohol, the stand G for it being independent of the rest of the apparatus, which Dr. Fol considers to be essential to prevent the shifting of the object. The objective may be one of Steinheil's

FIG. 36.



smallest aplanatics, or a low-power objective provided with a small diaphragm.

The camera being central, the object is placed at the level of the pivot *k*, and focused. The camera is then shifted 4° or 4·5° to the right, and a photograph taken, and then to the same extent on the left and another taken.

Objectives for Photo-micrography.*—Mr. W. H. Walmsley considers that to obtain the very highest results, all powers lower than

* The Microscope, v. (1885) pp. 219–20.

1/4 in., should be supplied with special corrections to render the visual and actinic foci coincident. At the same time it may be stated as an axiom that any objective that will give a clear, well-defined image of an object under the eye-piece, will also produce a sharp and accurate reproduction of the same upon the sensitive plate. He has made most excellent negatives with a French Triplet 1/4 in., costing no more than five dollars, and magnifying 200 diameters—not equal, it is true, to the results obtained with lenses of higher grade and finer corrections, but so good that only a critical eye would discern the difference between them. We quote in full the author's succeeding remarks:—

"So let not those possessing only cheap instruments be deterred from entering upon this fascinating branch of photography on that account, as their cheap tools will turn out good work with the aid of patience and careful manipulation. Wide angular aperture is not so conducive to good results as a moderate one. Given good corrections of spherical and chromatic aberrations, good penetrating and defining powers, and the objective of moderate aperture will defeat its wide-angled rival on the photographer's field in every encounter.

"It may safely be asserted that all powers in ordinary use may be successfully employed in photographing by aid of ordinary lamp-light. I have used them all from 4 in. to 1/18 homogeneous immersion; with, and without amplifiers, and all with equally good results. If a selection has to be made by one just furnishing an outfit, I would suggest a 1 in. or 2/3; 1/2 in. or 4/10; and 1/5 or 1/6. With these and a camera of sufficient bellows capacity, a range of powers from about 25 to 250 diameters may be obtained, quite sufficient for nine-tenths of the work ever required in this direction. If a higher power be necessary, then a 1/10 immersion is recommended. None of these powers from the 1/5 upwards will require any special correction. If they define any given object under the eye-piece, clearly and distinctly, it may be accepted as certain that they will produce a correspondingly good photograph of it. But for powers less than 1/4 in., I would earnestly recommend those specially corrected for photography, else sharply defined results cannot be depended upon with any certainty. I have seen objectives of low powers, in which there was no apparent difference between the actinic and visual foci, and which gave—without any further corrections—negatives as sharp as the image seen upon the focusing screen; but such instances are rare, and cannot be counted upon. I would therefore reiterate, for all powers lower than 1/4 in., employ *only* those specially corrected for photography."

Photography and Minute Details.*—The following remarks are made by a contemporary on the discussion on this subject at the November meeting.

"It appears to us that, in these discussions, sufficient allowance is not made for the varying acuteness of vision possessed by different

* Brit. Journ. of Phot., xxxii. (1885) pp. 786-7.

persons—a subject upon which we have found most observers are particularly touchy. . . . Almost every one has eyes which are more or less astigmatic; how very different, therefore, must a set of lines in the Microscope appear to most persons, according to the relation of their direction to that of the meridian of astigmatism! Again, as to actual acuteness of vision—that is to say, power of visual perception of minute objects—that varies in individuals to a degree which could scarcely be believed by those not conversant with the subject. . . .

"The moral we would draw from these facts is that, when questions of the eye against photography in the Microscope are discussed, the conclusions arrived at are worthless unless the powers of the observer's eyes are thoroughly ascertained, both as to acuteness of vision and extent of astigmatism."

The writer has not quite appreciated that the discussion turned, not on the limit of *visibility* of minute objects, but on resolution or the limit of visible *separation*. The latter depends on the wave-lengths of the portion of the spectrum used, and hence photography will resolve lines closer together than "white light" will.

Imperfection of the Eye and Test Objects.*—Mr. L. Howe calls attention to the fact that "fine parallel lines, whether drawn artificially or existing in natural objects, do not make fair test objects for the Microscope." This is caused by an ocular imperfection which is very common—astigmatism.

In consequence of this defect, when one of Nobert's test-plates is subjected to examination, the perpendicular lines which one person can see perfectly well, cannot be seen by another who considers his vision in every way normal. The same holds for other tests of a similar nature, such as diatoms or objects marked with fine dots or lines in close juxtaposition. This, the author says, is by no means an imaginary difficulty, as it has occurred to him more than once to find this difference of opinion between persons who are accustomed to view such objects, and whose eyes and hands are trained to use the Microscope. Fortunately, however, there is a very simple method of overcoming the difficulty. This consists in revolving the object on the stage of the Microscope, in such a way that lines which at first were vertical become afterwards horizontal; for when turned through an arc of 180° they pass through every meridian in which it would be possible to see them, provided the amplification and definition be sufficient to make them at all visible.

Pygidium of the Flea as a Test Object.†—Mr. E. M. Nelson finds that the so-called hairs of the pygidium of the flea are spines which "form nothing that can be called any sort of test for a high-power objective."

Webb's Lord's Prayer.—Mr. W. Webb, well known for his microscopic writing of the Lord's Prayer (the series of which com-

* The Microscope, v. (1885) pp. 226–8.
† Journ. Quek. Micr. Club, ii. (1885) p. 197.

mences at the rate of 3,616,791 letters to the square inch and extends to 212,746,216 letters, or at the rate of more than fifty-nine Bibles written in a square inch), has added a further novelty to the series, being a photograph and a writing of the Lord's Prayer side by side on the same slide, the former being photographed on the slide and the latter engraved on the cover-glass.

We observe that at a recent meeting of the Microscopical and Natural History Section of the Manchester Literary and Philosophical Society,* a member stated, "Mr. Webb died about ten or fifteen years ago, but I cannot give the exact date." Mr. Webb is, however, still alive, and as will be seen from the above, still engaged in microscopic writing.

Leeuwenhoek Medal. — The Gold Medal established by the Royal Dutch Academy in memory of Leeuwenhoek, was last year awarded to Prof. Ferdinand Cohn, as the histologist who in the last decade had most distinguished himself in the study of microscopical beings.†

ALLISON, F. B.—**Microscopical Binoculars.**

[Explains Mr. Nelson's difficulty as to the want of stereoscopic effect in the case of objects lying "vertical," by the diminished difference of perspective. Cf. this Journal, V. (1885) p. 1076.]

Engl. Mech., XLII. (1885) p. 262.

American Society of Microscopists.

[Report of Cleveland Meeting (by Dr. S. M. Mosgrove).—Also of the Working Session (by Dr. W. P. Manton).—Personal Notes on Cleveland (Editorial).—Mr. Griffith's latest (by Dr. F. L. James, from the 'National Druggist').]

The Microscope, V. (1885) pp. 193–203, 203–204, 207–210, 232–233.

B., C. R.—**A Cheap Dissecting Microscope.** [*Post.*]

Bot. Gazette, X. (1885) pp. 427–8.

Beck's New "Star" Microscope. [Cf. Vol. V. (1885) p. 512.]

Amer. Mon. Micr. Journ., VI. (1885) p. 229 (1 fig.).

Behrens, W. J.—**Rules for the Use of the Microscope.**

[As to "keeping the metallic part clean." Focus up with high powers. Microscope, if it is to be for a long time out of use, should be put away in some closely shutting cupboard in which is placed some chlorate of lime.]

Micr. Bulletin (*Queen's*), II. (1885) p. 41, from *The Microscope in Botany* (Transl. of the original German work).

BIGNELL, G. C.—**Photo-micrography.** [*Post.*]

Year-Book of Photography, 1886, p. 95.

BIRNBAUM, K., and J. GRIMM.—**Atlas von Photographien Mikroskopischen Präparate der reinen und gefälschten Nahrungsmittel. Abtheilg. I.: Atlas zur Mehlprüfung.** (Atlas of Photographs of Microscopic Preparations of pure and adulterated Foods. Part I. Flour testing.)

16 pp. and 16 phot. plates, fol., Stuttgart, 1886.

BOSTWICK, A. E.—**A new form of Absorption Cell.** [*Supra*, p. 140.]

Amer. Journ. Sci., XXX. (1885) p. 452.

---

* Chem. News, liii. (1886) pp. 34–5.

† Cf. Versl. en Med. K. Akad. Wet. (Amsterdam), ii. (1885) pp. 105–10 (Address of Prof. Stokvis to Prof. Cohn), and pp. 111–4 (Reply of Prof. Cohn). Also pp. 88–90.

BROTHERS, A.—**Microscopic Writing.**
[Webb's Lord's Prayer, &c.—Machine for writing, purchased by Mr. Rideout at the 1862 Exhibition.
Chem. News, LIII. (1886) pp. 33–4.

" " **[Electric Spark under the Microscope.]**
[Produced by a carbonate of potash battery (with an induction coil) at the extremities of two lead-pencil points.]
Proc. Manchester Lit. and Phil. Soc., XXIV. (1885) p. 20.

BULLOCH, W. H.—**About Magnification.**
[Queries as to the power of 1 in. lens, formula and power of 2 in. eye-piece, and length of a 10 in. tube.]
Amer. Mon. Micr. Journ., VI. (1885) p. 240.

Bulloch's (W. H.) Cobweb Micrometer. [*Supra*, p. 132.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 239–40.

Case, Convenient Microscopical.
["There are a great many pocket cases for microscopical mounts in the market, but the most convenient article for the purpose that we have seen is a flat muslin box which does not take up much more room than a large pocket-book. It contains four trays, each of them made to hold six slides lying flat, thus exposing the label as in the large cabinets" (Queen & Co.'s).]
St. Louis National Druggist, VII. (1885) p. 230.

CASTELLARNAU Y DE LLEOPART, J. M. DE.—**Vision Microscópica.** Notas sobre las Condiciones de Verdad de la Imágen microscópica y el modo de expresarlas. (Microscopical Vision. Notes on the Conditions of resemblance in Microscopical Images and the Method of Delineation.) *In part.* [*Post.*]
Anal. Soc. Espan. Hist. Nat., XIV. (1885) pp. 257–88 (1 fig.).

COE, H. C.—See Friedlander, C.

Cole's (A. H.) Self-adjusting Frog-plate.
[No description given.]
Micr. Bulletin (*Queen's*), II. (1885) p. 41.

COX, J. D.—**[Letter accompanying Photo-micrographs of Diatoms.]**
[Also comments on Dr. Cox's views by M. W. Prinz, who considers the new photographs "lead to the same confusions and consequently merit the same criticisms" as the previous series.]
Bull. Soc. Belg. Micr., XII. (1885) pp. 7–11.

CZAPSKI, S.—**[Abbe's Optical Theories.]**
[Conclusion of review of Dippel's 'Grundzüge der Allgemeinen Mikroskopie.' Cf. Vol. V. (1885) p. 1079.]
Zeitschr. f. Instrumentenk., V. (1885) pp. 405–8.

EVANS, F. H.—**Objectives.**
[As to surprising discrepancies in his measurements of the magnifying powers of various objectives.]
Engl. Mech., XLII. (1886) p. 361.

EVERETT, J. D.—**Outlines of Natural Philosophy for Schools and general readers.**
[Microscope, pp. 188–91, 1 fig.]
335 pp. and 216 figs., 8vo, London, 1885.

EWELL, M. D.—**Prof. Rogers' Ruling Machine and Method of ruling Standard Micrometers.** [*Post.*]
The Microscope, V. (1885) pp. 221–26.

FLINT, J. M.—**Rotary Object-carrier.** [*Supra*, p. 133.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 204–5.
Engl. Mech., XLII. (1885) p. 275.

FOL, H.—**Nouveau Microscope.** (New Microscope.) [*Post.*]
Arch. Sci. Phys. et Nat., XIV. (1885) p. 575.

FREY, H.—**Das Mikroskop und die Mikroskopische Technik.** (The Microscope and Microscopical Technique.)
8th ed., vi. and 524 pp., 417 figs., 8vo, Leipzig, 1886.

Friedlander, C.—**The Use of the Microscope.** Transl. by H. C. Coe.
2nd ed., 200 pp., 8vo, New York, 1885.

GÄRTNER, G.—**Ueber das electrische Microscop.** (On the Electric Microscope.) [*Post.*]
Med. Jahrb. K. K. Gesellsch. Aerzte Wien, 1884, pp. 217–44 (1 pl. and 1 fig.).
Med. Times, II. (1885) pp. 412–5 (1 fig.).

GLAZEBROOK, R. T., and W. N. SHAW.—**Practical Physics.**
["Travelling" Microscope for measurements, pp. 64–6. Microscopes used to measure expansion, pp. 200–1. Measurement of the magnifying power of a lens or of a Microscope, pp. 283–7. Measurement of the Index of Refraction of a plate by means of a Microscope, pp. 303–5 (1 fig.).]
xxii. and 487 pp., 80 figs., 8vo, London, 1885.

GOODWIN.—**Photo-micrography for Winter Evenings.**
New York Phot. Times, XV. (1885) p. 639.

GRIMM, J.—See Birnbaum, K.

H., R. O.—**[Objectives.]**
[Explanation of F. H. Evans' difficulty, *supra*, depends on the difference between the optical tube-length and 10 in.]
Engl. Mech., XLII. (1885) p. 427.

HEURCK, H. VAN.—**Le Microscope à l'Exposition Universelle d'Anvers.** (The Microscope at the Antwerp Universal Exhibition.) (*Contd.*)
[Microscopes, objectives, &c., of Herr C. Reichert, *supra*, p. 129.]
Journ. de Micrographie, IX. (1885) pp. 496–504 (6 figs.).

HITCHCOCK, R.—**Photo-micrography. I., II.**
[1. General consideration of photographic methods. 2. Apparatus. (*a*) Plates. Developing apparatus (trays). Lanterns. Dark room.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 201–3, 224–7 (6 figs.).

[HITCHCOCK, R.]—**Postal Club Boxes.**
[Contents of Boxes Cy, E, Cx, D, and Cw.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 217–8.

" " **Microscopical Societies.**
[List of thirteen American societies, with brief particulars.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 237–9.

" " **Palmer Slide Co.'s Bevel-edge Slides** (and remarks by Mr. G. S. Woolman)
Amer. Mon. Micr. Journ., VI. (1885) p. 239.

HOLMES, E.—**A simple and handy Compound Selenite and Mica Stage.**
[Indicates "how a very useful stage may be made for a few pence, which will answer most, if not all, the purposes of the most expensive apparatus." A whole revolution of the films is unnecessary. A lever motion can be made to give all the alterations. Take a film of selenite and one of mica, and mount on circular pieces of wood with projecting handles. Then take five thin slips of wood a little larger than an ordinary slip, and cut circular pieces out of each. Only two of these are just large enough for the films to move in, and the other three, slightly smaller, form top and bottom and centre piece to keep films apart. Glue all these together, with the selenite and mica films in place. When dry, these have a free movement of about 60° or so, and a thin strip at back, to lodge slide against completes it.]
Engl. Mech., XLII. (1885) p. 321 (3 figs.).

HOMOIOS.—**Objectives.**
[Further as to "objectives à l'immersion of topaz, diamond, or precious stones of high refractive index."]
Engl. Mech., XLII. (1886) p. 386.

HOPKINS, G. M.—**Das Mikroskop in den mechanischen Künsten.** (The Microscope in the Mechanical Arts.) [*Post.*]
Central-Ztg. f. Optik u. Mech., VI. (1885) pp. 270–2 (10 figs.).

HOWE, L.—**An Imperfection of the Eye and Test-Objects for the Microscope.**
[*Supra*, p. 147.] *The Microscope*, V. (1885) pp. 226–228.

[JAMES, F. L.]—See American Society of Microscopists.

Jeaffreson, J. B., Death of. *Nature*, XXXIII. (1885) p. 278.

KLÖNNE, J., and G. MÜLLER.—**Blendvorrichtung für Mikroskope.** (Diaphragm for Microscopes.) [*Post.*]

Title only of German Patent, Kl. 42. No. 3416.

„ „ „ **Pendel-Objecttisch für Mikroskope.** (Pendulum Stage for Microscopes. [*Supra*, p. 127.]

Title only of German Patent, Kl. 42, No. 4238.

M., W.—The Magnifying Power of an Inch Objective.

[Proposal to "settle the standard value of an objective which with standard length of tube and a 2 in. eye-piece shall have a certain magnifying power and be called a one-inch."]

Amer. Mon. Micr. Journ., VI. (1885) pp. 203–4.

MALASSEZ, L.—**Sur les Chambres claires en général et sur une Chambre claire à 45°.** (On Cameræ lucidæ in general, and on a 45° camera lucida.) [*Post.*]

Travaux Laborat. d'Histol. du Collège de France, 1884 (1885) pp. 166–79 (1 fig.).

MANTON, W. P.—See American Society of Microscopists.

Microscope and how to use it, with Instructions for Mounting Objects.

16 pp. and 3 figs., 8vo, London, n.d.

MOORE, A. Y.—**The Zeiss 1/18 in. Objective.**

[Results of comparison with a Spencer 1/10 in favour of the latter.]

The Microscope, V. (1885) pp. 228–29.

MOSGROVE, S. M.—See American Society of Microscopists.

MÜLLER, G.—See Klönne, J.

NELSON, E. M.—**A Method of Equalising the Thickness of Slips when using an Oil-immersion Condenser.** [*Supra*, p. 131.]

Engl. Mech., XLII. (1885) p. 280 (3 figs.).

„ „ **A New Aplanatic Pocket Lens.**

[Recommending Zeiss's No. 127. Extreme field 5/8 in., of which 7/16 in. is flat. Power 10.]

Engl. Mech., XLII. (1885) p. 283.

„ „ **Testing Objectives.**

["The art of testing object-glasses can only be acquired by long practice, and by seeing a great number of lenses, especially those by different makers."]

Engl. Mech., XLII. (1886) p. 427.

Photography and Minute Details. [*Supra*, p. 146.]

Brit. Journ. Phot., XXXII. (1885) pp. 786–87.

Photo-micrography.

[General consideration of photographic methods.]

New York Phot. Times, XV. (1885) pp. 691–2 (in part).

Presidents, Portraits of.

["The R. Micr. Soc. are adopting a plan which might be advantageously followed by all other scientific or learned societies."]

Brit. Journ. of Photography, XXXII. (1885) p. 786.

PRINZ, W.—See Cox, J. D.

Read's (H. T.) Fine Platinum Wire. [*Post.*]

St. Louis National Druggist, VII. (1885) p. 308.

ROGERS, W. A.—**The Microscope in the Workshop.**

[Paper read before Boston Meeting of Mechanical Engineers. *Post.*]

Engl. Mech., XLII. (1886) pp. 397–8.

ROSENBUSCH, H.—**Mikroskopische Physiographie** der Mineralien und Gesteine. Ein Hülfsbuch bei mikroskopischen Gesteinsstudien. Band I. Die petrographisch wichtigen Mineralien. (Microscopical Physiography of Minerals and Rocks. A guide to the microscopical study of rocks. Vol. I. The petrologically important minerals.)

[Describes the author's original polarising Microscope, and the Nachet and Klein forms, pp. 112–23 (6 figs.). Also Fuess's new stand and stage, pp. 562–4 (2 figs.). *Post.*]

2nd ed., xvi. and 664 pp., 177 figs., 26 phot. pls., and Newton scale in colours, 8vo, Stuttgart, 1885.

ROYSTON-PIGOTT, G. W.—**Microscopical Advances, Ancient and Modern, II., III., IV.**
[Advancing angular aperture. The definition of lines, points, and spherules. Refracting spherules or molecules, black dots, test rings, and lines. *Post.*]
Engl. Mech., XLII. (1885) pp. 291–2 (2 figs.), 331–2 (14 figs.), 417–8 (6 figs.).
Cf. also *Engl. Mech.*, XLII. (1885) p. 277 (Lucernal Microscope).

S., G. S.—**Accessories for Microscopical Drawing.** [*Supra*, p. 137.]
Sci.-Gossip, 1886, p. 8 (2 figs.).

SERVUS, H.—**Die Geschichte des Fernrohrs bis auf die neueste Zeit.** (The history of the Telescope to the most recent date.)
[Contains references to the Microscope, and deals fully with achromatism.]
vi. and 135 pp., 8 figs., 8vo, Berlin, 1886.

SHAW, W. N.—See Glazebrook, R. T.

Smith's (H. L.) "Homo-tester."
[New illustration of it.]
Micr. Bulletin, II. (1885) p. 43 (1 fig.).

SORET, J. L.—**Appareil permettant l'observation microscopique des globules de vapeur.** (Apparatus for the microscopical observation of globules of vapour.) [*Post.*]
Arch. Sci. Phys. et Nat., XIV. (1885) pp. 575–6.

STOWELL, C. H.—**[Death of] Thad. S. Up de Graff.**
The Microscope, V. (1885) p. 229

[STOWELL, C. H. and L. R.]—**Is it a Micro-photograph or a Photo-micrograph?**
The Microscope, V. (1885) pp. 208–9.

" " " **Ayres' Micro-photographs.**
Ibid., p. 209.

" " " **Is it a Fraud?**
[Comment on an editorial in the 'Cincinnati Medical News,' which denounced as a fraud an offer of a Microscope and 1/2 in. and 1/6 in. objectives for 22·50 dols.]
The Microscope, V. (1885) pp. 231–2.

" " " See American Society of Microscopists.

STUBBS, E. T.—**Presidential Address to the Postal Microscopical Society.**
[How best to carry on, advance, and improve the Society.]
Journ. of Micr., V. (1886) pp. 1–9.

THOMPSON, F. C.—**An Easy Method of Making Micro-photographs.** [*Post.*]
Year-Book of Photography, 1886, pp. 49–52.

VIGNAL, W.—See Malassez, L.

WALL, O. A.—**[Pinhole Microscopes.]**
["The simplest Microscope is a piece of paper, or cardboard, which is perforated with a pin. The pinhole is brought close to the eye, and objects examined through it are considerably magnified. If the surface of the card, or paper, is first blackened with ink, the image will appear plainer and brighter. In the absence of the Coddington lens, this method may serve to examine some of the superficial characters of drugs."]
St. Louis National Druggist, VII. (1885) p. 281.

" " **On Photo-micrograph Cameras.**
[Walmsley's and Atwood's Cameras. "Buy no form of apparatus in which the focussing plate is fixed in one immovable position," as it is easier to make slight changes of focus by moving the ground glass than by moving the objective. For enlargements also a movable plate is essential.]
St. Louis National Druggist, VII. (1885) p. 320.

" " **Druggists' Microscope.**
[Statement of some of the essential features advisable in an instrument intended for actual work.]
St. Louis National Druggist, VIII. (1886) p. 7.

WALMSLEY, W. H.—**How to make Photo-micrographs.**

["Plain and practical hints"; dealing with Microscopes, (any Microscope with a joint can be employed, a monocular body is better than a binocular, a rotating stage indispensable, and a centering substage a great convenience—the eye-piece should be removed and the body-tube lined with black flock paper), Objectives (*supra*, p. 145), Illumination (with 1/4 in. and higher an achromatic condenser is necessary, otherwise a bull's-eye is sufficient), and Cameras.]

The Microscope, V. (1885) pp. 217–21 (see also p. 233), 271–4.

" " **Photo-micrography by Lamp-light.**

New York Phot. Times, XV. (1885) pp. 274 and 289.

" " **Photo-micrographs on Gelatine Plates for Lantern Projection.**

[Title only of paper read at Ann Arbor Meeting of the Amer. Assoc. Adv. Sci., 1885.]

Amer. Journ. Sci., XXX. (1885) p. 327.

Walmsley's (W. H.) Photo-micrographic Camera.

[Cf. Vol. III. (1883) p. 556 and *post*.]

New York Phot. Times, XV. (1885) pp. 703–4 (1 fig.).

WOODWARD, H.—**[Microscopic research as applied to Palæontology and Mineralogy.]**

[Reference to this Society's work.]

Geol. Mag., III. (1886) pp. 47–8.

WOOLMAN, G. S.—See [Hitchcock, R.].

β. Collecting, Mounting and Examining Objects, &c.*

Obtaining Diatoms from poor Material.†—Herr K. Müller writes that he has "discovered a new system of obtaining specimens from poor material. Take the material and dilute it well with water in a bowl, and let it stand about a quarter of an hour. The mud must be well stirred in the water so that it looks like muddy water. Let it stand and rest again. The heavy mineral particles will sink down. After a quarter of an hour the water will be clear again, but on the top all vegetable particles will float. If you have a small, fine sieve, pour the water through, and all the rough parts will remain in the sieve, while the diatoms will go through and will float on the surface of the water; let it stand about a quarter of an hour, when the diatoms will have settled on the edge of the plate, and there form a greenish-black border, which you can take off and put under the Microscope."

Dissecting Trough.—Mr. R. J. Harvey Gibson, M.A., F.R.S.E., Demonstrator of Zoology, University College, Liverpool, describes the dissecting trough which he has devised as follows:—

"As is well known to naturalists, dissection is much more easily and successfully accomplished under water, the tissues being thereby floated up and supported. At the same time it is absolutely essential

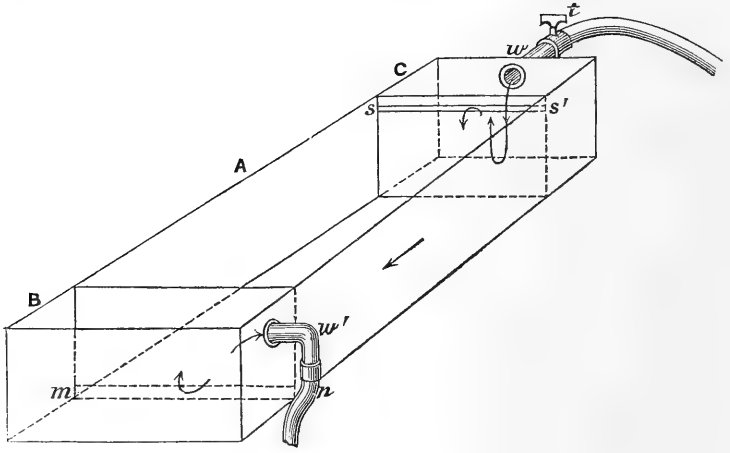
* This subdivision contains (1) Collecting Objects; (2) Preparing, (*a*) in general, (*b*) special objects; (3) Separate processes prior to making sections; (4) Cutting, including Imbedding and Microtomes; (5) Staining and Injecting; (6) Mounting, including preservative fluids, cells, slides, and cabinets; (7) Examining objects, including Testing; (8) Miscellaneous matters.

† Amer. Mon. Micr. Journ., vi. (1885) pp. 230–1.

to have the water kept clear. Whilst engaged in the prosecution of a research into the minute anatomy and histology of *Patella vulgata*, I found that owing to the granular character of the liver and nephridia of that mollusc, it was almost impossible to keep the water pure and free from granular débris, entailing constant journeys to and from the sink, with the risk of disturbing and destroying the dissection by the pouring off and renewal of the water. I accordingly devised a form of dissecting trough which has answered its purpose very well.

It consists (fig. 37) of a long box of zinc or tin (preferably the former) divided into three compartments. The central division A is the largest; the two end divisions are of much smaller size, equal

Fig. 37.



to each other, however. The partition between A and C has a slit $s\,s'$ about 1/2 in. from the top; that between A and B does not quite reach the bottom of the trough. Into compartment C a water pipe w opens with a stop-cock t in the position indicated; from compartment B an escape pipe w' passes off. The pipe w is in communication with a water tap by means of guttapercha tubing, w' by the same means with the sink. In compartment A a loaded block of paraffin is placed, the thickness of which varies with the size and depth of the dissection. The block is made so as to leave a clear space of half an inch between it and the sides of the trough. When the stop-cock t is turned on, the water flows in, fills chamber C, overflows into A when it has reached the level of the slit $s\,s'$, fills chambers A and B, escaping by the pipe w'. The direction of the current of water is indicated in the sketch by the arrows. The water is of course always kept at the same level by the inflow; the arrangement of the slits in the partitions, however, tends to cause the débris

of muddy water to sink to the bottom, the larger particles collecting at or near the slit *m n*. By this means the water in which the dissection is carried on is kept pure; the débris is removed, and the annoyance of having constantly to renew the water is avoided. The supply of fresh water of course is regulated in accordance with the necessity for renewal. The trough may be made of any length and shape to suit the nature of the dissections to be performed in it. It might be an advantage to have the sides sloping outwards instead of vertical. Wrist-supports might also be fitted on to the sides.

The trough was made for me by Mr. Frazer, optician, of Edinburgh, who suggested various mechanical improvements during its construction."

Differentiating Embryonic Tissues.*—It may be safely assumed that all hardening and staining fluids possess, in a higher or lower degree, the power of *developing*, in the photographer's sense, histological distinctions between embryonic cells, long before these distinctions become manifest in perceptible morphological differences. It is evident also, that this differentiating action varies in strength according to the conditions under which the reagents are applied. One of the best ways of intensifying the differential effects of hardening fluids, is to use several of them in combination or in sequence. The use of osmic acid, followed by Merkel's fluid, is an example of this kind. The advantages of this method in the study of pelagic fish eggs have already been noticed,† and Dr. C. O. Whitman now describes what the method will accomplish when applied to the eggs of *Clepsine*. The mode of procedure is as follows:—

The eggs are placed in 1/4 per cent. solution of osmic acid for ten minutes, then rinsed in clean water and transferred to Merkel's fluid (platinum chloride 1/4 per cent., and chromic acid 1/4 per cent. in equal parts), in which they are allowed to remain one and a half hours. They are next washed in flowing water for the same length of time, then treated with 50 per cent. and 70 per cent. alcohol. They need remain only a short time in the first grade of alcohol (about thirty minutes), but should be left for twelve to twenty-four hours in the second. For staining the author used Grenacher's alcoholic borax-carmine, adding to it from one-third to one-half its volume of glycerin. The glycerin intensifies the action of the dye, so that a moderately deep stain is taken in the course of twenty-four hours.

It is best to stain immediately after the eggs have remained the required time in alcohol, as receptivity for the staining fluid diminishes considerably with the lapse of time. The osmic acid has time to penetrate to all parts of the embryo, and the blackening is arrested and partially removed by the action of Merkel's fluid. The differential effects of the osmic acid are, however, sharpened under the influence of the chrom-platinum solution.

* Amer. Natural., xix. (1885) pp. 1134–5.

† Ibid., xvii. (1883) p. 1204, and Proc. Amer. Acad. Arts and Sci., xx. (1884) p. 28.

This method has enabled the author to trace out the history of the endoderm, and the precise origin of the nerve-cords, nephridia, salivary glands, larval glands, &c.

Preparing Mammalian Ovaries for Examination of Graafian Follicles.*—Dr. W. Flemming recommends a 2 per cent. solution of osmic acid, and also a mixture of chromic, osmic, and acetic acids for hardening ovaries and safranin or gentian-violet for staining the sections.

Preparation of Connective Tissues.†—Herr T. Ognew condemns most of the ordinary fixative agents, on account of their rendering connective tissue cells and their processes imperceptible. His best results were obtained from 1 per cent. solution of osmic acid. In using this, however, several precautions must be observed. The length of the embryo must be from 2–8 cm. The embryo must be still warm when placed in the hardening fluid. It must not remain in the acid longer than twenty-four hours. Preparations of connective tissue cannot be said to be properly stained unless the cells and their finest processes stand out quite clearly.

For the osmic acid preparations the best stain is a mixture of a saturated watery solution of safranin and Böhm's hæmatoxylin. Five to twenty drops of the hæmatoxylin solution are added to a medium-sized watchglassful of the safranin solution. After mixing it is necessary to remove the precipitate which arises, by filtration. Preparations stained by this method can be mounted in glycerin without detriment to their colour.

Preparing Spinal Cord.—At the December meeting of the Society a section of the spinal cord of the ox, prepared by Mr. C. Robertson, Demonstrator of Anatomy at Oxford, was exhibited by Dr. Beale, and the method of preparation is thus described by Mr. Robertson.

"Portions of the warm cord about an inch long are placed in weak spirit (10 over proof) from four or five hours, then transferred to a 6 per cent. solution of bichromate of potash for six days, care being taken during the process of hardening to remove with a razor thin sections from the ends to allow the solution to thoroughly penetrate to the interior of each piece. The process of hardening is completed by transferring to weak spirit for two days, then to strong for two or three more days, when the cord can be kept till wanted for sections. Portions of the cord are stained before sections are made by soaking for twelve hours in a solution of good picrocarmine, washed in weak spirit, and soaked for a short time in absolute alcohol, which should be used to wet the razor in cutting. The sections are cleared in oil of cloves, and mounted in dammar varnish or Canada balsam dissolved in benzole in the usual way.

I have tried most of the methods recommended in the text-books for demonstrating the structure of the spinal cord, brain, ganglia, &c., and find that none of the methods recommended bring out the

* Arch. f. Anat. u. Physiol. (Anat. Abtheil.), 1885, pp. 221-44 (2 pls.).
† Ibid., pp. 437–49 (1 pl.).

processes and cells or enable one to trace the cell process so well as the method of soaking in the picrocarmine before cutting; there is also little risk of damaging the sections after they are cut, as they can be washed off from the razor to the slide, cleared with oil of cloves and mounted in dammar varnish or balsam dissolved in benzole in the usual way.

It is very difficult to procure good picrocarmine in this country. The best thing that I have met with I obtained ready made from MM. Rousseau and Son, Paris. The only objection to the bichromate-of-ammonia method is that the solution is liable to deposit in the form of small specks amongst the nerve. Some of these specks are seen in the sections."

Preparing Teleostei for showing Development of Thyroid and Thymus Glands.*—Dr. F. Maurer studied the development of these glands chiefly in the trout. From eggs obtained recently spawned, the troutlets emerged in forty-eight to fifty-six days. Chrom-acetic acid was found to be the only satisfactory hardening agent (1/2 per cent. chromic acid, 1 per cent. acetic acid, in distilled water). During the first twenty days no deformity of the embryo need be anticipated, but from this period the amount of distortion goes on increasing. The eggs remained in the chrom-acetic from eight to twelve hours, they were next washed in water, and then, after the removal of the yolk, transferred to alcohol. Staining was always performed with alcoholic borax-carmine. In order to prepare the specimens for imbedding in paraffin, they were soaked in absolute alcohol, and afterwards in chloroform. Giessbrecht's shellac method was adopted for mounting in series.

For examination of the mature thyroid and thymus, these glands were injected with a watery solution of Berlin blue thickened with gelatine. The injection was effected by snipping off the apex of the heart and passing the canula through the ventricle into the bulbus arteriosus.

Permanent Mounting of Tracheæ of Insects.†—Mr. F. T. Hazlewood has succeeded in a very simple way in mounting permanently the tracheal system of insects.

He dissects out the soft parts and spreads them on a glass slide of the usual size; lets them dry perfectly; and then with pencil-brush gives them a good coating of collodion. After this melt a little hard, pure balsam in a test tube, and put it on the object with a cover-glass applied at once.

This method is remarkable for its results. The intestines, the ganglia, and the brain, are "perfectly magnificent." The intestine makes thus one of the most beautiful objects for dark-ground illumination. The brain shows the most abundant ramifications of the tracheæ, especially in the immense parallel branches in the rods of the eyes. The ganglia can be floated on a cover-glass, dried, and mounted in this way.

* Morphol. Jahrbuch, xi. (1885) pp. 136–8.
† The Microscope, v. (1885) p. 235.

Preparing Silkworms.*—Mr. A. C. Cole gives the following methods of preparation:—

The silkworms are to be hardened in spirit; the parts intended to be mounted are then to be cut, or dissected out, and placed in liquor potassæ for from thirty-six to forty-eight hours; then thoroughly washed and cleaned with a soft brush, then soaked in distilled water, to be once or twice changed, during three or four hours; then placed in acetic acid; next in water, to remove the acid; next in spirit, for re-hydration; next in oil of cloves; next in turpentine, and mounted in balsam.

When the tracheal tubes only (separated from the spiracle) are required for study, it is better to mount them in a cell, in glycerin jelly, and they should be placed, after the acetic-acid treatment, in a mixture of half glycerin and half water, with a slight addition of acetic acid, until all trace of air is removed.

Preparing Alimentary Canal of Crustacea.†—For *hardening* the river cray-fish, Dr. J. Frenzel recommends Kleinenberg's picro-sulphuric acid diluted with only twice its volume of water. The preparation is left fifteen minutes in the fluid, then treated with the usual grades of alcohol. Osmic acid and the various chromic solutions proved worthless. Perenyi's fluid caused a slight swelling, but was of some service in the study of the liver and the nuclei of the middle gut. Corrosive sublimate (saturated aqueous solution) proved an excellent means of isolating the epithelium of the middle gut in the lobster. In preparations hardened in this fluid the epithelium becomes loosened from the wall of the canal, so that it can be stripped off in sheets and prepared for surface-examination.

For *imbedding*, paraffin is to be preferred to celloidin. Precaution should always be taken to prevent the formation of large crystals, which not only render the paraffin brittle, but also injure the finer structure of the preparation, by immersing it in cold water and cutting soon afterwards. If the paraffin block is allowed to stand for weeks, crystallization sets in.

In *staining*, the sections are fixed on the slide with chrome mucilage, and then stained with alum carmine, alcohol carmine (Grenacher), aqueous hæmatoxylin (Böhmer), and safranin. For the epithelium of the middle gut, a double stain with acid carmine and hæmatoxylin offers some advantages.

Preservation of Medusæ.‡—Dr. W. Haacke preserves Medusæ in the following way, by which they are said to retain their shape better than by any other method known.

The Medusæ are placed in a vessel of sea-water, and killed by the addition of a few drops of concentrated solution of chromic acid; they are then placed in fresh sea-water, which is repeatedly changed

* Cole's Studies in Microscopical Science, iii. (1885) sec. 4, p. 34. "The tracheal system in our present preparation would have been thus mounted, but balsam being calculated to display the structure of the spiracle and foot to greater advantage, it was considered advisable to employ that medium."

† Amer. Natural., xix. (1885) p. 1246. From Arch. f. Mikr. Anat., xxv. (1885) pp. 141–3.

‡ Zool. Anzeig., viii. (1885) pp. 515–6.

until all trace of chromic acid is got rid of. A mixture of alcohol and glycerin is then added to the water, and the proportion of these latter is gradually increased until the Medusæ come to be in a pure solution of glycerin and alcohol, which is made of the same specific gravity as sea-water.

Mounting Diatoms in situ.*—Dr. F. L. James has found that the processes commonly in use, and recommended in the text-books for preserving diatoms, as well as other minute aquatic organisms, desmids, algæ, &c., in the natural state, are all of them more or less unsatisfactory, and he never succeeded in making a really good mount until he came across a letter from Mr. C. H. Stodder, of Boston,† giving his method of mounting *in situ*, which is briefly as follows:—

"The algæ upon which the diatoms are growing are thoroughly dried, as usual, on bibulous paper. It is presupposed that all extraneous dirt, &c., has been removed. I have provided a slide with a circle of ink marking the centre on the reverse side, clean cover-glass, a bottle of chloroform solution of Canada balsam, some chloroform, and a watch-glass. These must all be ready at hand, as the operation must be carried through quickly. I select a bit of the weed, just large enough to mount, put a few drops of chloroform in the glass, and immerse the weed in it. The chloroform seems to be as efficient as water in restoring the dried alga to its natural shape. As it evaporates quickly, a few drops should be added from time to time until the alga is thoroughly permeated and has a natural appearance. It is then transferred to the slide, covered with a drop or two of chloroform, and arranged in the position which it is to occupy. A drop of balsam is now put on, before the chloroform has entirely evaporated, and the cover-glass applied. When thus manipulated, the balsam follows the chloroform, penetrates the cells of the weed, and makes them translucent so as to show all the details of their structure admirably, and the diatoms are displayed adhering in their natural positions. The balsam must be allowed to harden slowly, as it will not do to apply heat, since there is danger of shrivelling the delicate structures by so doing.

While the specific markings of diatoms can rarely be shown in mountings of this description, what is equally important, the mode of growth, can thus be demonstrated—which cannot be with cleaned diatoms. I have before me a slide of *Ptilota*, from the Pacific, which displays finely several species of diatoms of which I had seen no trace until this method was tried. If you have a number of specimens to mount at once, it will be better to put them directly into a small bottle of chloroform instead of the watch-glass. They can thence be taken directly to the slide, well saturated with chloroform. The most important point is to add the balsam before the chloroform has evaporated."

The method of Mr. Stodder gives equally good results with fresh- or salt-water algæ.

* St. Louis National Druggist, vii. (1885) pp. 233-4.
† Amer. Journ. Micr., ii. (1877) pp. 142-3.

Another method, suggested by Mr. Atwood, of Chicago,* also gives most excellent results. It is as follows:—

"For mounting marine algæ I prepare an artificial sea-water by dissolving in rain or distilled water a sufficient amount of sea-salt, which can be procured of any druggist. The dried algæ immersed in this will, in an hour, have resumed their original state. When this has occurred I pick out and clip off such pieces as are best adapted for mounting, transfer them to a bowl of distilled water, and wash them clean. They are thence transferred into a saturated solution of salicylic acid. The slides are prepared for receiving the mounts, with cells made of bleached shellac dissolved in Cologne spirits, thoroughly dry. The specimen is removed from the salicylic solution and arranged in its place, and the cell is filled with the salicylic solution. The cover-glass, first breathed upon, is put into its place, the surplus fluid removed in the usual way, and the cell closed with a thin coating of gold size. In a day or two I lay on more size, and when it is dry finish off with zinc cement or Brunswick black.

In mounting an alga having *Isthmia* parasitic upon it, I have found it almost impossible to fill the diatoms if balsam be used, whereas the salicylic solution fills every valve and cavity. The acid sometimes, but not often, decolorizes the algæ. The immersion of marine algæ in the artificial sea-water is an important point that should not be neglected, as otherwise their full beauty cannot be brought out."

Preparing thin Sections of friable and decomposed Rocks, Sands, Clays, Oozes, and other Granulated Substances.†—Mr. F. G. Pearcey describes the method adopted in the case of some of the 'Challenger' collections, transparent sections of which were required, but which it was impossible to prepare by the ordinary method of the lapidary's wheel on account of their friability. It was therefore necessary to find some method of making them hard and compact, so that they could be subjected to this process. The principle of the method consists in the introduction of some foreign substance to cement the grains together, and make the material hard and compact. This is carried out by soaking in a solution of gum copal in ether, and then evaporating the ether, a method which is in use by naturalists for making sections of the hard parts of Echinoderms.

Preparation and Use of the Cement.—The first process consists in preparing a solution of gum copal in ether. Take one half-pound of the best gum copal and place it in a strong glass jar, sufficient to hold about one quart, with finely ground air-tight stopper; add about 20 ounces of ether B.P. (sp. gr. 0·735). This should stand for at least two days, and should be shaken frequently, or stirred with a glass rod; when all the gum copal is dissolved, it should form a clear, thin, transparent liquid, and is then ready for immediate use.

The substance to be hardened should be first well dried in a porcelain dish, upon a hot iron plate placed upon a tripod stand over

* Amer. Journ. Micr., ii. (1877) pp. 154–5.

† Proc. R. Phys. Soc. Edin., viii. (1885) pp. 295–300 (1 pl.).

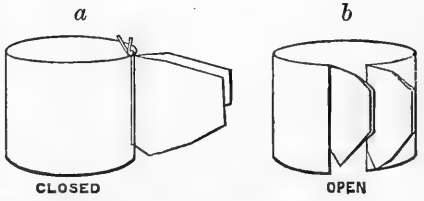
the flame of an ordinary Bunsen burner. The material is next placed in a porcelain crucible, varying in size according to the amount of substance required. About twice the volume of the solution of gum copal and ether should then be poured upon it, always taking care to press the stopper of the bottle well in afterwards.

The crucible is next placed upon the hot plate, care being taken to have a moderate heat at first, and to allow the mass to simmer till the ether has partly evaporated, when a greater heat may be applied. If the substance is a fine sand or ooze, it must be well stirred with a needle-point or small knife, otherwise it will stick to the bottom of the crucible, and not allow the gum copal to mix with it. If it is a soft, porous, or decomposed rock, it will only be necessary to turn it a few times, so that the solution may thoroughly penetrate all the pores. Great care must be taken during this part of the operation, as the cement is very inflammable, and therefore caution is essential, not only in stirring, in consequence of the gum having a tendency to stick to the sides of the crucible, but also in removing the stirring-needle to avoid contact with the flame.

After nearly all the ether has evaporated, the substance, if it is of a granular nature, should form a thin, stringy mass when stirred, and the operator can judge whether sufficient of the gum remains to cement the grains together; if too much has been applied, more of the substance and a small quantity of pure ether must be added, and the whole boiled over afresh. When there is a sufficiency of gum, the mixture should be kept boiling and well stirred till it becomes of a reddish or brown colour; sometimes it is difficult to discern the colour, as the substance interferes with it, but it can be seen in most cases. The operator, however, can easily ascertain whether it has been sufficiently boiled and has attained the necessary consistency, by taking a little out on the point of a knife, and rapidly cooling it by pressing it against some cold surface, or holding it a short time in water. If it hardens immediately, it has been boiled enough.

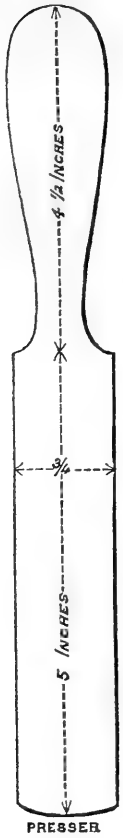
The crucible can now be taken off, and while yet warm, the substance should be scraped out with a knife, and rolled or pressed with the fingers into an oblong mass; it is then ready for moulding, or it can be laid aside and moulded at any time by gradually softening on a piece of glass or in a porcelain dish upon the hot plate. The moulds are easily made by cutting strips of ordinary tin 4 in. by 3/4 in., bent tightly over a round iron rod, a small slit being cut on one side of the tin to allow the wire connected with the mould to sink below the surface of the rim; this permits the mould to stand level and close to the glass plate; take the tin off the iron rod and bind it firmly round with fine copper wire: it is then ready for use (fig. 38 *a*).

FIG. 38.



Moulding.—This must be done while the substance is quite hot and plastic. First put a piece of common flat glass, three times the size of the cavity of the mould, upon the hot plate, with the mould on the top and the notched end downwards, so as to have it perfectly flat on the glass, and when quite hot, place the substance in the mould and press it firmly in with the presser (fig. 39), taking care to let as little as possible of the substance escape from the bottom. This may be to a great extent prevented by holding the mould down with the back of a knife with the left hand, and pressing in the substance with the right.

FIG. 39.



This done, take the whole off the plate smartly, with the glass attached, and press it on another flat slab or iron plate with the left hand, and with the right pour on a little cold water, when it will immediately set hard. Next place the whole in cold water for two or three minutes, after which the piece of glass at the bottom can be knocked or broken off; then loosen the wire which fastens the mould together, and open it a little (fig. 38, *b*); the moulded substance will then drop out in the form of a very hard mass, and is ready to be cut into sections. After a little practice, the whole operation can be done in an hour.

Preparation of the Sections.—Rub down and polish one end of the moulded substance, first upon a common hone, with a slow, equable motion, and a steady pressure, so as to produce the desired flatness of surface, and afterwards upon a Water-of-Ayr stone to give a fine polish. It must be held quite flat, so as to prevent the stones from getting worn into a hollow, when it will be impossible to get a perfectly flat surface.

The desired flatness and polish being secured, proceed to cement with Canada balsam the polished surface on an ordinary glass slide 3 × 1 in., or according to the size of the sections required. This is done in the same way as with hard rocks, but great care must at first be taken not to have the slide too hot, or the balsam will become too brittle. After having been properly mounted, it should be cemented round with a composition formed of four parts of resin and one of beeswax, melted together in a crucible on a hot plate, and put round the preparation with a glass pipette; when quite cold it may be cut with a lapidary's wheel, or ground down on a metal plate with emery powder. The slice remaining on the slide should be well cleaned and rubbed down on the hone to the required thinness. This part of the process is most difficult. The slides should be kept as flat as possible, and looked at frequently with the Microscope, so that the first indication of disruption may be detected. The proper thinness having been obtained, the sections should be at once covered

with a glass cemented with balsam; but considerable practice is required in this part of the work, as the preparation being very thin, is liable to be broken into pieces by very slight overheating. The superfluous Canada balsam around the slice should be first carefully scraped off with a sharp-pointed knife, and the slide well washed in spirit of turpentine, using a camel-hair brush to clean the section thoroughly. A little Canada balsam should then be dropped upon the centre of the section, and a clean cover-glass, heated a little, should be laid upon it while yet warm, and pressed down upon it, so as to force out the air-bubbles if any remain.

The slide on which the section still remains should not be too hot, otherwise the gum will become soft and the preparation spoiled. Several preparations may be quite easily made from one moulding, and when mounted, labelled and laid aside for future examination.

Mineral particles, no matter how small, can be cut into sections in the manner described.

Cedar-wood Oil for Paraffin Imbedding.*—Mr. A. B. Lee advocates the use of cedar-wood oil for clarifying tissues previously to imbedding them in paraffin.

The object is steeped in the oil, and then transferred to a bath of pure paraffin, or, if it be a delicate structure, first of all to a mixture of oil and paraffin. The cedar-wood oil clarifies very rapidly, and the object absorbs the paraffin quickly and thoroughly, so that it is only necessary to leave it for a very short time in the paraffin. The length of time that the object is left in the oil is of no moment, as it does not become brittle or over-hardened; treatment with this oil renders section-cutting very easy, and the method of procedure is exceedingly simple.

Apparatus for Imbedding Preparations specially adapted for the Nervous System.†—Instead of the ordinary clamp arrangement, Dr. S. v. Stein recommends a small metal case, open above, and to the bottom of which a clasp, with or without a slot, is fitted. The walls are formed by two rings. The upper ring, 30 mm. high, is pushed over the lower one, 10 mm. high. To make the imbedding mass adhere firmly, the floor of the box is fitted with three screws which project into the cavity for a distance of 4 mm.

When used, the upper ring is oiled and adjusted. The imbedding mass (one part oil and two parts wax) is then poured into the case until the screws are covered. After this has cooled down a little, the object is placed thereon, and the rest of the space filled up. The mass sets in a short time. The upper ring is then withdrawn, and there remains a wax column in which the object is firmly fixed. The sections are cut under water. This procedure is easily effected by the Leiser or Schanze microtome. The size and shape of the case (round or oval) depends on the form of the part of the nervous system (a hemisphere, &c.).

This method has the advantages—(1) that the specimen is not

* Zool. Anzeig., viii. (1885) pp. 563–4.

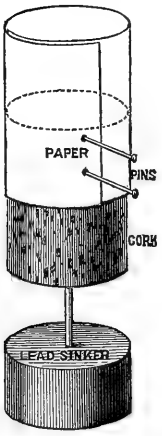
† Centralbl. f. d. Med. Wiss., 1884, pp. 120–6. Cf. Virchow and Hirsch's Jahresbericht (for 1884) 1885, p. 41.

exposed to any pressure, (2) the knife does not become blunt soon, as it does not come in contact with the upper plate, as is the case with Ranvier's microtome.

Imbedding in Celloidin.*—Dr. C. S. Minot advises that after dehydration in alcohol, the object should be placed for twenty-four hours in a mixture of equal parts of absolute alcohol and pure ether before immersing in the thin solution of celloidin. In this it remains for from one to three days, according to the size of the object, and is then imbedded in a thicker solution of celloidin.

This is best done as follows: A cylindrical cork of convenient diameter is selected; a strip of glazed paper wrapped round it tightly and fastened with a couple of pins as indicated in fig. 40. In the box thus formed the object is placed and the celloidin poured carefully over it. If necessary the object can be secured in any position by pins. Bubbles will rise from the cork and interfere with the imbedding; two precautions will essentially diminish this danger: 1. Pour in so much celloidin that it covers the object half an inch deep, giving an opportunity for the bubbles to rise above the tissue; 2. Before imbedding, cover the end of the cork with a thin layer of celloidin, which is allowed to dry on completely. After the object is covered, the cork is mounted on a lead sinker, and allowed to stand until a film has formed on the upper surface. It is then immersed in alcohol of 82–85 per cent. (stronger alcohol attacks the celloidin) for one to three days. The sections have to be cut under alcohol.

FIG. 40.



For mounting sections with celloidin left on them, Dr. Minot has found none of the methods hitherto recommended satisfactory, but after trying various reagents, considers chloroform the most convenient medium of transfer from alcohol to balsam. In using it, care must be taken to place the section for half a minute in perfectly fresh alcohol, which is really 95–96 per cent.; if this is done, chloroform will clear it up almost immediately. When the section is in chloroform on the slide, the mounting must be expeditious, and the balsam added *while the chloroform is still covering the section.* The transfer, particularly of a large section, from the spatula to the slide, with chloroform, is often very difficult. To mount a single section, put it in alcohol on the slide, wash with a few drops of fresh strong alcohol; let most of the alcohol drain off, but while the section is still covered with it add chloroform, drain off the mixture, and pour over the still moist section a fresh dose of chloroform; if the washings have been really thorough, the sections will clear at once.

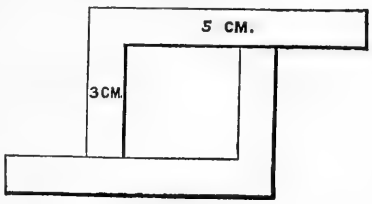
With regard to the paper-box, Dr. R. G. Hebb tells us that he has always used pill-boxes made of white board or of willow-wood.

* Amer. Natural., xix. (1885) pp. 828–9 (1 fig.).

They have all the advantages of the former, and are of all sizes and very cheap.

Imbedding-Box.*—A convenient box (fig. 41) introduced by Dr. Dimmock,† may be made of two pieces of type metal (or better of brass), each piece of metal having the form of a carpenter's square. A convenient size will be found in pieces measuring 5 cm. (long arm) by 3 cm. (short arm) and 7 mm. high. With such pieces a box may be constructed at any moment by simply placing them together on a plate of glass which has previously been wet with glycerin, and gently warmed. The area of the box will evidently vary according to the position given to the pieces, but the height can be varied only by using different sets of pieces.

FIG. 41.



Orientation of Small Objects.‡—Orientation becomes difficult only with objects so small that their position can be controlled only by the aid of a Microscope. Spherical objects, less than 1 mm. in diameter, e. g., many ova and embryos, are the most difficult to manage. Such objects may usually be successfully oriented in the following manner, as given by Dr. C. O. Whitman:—

1. Prepare the box; for this it will be necessary to use the two triangular pieces of metal, a rectangular glass plate (2 in. by 2½ in.). The plate should be cleaned and then smeared with glycerin, and the pieces of metal so adjusted that the arms are parallel with the edges of the plate.

2. Having warmed the box over a spirit-lamp, lift the object from the basin of paraffin by the aid of a *small, flat, thin* spatula (first starting it from the bottom by shaking the paraffin a little), and allow it to *flow* with the paraffin carried on the spatula into the box.

3. Then fill the box, 5–6 mm. deep, with the melted paraffin, and warm it a little over a spirit-lamp, just enough to keep *all* of the paraffin in a liquid condition for a few moments. Now place the box on a warm table of a dissecting Microscope, and by the aid of a hot needle proceed to place the object in the desired position. As the object is illuminated from below, it can be easily seen, turned over, and moved about at pleasure. If the paraffin sets before orientation is effected, it should be melted again as before, and the needle must be kept hot by repeatedly holding it in the flame of the lamp.

The difficulty of finding very small objects in a basin of paraffin will be very much lessened by keeping the paraffin free from dust, and the bottom of the basin (tin) scoured bright. A piece of emery cloth serves for polishing.

The necessity of re-warming the box of paraffin, which often arises

* Amer. Natural., xix. (1885) pp. 1247–8.
† Cf. this Journal, ii. (1882) p. 881.
‡ Amer. Natural., xix. (1885) p. 1248.

in the above method, may be removed by using a hot bath on the table of the Microscope. This bath should be a box of convenient size (not over 2 cm. high), with top and bottom of glass, with an opening at one end for filling with hot water, and another at the opposite end provided with a rubber tube and clamp, for drawing off the water as soon as the object has been arranged.

Prevention of Bubbles.*—After the imbedding process has been carried thus far, there is still another danger to be carefully guarded against. If the box is left to cool slowly in the air, bubbles are very likely to appear in the paraffin, which will prove a serious obstacle in cutting. Profiting by Caldwell's suggestion, to cool the box in water, one may avoid all such inconveniences. As soon as the paraffin cools around the object, so that its position is secured, the box should be held in a vessel of cold water, first at the surface (until the paraffin has set), then fully submerged. In this way the paraffin is quickly cooled sufficiently for removal from the box, which may then be used for imbedding a second object. A dozen objects may be thus imbedded in a very short time. If the box is plunged below the surface of the water before the paraffin has become rigid, holes will arise in the mass and fill with water.

Bulloch's Combination Microtome.—Since the description of this microtome was published, it has been further improved. The attachment for holding the knife consists of two discs, and when placed in position at zero, which is indicated by a spring stop, are 4/10 in. thick. Each disc is 2 in. in diameter and in the form of a wedge. The lower disc is divided into 25 parts, and by the proper position of each wedge any inclination or adjustment can be given to the knife. The periphery of the elevating wheel has a rachet with feeding attachment, but the adjustment for graduating the amount of elevation is on the block which carries the knife, and is worked by means of a sliding arm-piece, and can be gauged from one to twenty teeth, or 0·005 to 0·1 mm. By this arrangement the knife-carrier can be used on the full length of the bed at any adjustment of the feeding attachment. A ribbon carrier has also been attached.

Improved Roy Microtome.†—Figs. 42 and 43 show the Roy microtome as improved by M. C. Vérick, from suggestions by Prof. L. Malassez.

The special advantages presented by this instrument are that it cuts under water or spirit, and that the sections can be made of almost any desired thickness and in any direction. It is specially adapted for freezing, but can of course be used in the ordinary manner. In facility of management, rapidity of movement and sureness, it is claimed to be superior to all microtomes, and only yields to the Rivet microtome for extreme delicacy of sections.

The object to be cut is fixed in a metal tube fitted with a special but simple arrangement (not shown in the fig.), or if too soft to be

* Amer. Natural., xix. (1885) pp. 1248–9.

† Trav. Laborat. d'Histol. Collège de France, 1884 (1885) pp. 191–206 (3 figs.).

thus compressed, is first imbedded in carrot, pith, collodion, &c., or better still, fixed with liquid glue on a piece of wood.

Fig. 42.

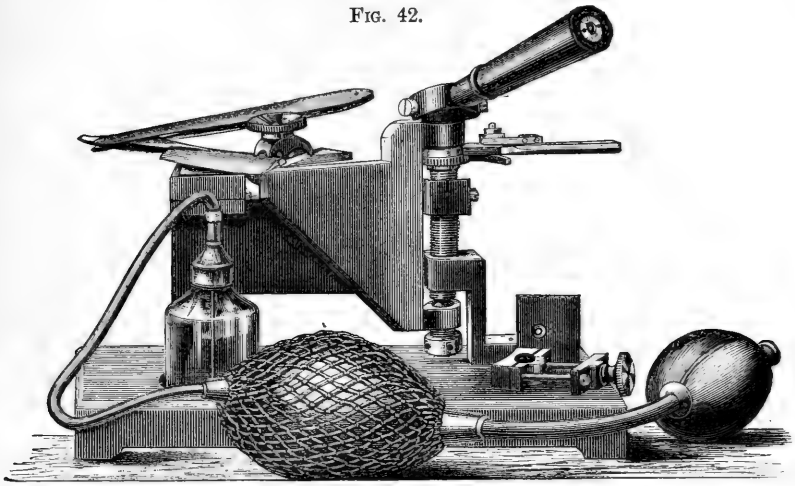
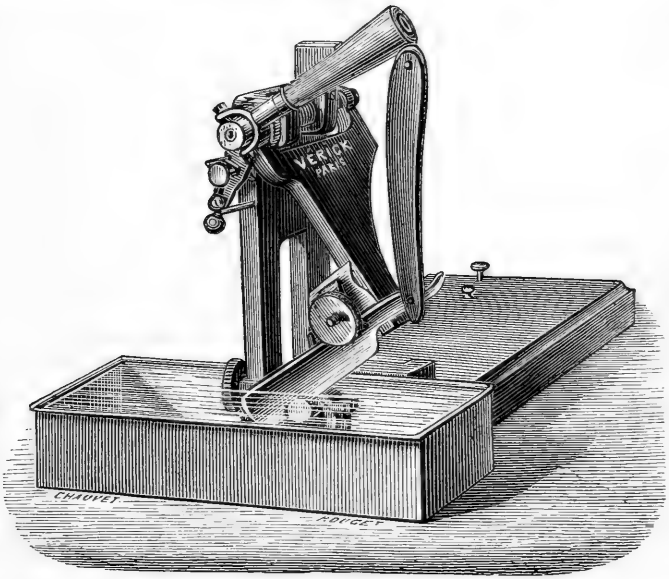


Fig. 43.



Any kind of razor may be used, and the knife may be placed in any position, and by the aid of thin metal blocks, any desired

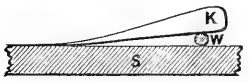
inclination may be imparted. The sections are made automatically and are of a definite thickness. By working to and fro the handle, which is in connection with the microtome screw, and having previously put the spring in action, the machine works automatically, cutting, at each complete turn, a section 1/100 of a millimetre in thickness. Thicker sections are made by stopping short just before cutting and reversing the action of the handle, &c.; thus two descents of the knife-carrier produce a section 0·02 mm. in thickness, and so on.

In cutting under water or alcohol the instrument is placed, as will be seen from fig. 43, in a position at right angles to that of fig. 42. A trough full of water or alcohol receives the object-carrier, and the sections fall off into the fluid.

When used for freezing, the object-grip or tube is replaced by a plate (fig. 42) beneath which is a reservoir for saving the superfluous ether. In place of ether Prof. Malassez advises the use of methyl chloride, which being volatile at the ordinary temperature and pressure, does not necessitate the use of a spray apparatus. A tin tube covered with caoutchouc and fitted with a stopcock is attached to the siphon which contains the methyl chloride. One jet of vapour is nearly always sufficient to freeze the object, and when this is effected it is advisable to place the machine in the vertical position and allow the sections to drop into a basin of water recently boiled or slightly alcoholized, in order to get rid of air-bubbles.

Sharpening Microtome Knives.*—Dr. C. O. Whitman considers that microtome knives can be properly sharpened only by those who understand their chief peculiarities, and who have trained themselves in this special work. The difficulties in acquiring the art are not, however, insurmountable; for with the proper means and a little perseverance they can be mastered in a short time. The first important step is to provide oneself either with a good razor-strop, or with a long and wide oilstone of the finest quality.

Fig. 44.



Strops made of a leather band, unsupported by a solid base, and kept tense by the aid of a screw working in a frame, should never be employed in sharpening these knives, for they invariably give a biconvex edge, with which it is impossible to do fine work. To secure a plane bevel of the cutting edge the surface of the strop must be perfectly smooth, flat, and hard. In using the strop the knife is drawn back and forth, back foremost, without pressure, until the edge appears sharp when tested in the manner before mentioned.

In using an oil-stone it is well to cover the surface of the stone with a mixture of glycerin (two parts) and water (one part). The blade is laid flat on the stone and pushed forward, edge foremost, in such a manner that the free end of the knife finishes by resting on the more distant end of the stone. Here the blade is turned on its back and returned, edge in advance as before, to the place of starting. In drawing the blade the utmost care should be taken never to raise

* Amer. Natural., xix. (1885) pp. 831–2 (1 fig.).

in the slightest degree the back from the stone; and further the knife must not be pressed on the stone, but held lightly by the finger-tips, and the necessary friction be left to capillary adhesion. After drawing the knife fifteen to twenty times it should be tested as before.

The knives furnished with the Thoma microtome should be provided with a wire support (fig. 44 *w*) for the back of the knife during the process of sharpening.

Chrome Mucilage as a Fixative.*—Dr. J. Frenzel recommends the following process:—Make a thin solution of gum arabic in water and add to this an aqueous solution of chrome alum. An excess of the latter does no harm. A little glycerin is added to the mixture to prevent it from drying too rapidly when painted on the slide.

After painting the slide with a small brush the sections are placed in order and the slide left for a few minutes (not over fifteen minutes) in the oven of a water-bath kept at 30–45° C. The gum is thus rendered insoluble. The paraffin is next removed in the ordinary way, and the sections stained according to desire. Fuchsin and safranin are the only anilin dyes which cannot be used, as they stain the film of gum deeply, and thus injure the preparation.

Fixing Serial Sections on the Slide.†—For this purpose gutta-percha dissolved in benzol and chloroform; caoutchouc dissolved in benzol; gum arabic; gum arabic dissolved in absolute alcohol; and collodion one part with three parts oil of cloves; have been used.

Dr. H. Leboucq's modification consists in combining the last two methods. He covers a warmed slide first with gum, and then with collodion. Sections still retaining their paraffin are placed upon the slide and the latter upon a glass plate warmed by a lamp. As soon as the paraffin is melted it is removed by means of turpentine oil or benzol, and finally the sections are mounted in Canada balsam.

Treatment of Sections with Osmic Acid.‡—Herr F. Stuhlmann has devised a method of treating tissues with osmic acid after they have been cut (by the paraffin method) and placed on a slide smeared with Mayer's solution of albumen and glycerin.

A few drops of the acid are placed in a watch-glass and the slide laid across it with the sections downwards; the whole is covered with a bell-glass to avoid undue evaporation, and kept for half an hour to an hour and a half. They are then stained a pale yellow, which is sufficient, but it is sometimes useful to stain them further with a watery solution of hæmatoxylin. The method is particularly useful for nerve-tissues.

Staining Nerve-fibres of Retina.§—Dr. S. Bernheimer colours pale nerve-fibres, especially those of the retina, with hæmatoxylin in the following manner.

* Amer. Natural., xix. (1885) p. 1246. From Arch. f. Mikr. Anat., xxv. (1885) p. 52.

† Ann. Soc. Méd. Gand, 1884, pp. 167–8. Cf. Virchow and Hirsch's Jahresbericht (for 1884) 1885, p. 41.

‡ Zool. Anzeig., viii. (1885) pp. 643–4.

§ SB. K. Akad. Wiss. Wien, xc. (1884) 6 pp. Cf. Virchow and Hirsch's Jahresbericht (for 1884) 1885, p. 40.

The preparations previously stained by Müller's fluid are thoroughly washed for twenty-four hours in distilled water, and then steeped for twenty-four hours in a concentrated alcoholic solution of hæmatoxylin, prepared fresh every time. To the latter (the exact quantity not given) are added four to five drops of an alum solution (1–300), and five to six drops of dilute ammonia. After twenty-four hours the solution is thoroughly washed and left in distilled water for twenty-four hours, and is then placed in glycerin.

Picroborate of Carmine.*—M. G. Dutilleul describes an alcoholic reagent which has all the advantages of picrocarmine without its disadvantages. It has great penetrating force and gives a double stain (yellow and red).

Mix, warm, equal volumes of borax-carmine and a saturated solution of picric acid, and add to the mixture one volume of 95 per cent. alcohol. Filter when cold. It can be kept indefinitely without leaving any deposit.

Staining with Iodine Vapour.†—Many of the micro-fungi, when mounted permanently in Canada balsam, become so transparent as to be nearly invisible. Mr. B. Piffard finds that if previously exposed to the action of iodine vapour, they assume, when mounted, a clear yellowish-brown colour by which their structure is beautifully defined.

Cold Mass Injection for Anatomical Preparations.‡ — The materials for this mass, which has been suggested by Herr A. K. Bjeloussow, are only two, viz. borax and finely powdered gum arabic. A solution of these substances is made separately, and the two solutions afterwards mixed in the proportion of one part by weight of gum to a half-part by weight of borax. The resulting mass resembles gelatin in its physical properties, and is almost insoluble in water. The gelatinous mass is next rubbed up with ordinary water, and then forcibly strained through a piece of linen. The last two steps are repeated once more, and then a solution, miscible with water in all proportions, is obtained.

Any pigments, except cobalt or cadmium colours, may be used to stain the injection mass. Carmine is perhaps the most useful, especially for fine capillary injection. Any injection apparatus may be employed to introduce the injection mass into the blood or lymph vessels. After injection, the object is placed in spirit, and this "sets" the injection mass. Should it be necessary to remove the mass from any part, this may be effected by dropping over it a little dilute acetic acid.

Mounting in Gelatin.§—Dr. L. Gerlach dissolves 40 grm. gelatin in 200 c.cm. of a saturated solution of arsenious acid, adds 120 c.cm. glycerin, and clears with albumen. The solution is yellowish. The

* Bull. Sci. Dép. Nord, xvi. (1885) pp. 371–2.

† Sci.-Gossip, 1886, p. 17.

‡ Arch. f. Anat. u. Physiol. (Anat. Abtheil.), 1885, pp. 379–84.

§ Cf. Virchow and Hirsch's Jahresbericht (for 1884) 1885, p. 68. From Gerlach's Beitr. zur Morphologie u. Morphogenie, pp. 118–20.

specimen is placed in a watch-glass with the solution, and then covered with a circular glass plate, at the edge of which is an evenly ground ring 1 cm. broad. The aperture is hermetically sealed first with melted wax, and on the following day with amberlac. Later on they are firmly fixed with a mixture of equal parts of guttapercha and tallow.

Styrax for Mounting.*—Professor A. B. Aubert, referring to Mr. Deby's statement (Vol. V. 1885, p. 745) that styrax never dries completely, states that his experience with the styrax of commerce has been the same; but that the southern sweet gum (the exudation of *Liquidambar styraciflua*), when treated as indicated by him,† gives a chloroform solution which hardens as thoroughly as the balsam solution, and has the advantage over it of rendering fine details more visible. As far as he had heard from persons using genuine American styrax (or storax), it has been satisfactory as a mounting medium, hardening thoroughly, and giving clear and in every way excellent mounts.

Meates's Mounting Medium.—Mr. W. C. Meates writes:—"I make this medium by taking one part of powdered metallic arsenic and six parts of pure sulphur, rub them together in a mortar, and put the mixture in a small test-tube, then apply heat by means of a spirit-lamp; the ingredients soon unite, and the sulphur turns a deep red. You must go on until the mixture has boiled for a minute or so, then pour it out on to a clean piece of glass, and let it cool. I am in the habit of forming drops on the glass about the size of a large pea, and, before the mixture is cold, keeping another piece of glass upon them so as to flatten them very much, then when cold break them up into small pieces.

It is very easily used, and it is not even necessary to finish them off with a pretty border, as the sulphide gets so hard when cold. I take a clean cover and place it on a very flat brass mounting table, then place the diatoms on it, and thoroughly dry it; then put a small piece of the sulphide on the centre, make it hot with a spirit-lamp until it melts and becomes of a deep red colour and on the point of flaming, then place the cleaned side centrally upon it, and with a piece of wood or lead pencil press them well together. The sulphide will extend all round, and on cooling will turn of a canary yellow colour. You can now immediately put the slide under the Microscope.

With this medium *Amphipleura pellucida* can be resolved as easily as in Smith's medium. With a Powell oil-immersion 1/8 and oil-immersion condenser I can distinctly see the markings in squares."

Limpid Solution of Dammar.‡—Dr. F. L. James finds no difficulty in getting a perfectly limpid solution of dammar if one will only use benzol sufficient to make a solution which will readily pass through filter paper. If the solution be too thin for immediate use, the surplus benzol is easily driven off by evaporation. If the amount be sufficient

* Amer. Mon. Micr. Journ., vi. (1885) p. 219.
† See this Journal, v. (1885) p. 744-5.
‡ St. Louis National Druggist, vii. (1885) p. 245.

to warrant the trouble, it can, of course, be recovered by distillation. The same result may be obtained by shaking up a thin solution of dammar with zinc oxide. The latter should be dropped into a bottle dry, and allowed to settle spontaneously. It carries down with it the suspended particles of dust upon which the turbidity of the solution depends.

Repairing Balsam Preparations.*—When balsam preparations have been made with a very thin solution, or with a small amount of fluid, evaporation sometimes causes the balsam to be invaded by air-spaces which it is difficult to refill, even with a thin solution of balsam. Such spaces Prof. E. L. Mark finds may readily be filled with the solvent of the balsam (benzol), and then a drop of thin balsam placed at the edge of the cover-glass will gradually replace the benzol as it evaporates, without leaving air-spaces. To prevent a too rapid introduction of the benzole, it is desirable to transfer it with a glass tube drawn to capillary fineness at one end, rather than with a glass rod. If the tube is not too large—5 or 10 mm.—and is drawn out quite gradually, enough benzole may be sucked into it to serve for repairing a large number of slides without danger of loss by its running out or by evaporation when the tube is laid down. The application of the capillary end of the tube to the edge of the cover-glass induces a steady and even flow of the fluid, until the space beneath the cover-glass is completely filled.

Arranged Diatoms.†—Mr. C. Febinger, who has made some excellent arranged mounts, uses as an adhesive material to hold the diatoms when placed in position, gelatin (the best photographer's) dissolved in six times its weight of glacial acetic acid. This should be done in a porcelain capsule with a water-bath. When the solution is complete, add one part of alcohol to every fourteen parts of the solution and filter. It is spread on the slide with a glass tube or needle.

Gold-plated Diatoms.—Mr. A. Y. Moore has now gold-plated some diatoms, but we have not heard whether they show any practical advantage over the slides of silvered diatoms which he recently produced.

Test Diatoms.—Amphipleura pellucida and A. Lindheimerii.—Mr. J. Deby sends the following note:—"Don Alfredo Truan y Luard, in his very interesting and well illustrated 'Ensayo sobre la Synopsis de las Diatomeas de Asturias,' gives full instructions for collecting, selecting, and mounting diatoms, and much original matter relating to the microscopical examination and study of the Diatomaceæ. The fact to which I wish, however, particularly to draw attention is his having discovered in the north of Spain, abundantly, as he states, *Amphipleura Lindheimerii*, a species hitherto known only from South America. In a footnote, the author states that Herr Möller of Wedel has asked him for a number of these diatoms, to be mounted by him as test objects. Now *A. Lindheimerii* is larger and has very much coarser striæ, easy of resolution, yet non-specialists

* Amer. Natural., xix. (1885) p. 1137.

† St. Louis National Druggist, viii. (1885) p. 196.

would have trouble to distinguish it from the commoner European species. I do not suspect for one minute that Herr Möller himself would knowingly offer for sale test slides of the coarser diatom under the name of *A. pellucida;* but others might be found not quite so scrupulous.

Special slides, it is well known, are often kept of *A. pellucida*, of *P. angulatum*, of *F. saxonica*, of *Surirella gemma*, and others, for the best exhibition of high-power objectives; and these pet 'coarse' slides are in general not willingly parted with by their fortunate owners. My advice is, 'Make sure in future that the *A. pellucida* you resolve with ease is not one of Don Truan y Luard's *A. Lindheimerii.*'

This last diatom is figured in Grunow, 1862, pl. XI. fig. 11, and was distributed by Prof. H. L. Smith, in his 'Species Typicæ,' No. 17. A careful examination of either of these will prevent any confounding of the two species."

Bevel-edge Slips.*—The Palmer Slide Company, of Geneva, N.Y., have recently introduced slips with bevel edges. These are said to be "certainly very attractive in appearance, and well adapted for ornamental preparations." Some are plain glass, very colourless and free from defects, others are flashed with a colour on the under surface, which modifies the light, or adapts them very well for opaque mounting. Careless handling may, however, result in chipped corners.

Mr. G. S. Woolman, in further recommendation of the slips, says, "Aside from the great beauty of the finished object, making them the most elegant slide yet introduced, their bevel edge allows them to slide smoothly under spring clips on the stage of the Microscope. They are made of Chance's crystal plate and Chance's flat crown, and with ground edges, or ground and polished edges."

Adhesiveness of Cements.*—Prof. A. B. Aubert has made comparative tests of various cements, using metallic cells, and leaving the cement to harden for 103 days.

Starting with Miller's cement = 1000, the following table represents the comparative adhesiveness of the cements tested:—

Miller's caoutchouc cement	1000
Bell's cement (shellac in alcohol?)	735
Canada balsam	664
Lovett's cement (this Journal, III. 1883, p. 786)	626
American styrax	575
King's cement	532
Gold size	395
Dissolved marine glue	304
Zinc white cement	241

The gold size was not sufficiently hardened or it would have been higher in place.

Strong Cements‡.—The following formulæ are given anonymously for cementing brass cells to glass slides:—

* Amer. Mon. Micr. Journ., xi. (1885) p. 239. † Ibid., vi. (1885) pp. 227–9.
‡ Micr. Bulletin (Queen's), ii. (1885) p. 45.

1. Carbonate of lead, 1/2 oz.; red oxide of lead, 1/2 oz.: litharge, 1½ oz. Grind thoroughly together in a mortar. Stir some of this into enough gold size to make it work stiffly. If too much adheres to the work, turn it off on turntable when a little set.

2. Best quality gum arabic, dissolve in cider vinegar; add a little sugar. A very strong cement, but not tested for durability.

Test for Preservative Fluids.*—Dr. C. O. Whitman considers that one of the best objects for testing methods is found in *Phronima sedentaria*. Here the cells and nuclei are so sharply defined that they can be seen in the living animal, and so the effect of a preservative fluid can be easily studied.

Molybdic Acid Test for Protoplasm.†—If a section of some living endosperm is treated with a solution of molybdic acid in strong sulphuric acid, the cell-wall will swell up, and the threads which traverse it will soon assume a blue colour, while the main mass of protoplasm becomes intensely blue. The cell-wall itself remains uncoloured. This very delicate reaction demonstrates the protoplasmic nature of the threads.

Butter and Fats.‡—Dr. T. Taylor in a further paper on this subject, in which he repeats the results already recorded,§ says that he has examined a number of other fats, vegetable and animal, and finds thus far, that animals and vegetables of distinctly different genera and even species, yield fats which give typical fatty crystals characteristic of the animals and plants which yield them, and he is confident that this new discovery will prove highly useful to microscopists and chemists, when investigating adulterated substances used as food or in medical preparations.

Micro-organisms in Potable Water.‖—Dr. T. Leone's researches tend to show that water which contains carbonic acid is detrimental to the existence of micro-organisms. His experiments were made with a typically pure potable water (Maugfall of Munich), in order to ascertain the number of micro-organisms which could be developed in a given time.

After repeated examinations it was found that on the fifth day this water contained more than half a million of micro-organisms to every cubic centimetre. It was further demonstrated that there was no practical difference between the number of micro-organisms developed in water kept at rest, or constantly agitated for a given period of time.

When, however, carbonic acid gas was passed for a period of half an hour through flasks filled with this Maugfall water, the number of

* 'Methods in Microscopical Anatomy and Embryology,' 1885, p. 16.

† Ibid., p. 212.

‡ The Microscope, v. (1885) pp. 212–4 (8 figs.). Cf. also Amer. Mon. Micr. Journ., vi. (1885) pp. 163–4 (8 figs.).

§ See this Journal, v. (1885) p. 918.

‖ Atti R. Accad. Lincei—Rend., i. (1885) pp. 726–32. Cf. transl. in Chem. News, lii. (1885) pp. 275–6.

micro-organisms actually diminished. After being kept fifteen days the water thus treated was found to contain only two micro-organisms to 1 c.cm. Hence the results of these experiments leave no doubt that carbonic acid is an impediment to the existence of micro-organisms in potable water. The practical importance of this of course is obvious, and needs no comment for those who are accustomed to drink waters "aerated" with carbonic acid, for according to Dr. Leone, the longer these aerated waters are kept the less chance there is of their being contaminated with bacterial impurities.

Microscopical Structure of Iron and Steel.*—Dr. H. C. Sorby has dealt with this subject in a paper read before the Iron and Steel Institute, and from which we extract the parts which refer to the preparation of the objects and their illumination.

The microscopical study of fractured surfaces is, he considers, unsatisfactory, not only on account of the optical difficulties, but because a fracture shows the line of weakness between the crystals, and not their internal structure. All his results were therefore based on the examination of flat sections. These should be finished by grinding with Water of Ayr stone, and polished so as not to alter the true structure of the extreme surface. Anything approaching to a burnished surface or polished scratches is fatal to good results. In general, after having been polished with the finest rouge and water, so as to show few or no scratches, the surface was acted on by very dilute nitric acid, and repeatedly examined in a small trough of water, until it was found that the acid had properly developed the structure. In some cases it is, however, best to polish with dry rouge on parchment, and not to use acid. Thin glass covers were afterwards mounted over the surface with Canada balsam. Some of his preparations have kept perfectly well for above twenty years, but others have deteriorated considerably.

Objects thus prepared must be examined by means of two special kinds of surface illumination, viz. first, the side parabolic reflector now common, but the author believes originally made for this purpose, which gives oblique light, and secondly, a small silver reflector, covering half the object-glass, which throws the light directly down on the object, and from this it is reflected back through the other half of the lens (see *supra* p. 130, fig. 14). With the oblique illumination, a polished surface looks black, but with the direct illumination it looks bright and metallic. A truly black substance appears black in both cases. A magnifying power of about sixty linear is most generally suitable, but the sections will bear a higher perfectly well.

In commenting on a paper on the properties of malleable iron by Dr. H. Wedding, Dr. Sorby wrote†:—"As far as I can judge the reason why his (Dr. Wedding's) conclusions differ so much from mine is that his sections were not ground down with soft stone before final polishing. It was not till I adopted this method that I was able to see the ultimate structure properly. This explains why he

* Sorby, H. C., 'On the Microscopical Structure of Iron and Steel,' 8vo, Iron and Steel Institute, 1885, 8 pp.

† Colliery Guardian, xlix. (1885) p. 908.

has not been able to detect the ultimate crystals in bar iron. My sections of these show it splendidly, as will be seen when I exhibit the microscopical photographs taken from the objects themselves. What strikes me as so strange is that he has not appreciated the total and complete difference between the intensely hard constituents of blister steel and white iron, and soft iron of a malleable bar. Possibly this may be in part due to the illuminative employed. The direct illuminative contrived by me is so indispensable, that I feel sure that no one can arrive at sound conclusions without it, and I feel almost sure he did not use it."

Microscopical Chemical Reactions.*—Herr A. Streng, from the frequent application of chemical methods in the examination of rocks, is enabled to improve and simplify the methods of microscopical chemical research. He gives microscopical reagents for potassium, sodium, lithium, calcium, strontium, barium, magnesium, aluminium, and phosphoric anhydride.

Hussak's Guide to the Determination of Rock-forming Minerals.†—The first part of this book deals with methods of research, describing Microscopes and apparatus, and giving directions for making preparations. Optical methods and chemical methods of investigation are detailed, as well as the mechanical separation of the minerals by biniodide of potassium and mercury, biniodide of barium and mercury, Klein's solution, acids, and the electro-magnet.

The second and principal part (pp. 81–191) of the book consists of well-arranged tables, in which the properties of the various minerals are placed in columns (in some cases as many as seventeen), showing at a glance the various points required to be known for their identification.

Whitman's 'Methods in Microscopic Anatomy and Embryology.'‡—Dr. C. O. Whitman, of Boston, U.S.A., is well known to the readers of this Journal as an able writer on all branches of microscopical technique, and in this book he has brought together not only the results of his own practical experience, but the principal methods in use at the present time. The result is a well-arranged and very useful work for the practical microscopist, and the more useful as it has not been limited to histological requirements only, but includes to a large extent embryological also.

The book is divided into two principal parts, (1) general methods and (2) special methods. The former includes methods of killing, hardening, preserving, bleaching, macerating, decalcifying, desilicifying, staining, and imbedding, with a description of microtomes, and chapters on fixatives for serial sections, mounting media, and the uses of collodion. The special part is subdivided into embryological methods, times and places of ovulation, nuclei, (karyokinetic figures, &c.), preparation of nervous-tissue, histological methods, and recon-

* Jahrb. f. Mineral., 1885, i. Mem. pp. 21–42.

† Hussak, E., 'Anleitung zum Bestimmen der Gesteinbildenden Mineralien,' iv. and 196 pp. and 103 figs. 8vo, Leipzig, 1885.

‡ Whitman, C. O., Methods of Research in Microscopical Anatomy and Embryology,' ix. and 255 pp. and 37 figs., 8vo, Boston, 1885.

struction from sections. An appendix describes methods of injection and museum methods, and gives formulæ for most of the important reagents, &c."

Examination of Blood. — If we did not fear to disturb the exceptional harmony which has always existed between English microscopists and their American colleagues, we should be tempted to preface the extract here given by the stereotyped formula of the newspapers, "The following is from an American source":—

"A man was found shot in his bedroom, while his wife was lying wounded in another part of the room. She said that her husband had come home in a rage, hit her on the head with the butt of his revolver while her head was on the pillow, and spattered blood over the linen; that she jumped up, and he shot her. She then rushed at him, and, snatching the revolver, shot him through the heart. He reeled to the corner where he was found, and died. The prosecution did not believe her story, and set up the theory that she shot him when he was asleep, and dragged him to the corner, and then inflicted the wound upon herself. The carpet where the dead man lay was saturated with blood. According to the theory of the prosecution, the blood on the pillow was his also.

Dr. Piper put the section of the pillow with blood upon it under the Microscope, and drew the shape of the corpuscles, enlarged about 2000 diameters. He then put the blood on the carpet under the Microscope in the same way. The comparison settled the question at once. The blood-corpuscles were as different as day and night, and sustained the woman's account of the shooting. She was acquitted on that and other evidence." *

Dr. C. H. Stowell, amongst other sarcastic comments on this story, suggests † that "perhaps when a man is on a pillow his blood-corpuscles are softer and rounder than when on a hard flat carpet."

Microscopical Jurisprudence.‡—Dr. H. J. Detmers cites a case recently on trial in Illinois, where a murder was committed in an old ice-house. The murdered man was found lying on a pile of pine sawdust. A man was arrested for the murder upon whose boots and pantaloons small particles of sawdust were found clinging. He exclaimed that he had not been near the ice-house where the murder was committed, but had been sleeping in another ice-house several yards away. It was conclusively shown that all the sawdust in the house where he claimed to have been was from hard wood. There was no hard wood sawdust in the house where the murder was committed. Particles of sawdust from the prisoner's boots and clothes were placed under the Microscope by an expert, who conclusively proved that it was pine sawdust exactly like that found at the scene of the murder. The microscopist's evidence led to the conviction of the prisoner.

* The Microscope, v. (1885) pp. 234–5. From 'Scientific American.'
† Ibid, p. 230. ‡ Amer. Mon. Micr. Journ., vi. (1885) p. 199.

ARTHUR, J. C.—**Some Botanical Laboratories of the United States.**
[Describes twelve laboratories, with the Microscopes, &c., used. "The number of compound Microscopes employed is above twenty on the average for each Institution, while the number of students who make use of the laboratories during the year ranges from fifty to a hundred."]
Bot. Gazette, X. (1885) pp. 395-406 (5 figs.).

" " **A Germinating Pan.**
[Found so satisfactory at the New York Agricultural Experiment Station as to supersede all others.]
Ibid., pp. 425–6 (2 figs.).

AUBERT, A. B.—**Styrax for mounting.** [*Supra*, p. 171.]
Amer. Mon. Micr. Journ., VI. (1885) p. 219.

" " **Results of Experiments upon the adhesiveness of some Microscopical Cements.** [*Supra*, p. 173.] *Ibid.*, pp. 227–9.

B. SC.—See Wood Sections.

Bausch & Lomb Microtome.
[Laboratory microtome. See this Journal, V. (1885) p. 1089.]
Amer. Mon. Micr. Journ., VI. (1885) pp. 205–7 (1 fig.).

BECKER, A.—**Neuerung an Mikrotomen.** (Improvement in Microtomes.)
Title only of German Patent, Kl. 42, No. 6065.

BELL, J.—**[Instrument for making Cells.]**
[A home-made arrangement.] *Engl. Mech.*, XLII. (1886) p. 407 (1 fig.).

BELLONCI, G.—**Del fuso direzionale e della formazione di un globulo polare nell' ovulo ovarico di alcuni mammiferi.** (On the structure and formation of a polar globule in the ovule of some mammalia.)
[Process of preparation, *post*.] *Rend. R. Accad. Lincei*, I. (1885) pp. 285–6.

BERNHEIMER, S.—**Zur Kenntniss der Nervenfaserschicht der menschl. Retina.** (On the knowledge of the nerve-fibres of the human retina.) [*Supra*, p. 169.]
SB. K. Akad. Wiss. Wien, XC. (1884).

BIGG, J. S.—See Wood Sections.

BOOTH, C. F.—**Limpid Solution of Damar.** [Cf. *infra*, James, F. L.]
St. Louis National Druggist, VII. (1885) p. 245 and 293.

BOTTONE, S.—See Wood Sections.

BURRILL, T. J.—**Section Cutting.**
[Directions for cutting botanical specimens. "Nothing new is offered."]
Bot. Gazette, X. (1885) pp. 421–4.

" " **Starch Grains.** [*Post*.] *Ibid.*, pp. 424–5.

" " **Germination of Fungus Spores.** [*Post*.] *Ibid.*, p. 428.

" " **Exhibiting streaming of Protoplasm.** [*Post*.]
Ibid., pp. 428–9.

CAMPBELL, D. H.—**A Method of Spore Germination.** [*Post*.] *Ibid.*, p. 428.

Carmine, Preparation of.
[Madame Cenette's and other processes.]
Engl. Mech., XLII. (1885) p. 297.

CARPENTER, J.—**Foraminifera to mount in Balsam.** [*Post*.]
Journ. of Micr., V. (1886) p. 50.

Castellarnau, J. M. de.—**Procédés pour l'examen microscopique et la Conservation des Animaux à la station zoologique de Naples.** (Methods for the microscopical examination and preservation of animals at the Zoological Station of Naples.)
[Transl. by Dr. J. Pelletan of second part of the Report noted Vol. V. (1885) p. 746.]
Journ. de Microgr., IX. (1885) pp. 405–410, 482–7.
Cf. also pp. 323–4.

Cement for fixing Wood to Glass.
[Gelatin dissolved in hot acetic acid in such proportions that it solidifies on cooling.]
Journ. of Micr., V. (1885) p. 67, from *Chem. Rev.* and *Echo Forestier*.

Cements, Strong. [*Post*.] *Micr. Bulletin* (*Queen's*), II. (1885) p. 45.

Cleaning Glass Slides and Covers.

[First wash well in a solution of soda or potash; if this does not suffice, use the following:—Bichromate of potash, 2 oz.; sulphuric acid, 3 fluid oz.; water, 25 oz.; and afterwards thoroughly rinse in warm and cold water.]

The Microscope, V. (1885) p. 215.

COLE, A. C.—**Studies in Microscopical Science.** Nos. 11 and 12, pp. 41–4, 45-8.

Sec. 1. (Botanical Histology.) Structure of the Sexual Organs of Reproduction in Angiosperms. No. 1. Anther of *Lilium*. Plate XI. Trans. Sect. No. 2. Ovary of *Lilium*. Plate XII. Trans. Sect. of Mature Ovary.

Sec. 2. (Animal Histology.) On the disposition of the Organs in the Invertebrata and Vertebrata. Plate XI. Earthworm (*Lumbricus terrestris*). Trans. Sect. posterior half of body. Semi-diagrammatic. Plate XII. Young Lamprey (*Petromyzon fluviatilis*). Trans. Sect. through anterior abdominal region × 30.

Sec. 3. (Pathological Histology.) Pleurisy (*concld.*). Pulmonary Carcinoma. Plate XI. Lung. Carcinoma × 38. Anthracosis (Collier's Phthisis). Plate XII. A. of Coal Miner's Lung × 6⅔.

Sec. 4. (Popular Studies.) Insectivorous and Carnivorous Plants (*concld.*). *Trichina spiralis*. Plate XI. Long. and Trans. Sect. × 250. The Diatom *Cestodiscus superbus*. Plate XII. × 690.

Collins' (C., jun.) "Special" Micro-Slides.

[Fish scales and skins. Heads of Insects. Parasites. The Silkworm and Moth. Anatomy of Blow-fly, Honey Bee, Great Water Beetle, and Oil Beetle. Palates in fluid and for Polariscope.]

Sci.-Gossip, 1885, p. 259.

COULTER, J. M.—**Laboratory Appliances.**

[Microscopes, microtomes, forceps, reagents, &c.]

Bot. Gazette, X. (1885) pp. 409–13.

„ „ **Cultivation of Pollen-spores.** [*Post.*] *Ibid.* 427.

CROOKSHANK, E. M.—**An Introduction to Practical Bacteriology based upon the Methods of Koch.** [*Supra*, p. 121.]

xxii. and 249 pp., 30 pls. and 42 figs. (8vo, London, 1886).

DEBES, E.—**Die Herstellung von Diatomaceen-Dauer-präparaten.** (Making permanent preparations of Diatoms.)

[Supplementary notice to his original paper on Hamilton L. Smith's Media, Vol. V. (1885) p. 1097.]

Hedwigia, XXIV. (1885) pp. 251–2.

DIMMOCK, G.—[**Separating the Layers of the Wings of Insects.**] [*Post.*] *Psyche*, 1884, p. 170.

DOCTOR MEDICINÆ.—See Wood Sections.

DRAPER, E. T.—**Graphic Microscopy.** XXIV. Eggs of Parasite of Vulture. *Sci.-Gossip*, 1885, p. 265 (1 pl.).

DUTILLEUL, G.—**Le Carmin Picroborate.** (Picroborate of Carmine.) [*Supra*, p. 170.] *Bull. Sci. Dép. Nord*, XVI. (1885) pp. 371–2.

ENAL.—**Microscopical Examination of Yeast.**

[Directions for examining staining, &c. Recipe for Pasteur's fluid.]

Engl. Mech., XLII. (1885) p. 325.

„ **Dry Mounting.** Zinc Cements. [*Post.*] *Ibid.*, p. 340.

ERDÖS, J.—**Eine Vorrichtung am Thoma'schen Mikrotom zum Schnellschneiden.** (A contrivance for rapid cutting with the Thoma microtome.) [*Post.*]

Internat. Monatsschr. f. Anat. u. Histol., II. (1885) pp. 343–6 (figs.).

Flemming's Method of preparing the Retractile Tentacles of Pulmonata.

Amer. Natural., XIX. (1885) pp. 1246–7, from *Arch. f. Mikr. Anat.*, V. (1870) p. 440, and *Zeitschr. f. Wiss. Zool.*, XXII. (1872) p. 366.

Frenzel's (J.) Chrome Mucilage as a Fixative. [*Supra*, p. 169.]

Amer. Natural., XIX. (1885) p. 1246, from *Arch. f. Mikr. Anat.*, XXV. (1885) p. 52.

„ „ **Method of preparing the Alimentary Canal of Crustacea.** [*Supra*, p. 158.] *Amer. Natural.*, XIX. (1885) p. 1246, from *Arch. f. Mikr. Anat.*, XXV. (1885) pp. 141–143.

GARBINI, A.—**Di un nuovo metodo per doppia Colorazione.** (On a new method of double staining.) [*Post.*] *Zool. Anzeig.*, IX. (1886) pp. 26–9.

GERLACH, L.—**Technische Notiz.** (Note on Technique.) [*Supra*, p. 170.] *Beitr. zur Morphol. u. Morphog.*, I. (1883) pp. 118–120.

Gierke, H.—**Staining Tissues in Microscopy. V., VI.**
[Transl. from 'Zeitschr. f. Wiss. Mikr.']
Amer. Mon. Micr. Journ., VI. (1885) pp. 210–6, 234–6.

Gottsche and Grenacher's methods of isolating the dioptric layers of the Compound Eye.
[Gottsche, from 'Müll. Arch.' 1852, pp. 488–9. Grenacher, from 'Das Sehorgan d. Thiere' (?) p. 148.] *Amer. Natural.*, XX. (1886) pp. 91–2.

Grenacher's Methods of preparing the Arthropod Eye.
[Hardening Fluids (alcohol 70–90 per cent.) Bleaching (nitric acid 20–25 per cent., or glycerin, alcohol, and hydrochloric acid.] [*Post.*]
Amer. Natural., XX. (1886) pp. 89–90.

HAZLEWOOD, F. T.—**Permanent Mounting of Tracheæ of Insects.**
[*Supra*, p. 157.] *The Microscope*, V. (1885) p. 235.

HENNING, P.—**Preserving Plants.**
[For the last three years, certain fruits, flowers, and other portions of plants have been preserved in perfect condition at the Berlin University (Botanical Museum), by means of a solution consisting of four parts of water and one part of alcohol saturated with salicylic acid.]
Bull. Torrey Bot. Club, XII. (1885) p. 121.

HICKSON, S. J.—**The Eye of Insects.**
[Summary of some of the methods in his paper, Vol. V. (1885) p. 633.]
Amer. Natural., XX. (1886) pp. 88–9.

[HITCHCOCK, R.]—**Smith's new Mounting Media.**
[The stannous chloride is not the bichloride of pharmacists, but the protochloride of tin—the 'salts of tin' of dyers. Wax rings should be used.]
Amer. Mon. Micr. Journ., VI. (1885) p. 217.

JAMES, F. L.—**White Zinc Cement.**
[*Ante*, Vol. V. (1885) p. 1101.]
St. Louis National Druggist, VII. (1885) p. 181,
Amer. Natural., XIX. (1885) pp. 1138–9.
See also p. 196 as to the difference between benzin and benzol.

" " **Limpid Solution of Damar.**
[Methods of securing a limpid solution with much less trouble than that of Mr. C. F. Booth, *supra*.]
St. Louis National Druggist, VII. (1885) p. 245.

" " **Cleaning Slides.** [*Post.*]
The Microscope, V. (1885) pp. 253–4, from *St. Louis National Druggist.*

" " **Separation of Sand from Diatoms and Foraminifera.** Cleaning Diatoms. *Micr. Bulletin* (*Queen's*), II. (1885) pp. 43 and 45, from *St. Louis National Druggist.*

" " See Stowell, C. H. and L. A.

James's (Dr. F. L.) Cements. *St. Louis National Druggist*, VII. (1885), p. 307.

JENKINS, A. E.—**Methods of Study.**
[Fixing and hardening: Picro-sulphuric acid (Kleinenberg's fluid); corrosive sublimate; perchloride of iron. Hardening: Special methods: Dissociating or macerating fluids; Müller's fluid; Eau de Javelle; nitric and hydrochloric acid; chalk and baryta waters; potassium hydrate. Decalcifying: Chromo-nitric acid; picro-nitric acid. Removing silica. Iodine. Hot water. Acid alcohol. General remarks on killing fluids.]
The Microscope, V. (1885) p. 243–50.

KELLICOTT, D. S.—**[Modified Pipette.]**
["The glass tube passes completely through the ball, the end of the tube being closed with a cork or hermetically sealed; holes for suction being drilled through that portion of the tube enclosed within the ball. The advantages of this contrivance lie in the increased firmness in handling the pipette, and consequently greater suction-power."]
Science, VI. (1885). Not paged, 2nd page after p. 524.

KLÉMENT and RENARD.—**Réactions Microchimiques basées sur la formation de cristaux et leur application à l'analyse qualitative.** (Micro-chemical reactions based on the formation of crystals and their application to qualitative analysis.)

[Résumé of paper to appear in the 'Annales.']

Bull. Soc. Belg. Micr., XII. (1885) pp. 11–16, 32–5.

KRAUSE, W.—**Untersuchungsmethoden.** (Investigation methods.)

[For preserving and isolating the retinal elements, a 10 per cent. aqueous solution of chloral hydrate is recommended. It is superior in many respects to osmic acid.]

Internat. Monatsschr. f. Anat. u. Histol., I. (1884) pp. 152–7.

KÜKENTHAL, W.—**Vereinfachung der Färbetechnik.** (Simplification of Staining Technique.) [*Post.*]

Zool. Anzeig., ix (1886) pp. 23–5.

LACROIX, A.—**Examen optique de quelques minéraux peu connus.** (Optical examination of some little known minerals.)

["The study by the Microscope with parallel and convergent light, of thin plates of minerals, gives at the present day to their determination a degree of certainty which was wanting when it was not possible to verify the purity of the substances submitted to analysis,"—followed by descriptions of Kirwanite and four other minerals.]

Comptes Rendus, CI. (1885) pp. 1164–6.

LATHAM, V. A.—**The Microscope and how to use it.**

[V. Double-staining, &c.]

Journ. of Micr., V. (1886) pp. 36–43.

LEBOUCQ, H.—**Un mot sur la Technique des coupés en series.** (A word on the technique of series sections.) [*Supra*, p. 169.]

Ann. Soc. Méd. Gand, 1884, pp. 167–8.

LÉPINAY, MACÉ DE.—**Méthode optique pour la mesure absolue des petites longueurs.** (Optical method for the absolute measurement of minute lengths.)

Comptes Rendus, C. (1885) pp. 1377–9.

LONG.—**Test for Beeswax.**

[A few drops of solution in chloroform shows in half an hour characteristic dumbbell crystals, the balls of which consist of curved crystal bundles instead of solid masses.]

St. Louis National Druggist, VII. (1885) p. 293, from *Chem. Ztg.*

LOWNE, B. T.—**Method of Examining the Reflex in the Compound Eye of Insects.** [*Post.*]

Amer. Natural., XX. (1866) pp. 90–1, from *Trans. Linn. Soc. Lond.*

MALASSEZ, L.—**Microtome de Roy perfectionné.** (Improved Roy Microtome.) [*Supra*, p. 166.]

Travaux Laborat. d'Histol. du Collège de France, 1884 (1885) pp. 191–206 (3 figs.)

MALASSEZ, L., and W. VIGNAL—**Sur le Micro-organisme de la Tuberculose Zooglœique.** (On the Micro-organism of Zoogloeic Tuberculosis.)

[Methods, *post.*]

Ibid., pp. 18–42 (2 pls.)

MEYER, A.—**Mikrochemische Reaction zur Nachweis der reducirenden Zuckerarten.** (Microchemical Reaction for demonstrating the reducing kinds of sugar.) [*Post.*]

Ber. Deutsch. Bot. Gesell., III. (1885) p. 332.

MOELLER, J.—**Mikroskopie der Nahrungs- und Genussmittel aus dem Pflanzenreiche.** (Microscopy of the nourishing and useful substances of the vegetable kingdom.)

[Introduction, pp. 1–24 (Preparation, Reagents, Measuring, Drawing.)]

vi. and 394 pp., 308 figs. (8vo, Berlin, 1886).

Mounting Microscopic Objects.

[Staining Wood Sections. (Carmine or logwood, but better double stained. To fix the anilin stain, tannic acid is useful.) Orange Peel. (Gum method is preferable. After drying between glass slips, soak in turpentine and mount in balsam.) Sponge. (Cut between pieces of cork, or immerse in paraffin or mucilage.)]

The Microscope, V. (1885) pp. 238–9.

Mucilage for Slide Labels.

[As used for postage stamps. Dissolve 2 oz. dextrine in 1 oz. acetic acid diluted with 5 oz. water; when dissolved add 1 oz. alcohol.]

Micr. Bulletin (*Queen's*), II. (1885) p. 46.

Müller, K.—**Diatoms and how to collect them.** [*Supra*, p. 153.]

Amer. Mon. Micr. Journ., VI. (1885) pp. 230–1 (*Transl.* of private letter).

MYLIUS, C.—See SYDOW, P.

P., J. W.—**Glass-covers in the Tropics.**

[Cover-glasses should not be brought into the Tropics bedded in lime or chalk. They should be glued together by a little clove oil run in between the plates by capillary attraction.]

Sci. Gossip, 1885, p. 279.

PEARCEY, F. G.—**Method of Consolidating and Preparing thin sections of friable and decomposed Rocks, Sands, Clays, Oozes, and other granulated substances.** [*Supra*, p. 160.] *Proc. R. Phys. Soc. Edin.*, VIII. (1885) pp. 295–300 (1 pl.).

PENNINGTON, A. S.—**British Zoophytes:** an introduction to the Hydroida, Actinozoa, and Polyzoa, found in Great Britain, Ireland, and the Channel Islands.

[Zoophyte collecting and preserving, pp. 336–40.]

xvi. and 363 pp., 24 pls. (8vo, London, 1885).

PIFFARD, B.—**Staining with Iodine Vapour.** [*Supra*, p. 170.]

Sci.-Gossip, 1886, p. 17.

REEVES, J. E.—**Staining Urinary Sediment.**

Micr. Bulletin (*Queen's*), II. (1885) p. 48.

RENARD.—See Klément.

RIGGS, J. V.—**Resorcin and Antipyrine.**

["Crystallized from their alcoholic solutions upon the slide make most magnificent specimens of crystals for polarized light."]

Micr. Bulletin (*Queen's*), II. (1885) p. 46.

SARGENT, F. L.—**A Spring Clip.**

[Made of a rather large hairpin with ends bent with pliers.]

Bot. Gazette, X. (1885) p. 425 (1 fig.).

SERRANO Y FATIGATI, E.—**Precipitacion de cristales en el campo del Microscopio.** (Precipitation of crystals in the field of the Microscope.)

[*Post.* Cf. also "Fatigati, E. G.—Recherches sur les réactions chimiques dans le champ du Microscope." Title only of paper read at Stockholm Academy of Sciences, Nov. 11th. *Nature*, XXXIII. (1885) p. 216.]

Anal. Soc. Espan. Hist. Nat., XIV. (1885), *Actas*, pp. 58–60.

SLACK, H. J.—**Pleasant Hours with the Microscope.**

[Sclerogen cells of pear.] *Knowledge*, IX. (1885) p. 48 (3 figs.).

SMITH, H. L.—**Directions for using the Stannous Chloride medium in mounting Diatomaceæ.**

[Similar to that given Vol. V. (1885) pp. 1097–8.]

Micr. Bulletin (*Queen's*), II. (1885) p. 46.

Staining, double. *The Microscope*, V. (1885) p. 214–5.

STEIN, S. v.—**Einfache Vorrichtung für das Microtom zur Einbettung der Präparate.** (Simple arrangement for the Microtome in imbedding preparations.)

[*Supra*, p. 163.] *Centralbl. f. d. Med. Wiss.*, 1884, p. 100.

STOWELL, C. H. and L. R.—**White Zinc Cement.**

[Extract from letter of Dr. F. L. James, as to the necessity for all the ingredients being of the best quality.]

The Microscope, V. (1885) pp. 230–1.

Striæ of Diatoms on the Möller Probe-Platte. [*Post.*]

Amer. Mon. Micr. Journ., VI. (1885) p. 234.

SYDOW, P., and C. MYLIUS.—**Verzeichniss der bekannteren Reagentien und Stoffe,** die bei mikroskopischen Pflanzenuntersuchungen gebraucht werden. Mit kurzen Notizen über Bereitung, Anwendung, Wirkung, &c. (List of the more ordinary reagents and substances used in microscopical researches on plants, with short notes on their preparation, use, action, &c.)

Botaniker-Kalender, 8vo, Berlin, 1886, pp. 79–89.

TAYLOR, T.—**Butter and Fats.** [*Post.*]
The Microscope, V. (1885) pp. 212–4 (8 figs.).

Threlfall's Method of Fixing arranged Diatoms and Sections.
[Cf. Vol. III. (1883) p. 600, and Vol. IV. (1884) p. 308.]
Amer. Mon. Micr. Journ., VI. (1885) p. 233.

TRELEASE, W.—**A convenient Laboratory Plant.**
[A *Mucor* of the Rhizopus section, which springs up spontaneously and can be kept growing almost indefinitely on bread.]
Bot. Gazette, X. (1885) pp. 426–7 (1 fig).

TSCHIRCH, A.—**Ueber eine Methode den grünen Farbstoff der Blätter aus . . . Rohlaugen zu entfernen.** (On a method of removing the green colouring matter from leaves.)
[*Post.*] *Bot. Centralbl.*, XXIV. (1885) pp. 314–5.

" " **Chlorophyll-präparate.** (Preparations of chlorophyll.)
[The ordinary preparations are more or less yellow-green, not emerald-green. Schütz of Vienna supplies a pure emerald-green preparation after a method of the author.]
Bot. Centralbl., XXIV. (1885) p. 315.

VIGNAL, W.—See Malassez, L.

WALL, O. A.—**The Microscopical Examination of Drugs.**
[A large number may be satisfactorily examined with a Coddington lens magnifying 10 or 12 times. Pharmacopœial requirements. Objects to be examined by low power. Value of characteristic marks. Sections by reflected light. Chemical treatment of simple sections. Objects to be examined. Importance of studying sections. Preparing drugs for examination "without making regular mounted sections."]
St. Louis Nation. Druggist, VII. (1885) pp. 257 and 269, 293 and 307.

" " **Proper Thinness of Sections.**
[Criticism of an article by Dr. E. C. Mann in 'Medical Bulletin,' that the "best test of a fine section is the ease with which it floats in a glass of water!"]
Ibid., p. 320.

WARDEN, C. J. H.—**The Biological examination of Water.**
[On examining potable water for micro-organisms. 1. Description of bacteriological apparatus. 2. Preparation of reagents. 3. Collection of samples. 4. Analytical process. 5. Inferences to be drawn from the results.]
Chem. News, LII. (1885) pp. 52–4 (9 figs.), 66–8 (3 figs.), 73–6 (2 figs.), 89, 101–4.

WEIGERT.—**Nowy Mikrotom do duzych skrawków.** (New microtome for large sections.)
Hirsch's Jahresbericht Anat. u. Physiol. (for 1884) 1885, p. 38, from *Gazeta Lekarska*, 1884, No. 51.

WHITE, T. C.—**Aids in Photo-micrography.**
[Bleaching brown chitin of insects—Braxton Hicks' bleach. Keeping Infusoria quiet—Sternberg's fluid, Vol. V. (1885) p. 912.]
Year-book of Photography, 1886, pp. 103–4.

WHITMAN, C. O.—**(1) Imbedding in Paraffin. (2) Orientation with small objects. (3) Prevention of Bubbles.**
[(1) Clarifying media. Lee, *supra*, p. 163. Holl, cf. Vol. V. (1885) p. 541. Imbedding box, *supra*, p. 165. (2) *Supra*, p. 165. (3) *Supra*, p. 166.]
Amer. Natural., XIX. (1885) pp. 1247–9 (1 fig.).

Wood Sections.
[Directions for cutting by B.Sc., J. S. Bigg, S. Bottone, and Doctor Medicinæ, and drawing of Microtome.]
Engl. Mech., XLII. (1886) pp. 391 and 411 (1 fig.).

Zeiss's New Catalogue. *Amer. Mon. Micr. Journ.*, VI. (1885) p. 218.

PROCEEDINGS OF THE SOCIETY.

MEETING OF 9TH DECEMBER, 1885, AT KING'S COLLEGE, STRAND, W.C., MR. A. D. MICHAEL, F.L.S., VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the meeting of 11th November last were read and confirmed, and were signed by the Chairman.

The List of Donations (exclusive of exchanges and reprints) received since the last meeting was submitted, and the thanks of the Society given to the donors.

	From
Curiosities of Animal Life, with the recent discoveries of the Microscope. viii. and 192 pp., 66 figs. (8vo, London, 1859)	*Mr. Crisp.*
Wrisberg, H. A., Observationum de Animalculis Infusoriis Satura. 110 pp. and 14 figs. (8vo, Gœttingæ, 1765) ..	„
Whitman, C. O., Methods of Research in Microscopical Anatomy and Embryology. viii. and 255 pp., 37 figs. (8vo, Boston, 1885)	*The Publishers.*
Slides (29) of *A. pellucida* mounted in various media	*Dr. Morris.*
Slides (2) Retina of Pig, and v.s. through cornea of Eye of Ox	*Mr. A. C. Cole.*
Slide of Russian Diatoms	*Dr. Stolterforth.*
Photograph of the late Dr. Carpenter	*Mr. F. Enock.*

A letter was read from Dr. P. Herbert Carpenter acknowledging, on behalf of Mrs. Carpenter, the resolution passed at the meeting of the 11th ult.

Mr. Crisp called attention to some slides presented by Dr. Morris, which were mounted in a highly refractive medium, which by some misconception was imagined to have the effect of increasing the aperture of the objective in proportion to the increase of refractive index, so as to make objectives of low aperture resolve as easily as wide-angled homogeneous lenses.

Mr. Swift's large photo-micrograph of the tongue of the blow-fly, which had obtained the prize medal at the recent Exhibition of the Photographic Society, was exhibited.

Mr. J. Mayall, jun., said that this photograph was made on a plan for which he was partly responsible, having suggested it to Mr. Swift as more likely to produce good results than the ordinary method, in which the increase of size was obtained by increasing the distance of the plate from the eye-piece. The plan adopted in this case was to make an enlarged photograph from a small negative obtained by a paraffin lamp; by this process and by chemically intensifying the enlarged negative, the specimen before the meeting had been produced, and it was one of the best, if not the very best, he had ever seen. Mr. Swift was, of course, entirely responsible for the success with which the process had been carried out.

Mr. Crisp exhibited Klein's Heating Microscope for observing crystals at high temperatures; Kunckel d'Herculais' compressor, and Vérick's apparatus for enabling four photographs to be taken of the same object.

Mr. J. Mayall, jun., said that the intention of the latter apparatus was to enable four different plates to be used, so as to give a different length of exposure to each, or to photograph different parts of the same object without loss of time.

Dr. Maddox said that at the request of his friend Dr. Mercer, of Syracuse, he had brought to the meeting for exhibition a series of photographs of inked surfaces covering pencil lines. A note descriptive of the photographs was read, and the specimens in illustration handed round for inspection.

Mr. Crisp said that a somewhat similar case was recorded last year, in which a person wanted to add some words to a bond which had been originally written with very pale ink; as the added words were written in much darker ink, he had to go over the original writing to make it look alike. Examination with the Microscope, however, at once showed where this had been done.

The Chairman said that any one who examined Dr. Maddox's photographs would see that the marks of the graphite were perfectly plain, and there could be no doubt about them; but, as a rule, he confessed that he was not a great believer in the evidence afforded by the Microscope in cases of forgery. So far as his experience went, he thought that the results obtained in this way were by no means so reliable as could be desired.

Mr. Bennett said that when he attended the meeting of the American Society of Microscopists at Rochester as a deputation from their Society, several papers were read on this subject, and he believed that the general opinions then expressed agreed with that just given by the Chairman.

Dr. E. Crookshank read a paper "On the Cultivation of Bacteria," which he illustrated by numerous drawings, and by a series of preparations exhibited under Microscopes. He also exhibited and described a collection of apparatus of the latest and most approved construction for the cultivation of bacteria and for the preparation of the media employed. (*Supra*, p. 25.)

Dr. Maddox felt sure that all present must have listened with great pleasure to the very interesting paper which they had just heard. With regard to the paper process, Dr. Miquel, of Paris, had pointed out that there was a certain objection to Koch's method in the cases of those organisms which required a long time for their growth, some of which it was known did not develop for at least twenty days, during which time it was most probable they would be overspread by organisms, and consequently the original cultivation would be lost. Dr. Hesse's arrangement for drawing air through a tube was one which he thought they would recognize. Many of the Fellows would recollect that some time ago he exhibited at one of their

meetings an aëroscope or aspirator for this purpose, from which the German one differs only in the length of tubes. He thought the Germans were rather apt to run away with our ideas in this way; but though he did not at all object to any one copying any of his own contrivances, he thought it ought not to be done without some kind of acknowledgment. He could only express his own thanks to Dr. Crookshank for the exhibition of this apparatus, and for the magnificent drawings with which he had illustrated the subject of his paper.

Mr. F. Cheshire said that reference had been made to *Bacillus alvei*, and it might be interesting to know that even in the case of the bee itself the peculiar growth was found in the body of the larva. Undoubtedly it did arrange itself in that particular lined way that had been mentioned.

The Chairman said they must all feel greatly indebted to Dr. Crookshank for his paper upon what was, perhaps, *the* microscopical subject of the day. It was especially gratifying to them to hear the subject dealt with by a gentleman who was not only such a thorough master of it, but who also possessed so fine a collection.

Mr. Crisp mentioned that Dr. Crookshank was embodying his ideas on these subjects in a book which would appear shortly.

Mr. Robertson's note On a Mode of Preparing Spinal Cord was read (*supra*, p. 156).

Mr. W. C. Meates's note On a new Highly Refractive Medium for Mounting was read, the substance employed being a mixture of one part arsenic to five, six, or seven parts sulphur (*supra*, p. 171).

Mr. Cheshire read a note, "On the Pulvillus of the Bee," illustrating the subject by a drawing on the blackboard. He also called attention to a notch found upon the leg of the bee, and explained what he considered to be its use as opposed to the explanations given by some other observers.

Mr. Bennett said that it had been stated by some writers that this part of the bee was used for opening the anthers of flowers so as to get at the pollen. Could Mr. Cheshire say from his experience whether this was so?

Mr. Cheshire said that he had no knowledge of the fact from his own observations.

Mr. Bennett said it was quite certain that many of the Diptera did feed largely upon pollen, but he did not know if the same thing prevailed in the case of Hymenoptera.

Mr. Cheshire said that in the case of the bee it certainly was so, as the stomach was always found to contain pollen. The queen also, before mating, fed upon it, but after she had mated she was fed with a peculiar glandular secretion by the workers. This was found to be a highly nitrogenous food, and under this diet the queen rapidly increased in weight from $1\frac{1}{2}$ to $3\frac{1}{4}$ grains. The workers, however, all fed on pollen.

The Chairman said that the gradual raising of the pulvillus, as described by Mr. Cheshire, was a tolerably widespread method amongst the *Acari;* in many instances it was so large in proportion to the size of the creature that it would probably be quite impossible to lift it off straight.

Mr. Cheshire asked if the form of pleating was generally observed in the case of the *Acari?*

The Chairman said that it was not so in all cases, but in some the folding was much the same as in a closed fan, and the opening out was similar to the way in which such a fan might be opened out by vertical pressure.

A Circular received from America, explaining the objects and scope of the Elizabeth Thompson Science Fund, was read as follows:—

"This fund, which has been established by Mrs. Elizabeth Thompson, of Stamford, Connecticut, 'for the advancement and prosecution of scientific research in its broadest sense,' now amounts to $25,000. As the income is already available, the trustees desire to receive applications for appropriations in aid of scientific work. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations *not already otherwise provided for*, which have for their object the advancement of human knowledge, or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance.

Applications for assistance from this fund should be accompanied by a full statement of the nature of the investigation, of the conditions under which it is to be prosecuted, and of the manner in which the appropriation asked for is to be expended. The applications should be forwarded to the Secretary of the Board of Trustees, Dr. C. S. Minot, 25 Mount Vernon Street, Boston, Mass., U.S.A. The first grant will probably be made early in January 1886."

Mr. Crisp mentioned with regard to the new Aperture Table Vol. V. (1885) p. 972, that the original table was based on the figures 48,200 as representing half the resolving power of numerical aperture 1·00, the exact figures being 48,205. The last figure (5) being obviously unimportant, it was discarded; but as two new columns are now added, Mr. Stephenson had thought it desirable to make the corresponding correction throughout the table.

Mr. J. W. Groves exhibited some mounted sections cut by the large Barret microtome, shown at the preceding meeting, and described in the last number of the Journal (Vol. V., 1885, p. 1089). The sections were not as thin as it was possible to cut them, but were exhibited to show how large good sections could be made with the instrument.

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

Dr. Beale:—Section of Spinal Cord of Ox, prepared by Mr. Robertson's process.

Mr. Bolton:—*Chirocephalus diaphanus* or *Branchipus stagnalis.*

Mr. Crisp:—(1) Klein's Heating Microscope; (2) Kunckel d'Herculais' Compressor; (3) Vérick's apparatus for taking four photographs with the Microscope.

Dr. Crookshank:—Preparations of Bacteria, and a large collection of apparatus for cultivating bacteria and preparing media.

Mr. Groves:—Sections cut with the Barret Microtome.

Dr. Maddox:—Photographs of inked surfaces covering pencil lines.

Mr. M. J. Swift:—Photo-micrograph of Tongue of Blow-fly.

New Fellows:—The following were elected *Ordinary* Fellows:—Messrs. J. G. Carswell, E. F. Hodges, M.D., W. Kirkby, John Melhuish, J. C. Skelton, F. R. B. Walton, and Edmond Warner. Prof. H. de Lacaze-Duthiers was elected an *Honorary* Fellow.

MEETING OF 13TH JANUARY, 1886, AT KING'S COLLEGE, STRAND, W.C. THE PRESIDENT (THE REV. DR. DALLINGER, F.R.S.) IN THE CHAIR.

The Minutes of the meeting of 9th December last were read and confirmed, and were signed by the President.

The List of Donations (exclusive of exchanges and reprints) received since the last meeting was submitted, and the thanks of the Society given to the donors.

	From
Crookshank, E. M., An Introduction to Practical Bacteriology based upon the Methods of Koch. xxii. and 249 pp., 30 pls. and 42 woodcuts. (8vo, London, 1886)	*The Author.*
Forbes, W. A., The collected Scientific Papers of the late. Edited by F. E. Beddard, M.A., with preface by P. L. Sclater, M.A., Ph.D., F.R.S. xiii. and 496 pp., 25 pls., and 142 woodcuts. (8vo, London, 1885)	*Mr. F. Crisp.*
Three Slides, *Phyllocactus phyllanthus*	*Mr. J. Kruttschnitt.*

Mr. Crisp called attention to a series of forty very thin sections of European woods, each cut in three different ways, which had been sent by Mr. M. Wilmersdorffer, for exhibition.

Mr. E. M. Nelson exhibited a 1 in. aplanatic lens by Zeiss (after Steinheil), which was made upon a somewhat new formula—a kind of achromatic Coddington; its great merit being the very large and flat field which it gave at a focal distance of about an inch.

Mr. Michael said he had been afforded an opportunity of examining this lens, and it struck him that the large size of the field would be found to be of very great advantage. This, together with its long focus and excellent definition, made the lens a very useful addition to the existing means of casual investigation.

Mr. Crisp exhibited some of Dr. Zenger's double-sided slides for mounting objects so that both sides could be examined if required. The slides had an aperture pierced through the centre so that two thin glass covers could be put on with the object between them. (Vol. V., 1885, p. 908).

Messrs. Coxeter and Nehmer exhibited their new silico-carbon battery and incandescence lamp for the Microscope.

Mr. C. Beck exhibited a form of the "Star" Microscope, which had been specially fitted to suit the requirements of petrological investigation; also a battery and incandescence lamp for the Microscope.

Mr. Crisp exhibited Prof. Martius' stroboscopic apparatus for determining by the vibration of a lever on the armature of an electromagnet the rate of ciliary vibration in cells, Rotifers, Infusoria, &c. The lever carried a small diaphragm of paper at the end, by which means the rays from the illuminator were periodically cut off and admitted to the Microscope.

Mr. Deby's note on the discovery of *Amphipleura lindheimerii* in Spain, was read. (*Supra*, p. 172.)

Mr. A. W. Bennett gave a *résumé* of his paper 'On the Freshwater Algæ of the English Lake District,' illustrated by coloured diagrams and drawings on the black-board (*supra*, p. 1).

The President said that the paper afforded an excellent illustration of the kind of work which was within the reach of all present, and which could be carried out with the instruments which they possessed, and it showed how it was possible to ultilize a holiday by doing good work and at the same time adding to the pleasure derivable from it. It had often seemed to him that work of this kind was apt to become periodic; they did certain work, and then there seemed to be years of pause in which very little more was done in the same direction, and in the case of the Desmids there was still a large field open to those who were willing to devote themselves to the study. The literature of the subject was not so great as might have been expected, and it was quite within the power of any one who would try, to add a great deal to their knowledge of these organisms. He felt sure that the Fellows of the Society were much obliged to Mr. Bennett, not only for his paper, but also for the very concise way in which he had presented to them the results which it embodied.

Mr. G. F. Dowdeswell's paper 'On the Appearances which some Micro-organisms present under different conditions, as exemplified in the Microbe of Chicken Cholera,' was read (*supra*, p. 32).

The President said that they were greatly indebted to the author of this valuable contribution to a subject of such admitted importance. He entirely agreed with the observations it contained as to the deceptiveness which many of the processes of staining and preparation produced. No doubt they had their special value, and it would be quite true to say that a great deal was to be learnt by the employment of such means when they were regarded as processes ancilliary to the object of the inquiry, and were used as means to an end. But to regard such methods as producing results which they could afterwards rely upon, was, he thought, only to place confidence in that which further experience would be unlikely to sustain. The drying of the object, and the staining it, in most cases so entirely changed it, that too much stress could not be laid upon the protest now made, for he had found that some of the organisms which he had examined in the living state, had altered so much during the process of treatment by reagents, that it would have been impossible to identify them as the same. It was only in proportion as they worked with the living, or at least unaltered specimens, that they would be able to reach conclusions likely to advance their knowledge of what was true concerning them. He was glad to find his own experiences so entirely confirmed by an observer who had made these more recent observations.

Dr. Maddox called attention to the death of Dr. John C. Draper, of New York, who had for many years devoted himself largely to the study of blood-corpuscles, and to photographing them.

Mr. J. W. Stephenson's paper "On 'Central' Light in Resolution" was read, the object of the paper being to call attention to the misunderstanding that had arisen by the alleged resolution of *Amphipleura* by central light, that is with half the real aperture (*supra*, p. 37).

Mr. E. M. Nelson thought the paper touched upon a very important matter, with regard to the questions of central and oblique light. When Prof. Abbe's theory came out, it was said that every microscopist should have an apparatus to examine the diffraction spectra, on which alone the power of resolution depended. This appeared to him to be manifestly wrong, because it was quite certain that the best resolution of *P. formosum* was obtained when the whole field of the Microscope was full of light, and no diffraction spectra were visible. This theoretically reduced the power of resolution, but as a fact, the resolution itself was enormously increased. He was about to read a paper bearing upon the subject, at another place, dealing with an object which was immensely more minute than most of the so-called tests; this could be seen only with central illumination, and he thought the ability to resolve this was of more value than the resolution of lines. What he referred to was a small spicule extending across one of the spaces between the lines on the diatom; taking the

distance between two adjoining areolations to be the 1/24,000 in., and the interspaces being about equal, or the 1/48,000 in., and estimating the small marking at even 1/3 of the interspaces, that would give it a diameter of the 1/144,000 in. This was a thing that could not, anyhow, be resolved under the oblique light system, but could only be seen when the objective was full of light.

Mr. Crisp said that Mr. Nelson was such a well-known expert in such matters, that it was, perhaps, a little presumptuous for him to point out that he had mixed up two entirely different questions—visibility and resolution—which perhaps accounted for the misunderstanding to which the paper was directed. In the same way the claim to have seen 1/1,000,000 in. was supposed to have disproved the limit of resolution depending upon wave-length. It was, however, only a question of visibility, whereas the diffraction theory, in this aspect of it, referred to resolution. In the last case, put by Mr. Nelson, so far from the resolution not being effected by oblique light, it was oblique light and nothing else that resolved the object. As to the notion that the better the diffraction spectra were seen, the better they could see an object, he (Mr. Crisp) now heard it for the first time, he did not understand where Mr. Nelson could have found such a statement. Again, no theory that he was aware of, suggested that there was such a "reduction of the power of resolution" as Mr. Nelson had referred to. No such reduction in fact took place.

Dr. Matthews said he was one of those who had been stumbling over this question, and it had seemed to him that resolution and visibility meant very much the same thing. Most photographers would bear out the statement, that a picture taken at midday was never so effective as one taken when the sun's rays fell upon the objects at a greater angle, and when the contrasts of shadows enabled the eye to perceive the details in a more effectual manner. Just in this way it seemed to him that when a thing was said to be "resolved," it meant that its component parts seemed to be more visible.

Mr. Crisp said, the difference between visibility and resolution would be understood from the fact that though they might be able with a dry objective to see a line which measured the 1/1,000,000 in., yet they could not separate two or more of such lines. In reference to a question from Mr. C. Beck, he further said that there could be no manner of doubt as to the difference made by Prof. Abbe between resolution and visibility, and read the following quotation from Prof. Abbe's original paper: "Such objects *can* be seen *however minute they may be;* this is merely a question of contrast in the distribution of light, of good definition in the objective, and of sensibility of the retina. In point of fact, neither Prof. Helmholtz nor the author have ever spoken (as, however, has so often been supposed) of a limit of 'visibility'—only of a limit of visible 'separation.'" (Cf. Vol. I., 1881, pp. 415–6.)

Mr. Nelson drew a diagram upon the board, showing the appearance under the Microscope of the spicule to which he had previously referred, and which he said he saw perfectly with an immersion objective of 1·43 N.A. and a dry achromatic condenser. How was it

possible, he asked, that a thing like this, with a diameter of the 1/144,000 in. only, could be seen?

Mr. Crisp said that was simply a repetition of the difficulty with which they had started. The spicule was merely a question of visibility, and not of resolution, and it could be seen with almost any aperture. All that was here required was sufficient power and definition in the objective, as well as appropriate illumination. A series of such objects, however, could not be seen except with large aperture.

Notice was given that the next Meeting would be made Special, for the purpose of enabling Dr. Dallinger to be elected as President for a third year.

The List of Nominations for Council and Officers for the ensuing year was read. Mr. Curties and Mr. Hembry were elected Auditors of the Treasurer's accounts.

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

Mr. C. Beck:—(1) "Star" Petrological Microscope; (2) Electric Incandescence Lamp and Battery.

Mr. Bolton:—*Vaginicola?*

Messrs. Coxeter and Nehmer:—Silico-carbon Battery and Electric Lamp.

Mr. Crisp:—(1) Martius' Microscopic Stroboscope; (2) Zenger's Slides.

Mr. E. M. Nelson:—Zeiss's 1 in. Aplanatic Lens.

Dr. Ondaatje:—Cuticle of Leaf of Talipot Palm, Ceylon.

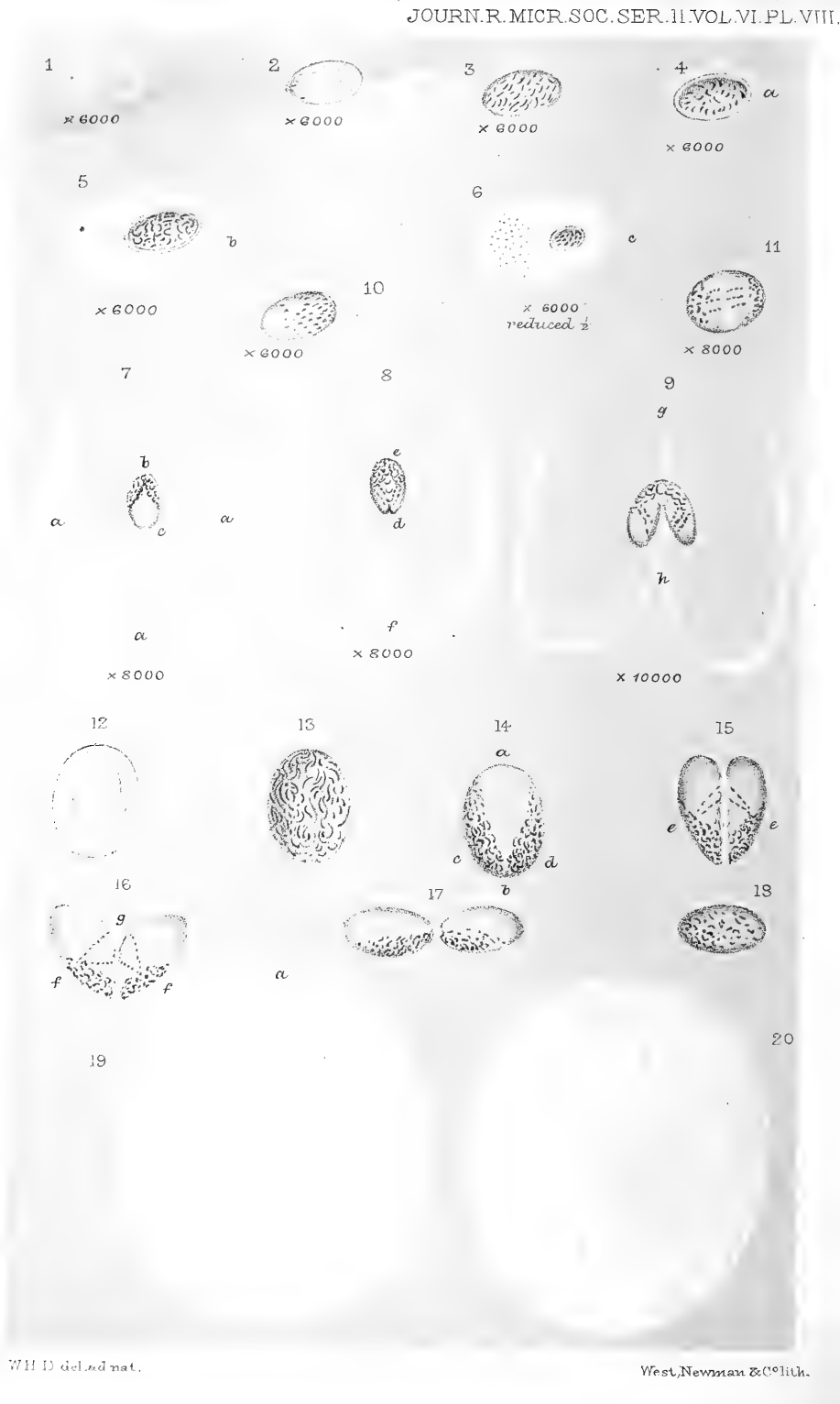
Mr. M. Wilmersdorffer:—Album of Forty European Woods.

New Fellows:—The following were elected *Ordinary* Fellows:—Messrs. Charles Fletcher, R. J. Harvey Gibson, M.A., James Morgan, and Maitland L. Mallory, M.D.

W.H.D. del. ad nat.

West, Newman & Co.ª lith.

Researches on the Cell-nucleus.



WH D del.ad nat.

West,Newman & Colith.

Researches on the Cell-nucleus.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

APRIL 1886.

TRANSACTIONS OF THE SOCIETY.

VII.—*The President's Address.*

By the Rev. W. H. DALLINGER, LL.D., F.R.S.

(*Annual Meeting*, 10*th February*, 1886.)

PLATES VII., VIII., AND IX.

A COMPREHENSIVE and impartial review of the results of a year of work accomplished by a scientific use of the Microscope would be no doubt of considerable interest and of some value. But it would be a task impossible of accomplishment in an address such as I have to-night the honour to give. The mind most familiarized with the vast area of activity and research in this direction would be the

EXPLANATION OF PLATES VII., VIII., AND IX.

PLATE VII.

Fig. 1.—*Hetcromita rostrata*, showing nucleus *n*, × 3000.
„ 2.—*Polytoma uvella*, showing nucleus *n*, × 1400.
„ 3.—*Tetramitus rostratus*, showing nucleus *n*, × 1400.
„ 4.—*Dallingeria Drysdali*, showing nucleus *n*, × 3000.
„ 5–8.—Spore-sacs of the above in the act of emitting spores.
„ 9.—Amœboid condition of *T. rostratus* before genetic fusion (flagella *a*), × 1200.
„ 10.—Ditto after the blending of two forms just before the union of the nuclei, × 1200.

PLATE VIII.

Fig. 1.—Nucleus of *P. uvella* when it has attained full size by growth from the germ, × 6000.
„ 2.—Ditto with nuclear wall shown, × 6000.
„ 3.—Ditto showing internal development or plexus-like structure, × 6000.
„ 4.—Ditto after complete internal development, giving origin to body-sarcode and flagella (*a*), × 6000.
„ 5, 6.—Further stages of the development of sarcode (flagella *b* and *c*), × 6000, and 6000 reduced one-half respectively.

readiest to shrink from the labour. It must be a relatively inefficient sketch, or a plethora of congested details; neither of which could, as I venture to think, accomplish in the best way our end.

On the other hand, a careful study afresh of the work done by the Fellows of this Society since our last annual meeting, while peculiarly interesting, and capable of awaking a measure of pride, purpose, and hope in all of us, would yet, it appears to me, be but a work of pleasurable supererogation. It may be true that exhaustive discussion does not follow every paper or monograph presented to us: but genial, friendly, and truth-seeking criticism is by no means absent; and the incisive and experienced judgment of the expert is sought and given. And so wide and diversified has the field of research become, that it is to experts chiefly that we must look for criticism, interpretation, and suggestion of the most lasting value.

That this is at once a triumph and a peril to modern science in all its sections I have, no doubt in common with most of you, long felt.

Science has progressed with such rapidity, and extended its area on so vast a scale, that the autonomy of the expert and the specialist is a danger that all who care for the unity and wholeness of the ever-widening stream of human knowledge must be alive to.

Wise and well-timed indeed were the words of Professor Huxley in his address, so recently given, on quitting the chair of the Royal Society. "Of late years," he says, "it has struck me with constantly increasing force, that those who have toiled for the advancement of science are in a fair way of being overwhelmed by the realization of their wishes: . . . it has become impossible for any man to keep pace with the progress of the whole of any important branch of science. . . . It looks as if the scientific, like

---

Fig. 7–9.—Different stages in the progress of the fission of the nucleus of *D. Drysdali*, showing that nuclear changes precede somatic changes (*a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, see pp. 200–202), × 8000 and 10,000.

„ 10.—The above nucleus after complete division, showing how the plexus structure is at once diffused over the hyaloplasm of the nucleus again, × 6000.

„ 11.—Nucleus of *Polytoma uvella* in fission.

„ 12.—Nucleus of *T. rostratus* before actual division.

„ 13–18.—Fissional phenomena in the nucleus of *T. rostratus* (*a*, *b*, *c*, *d*, *e*, *f*, *g*, see pp. 202–203).

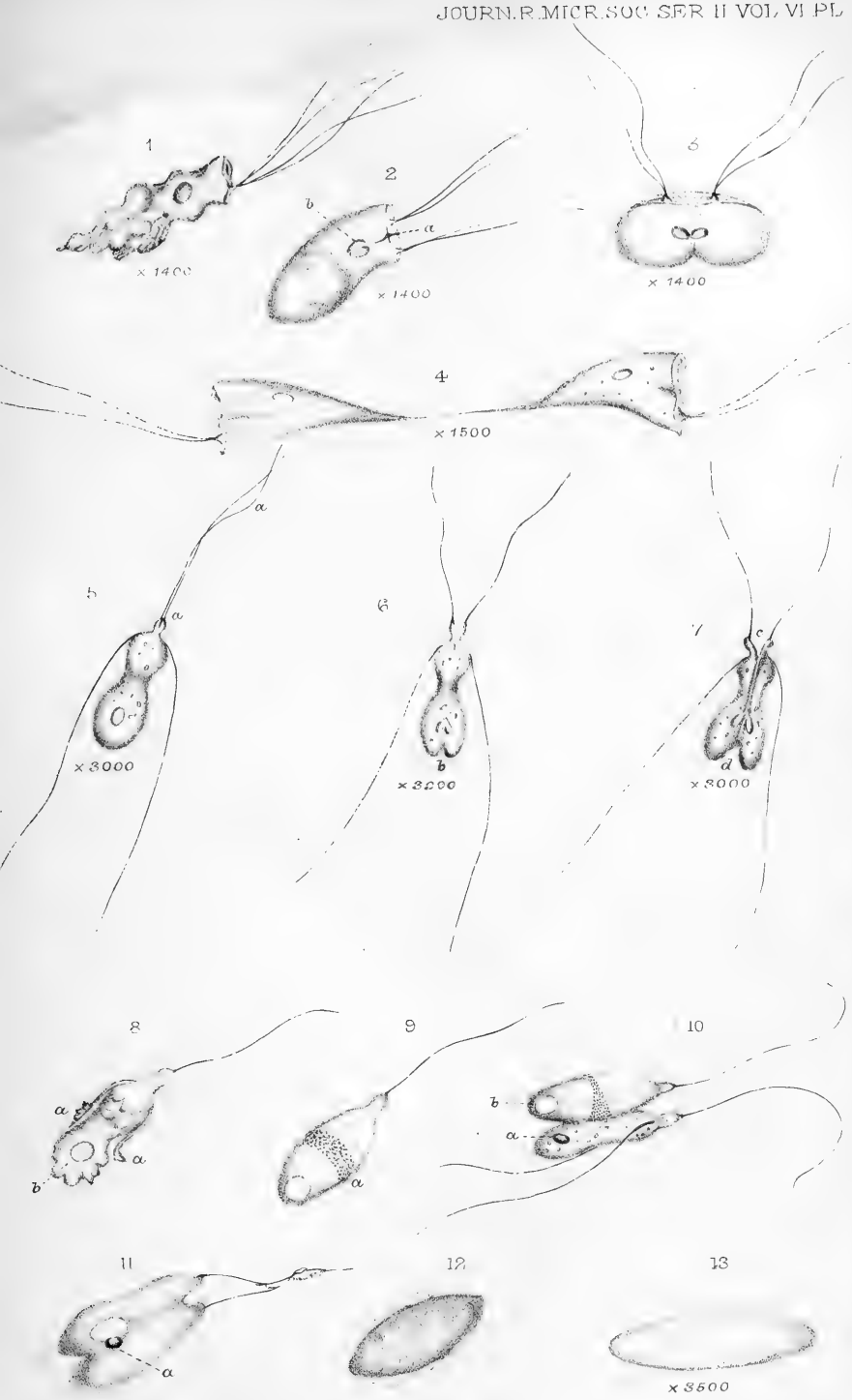
„ 19–20.—Phenomena presented by nucleus of *T. rostratus* in genetic fusion.

PLATE IX.

Fig. 1–4.—Various conditions of the body of *T. rostratus* in the act of fission, × 1400, fig. 4 × 1500.

„ 5–7.—The stages of body fission in *D. Drysdali* × 3000.

„ 8–13.—The stages seen in the genetic blending of *D. Drysdali*.



W.H.D. del. ad nat.

West, Newman & Co° lith.

Researches on the Cell-nucleus.

other revolutions, meant to devour its own children . . . as if the man of science of the future were condemned to diminish into a narrower and narrower specialist as time goes on."

"I am happy to say," he continues, "that I do not think any such catastrophe a necessary consequence of the growth of science; but I do think it a tendency to be feared, and an evil to be most carefully provided against. The man who works away at one corner of nature, shutting his eyes to all the rest, diminishes his chances of seeing what is to be seen in that corner; . . . that which the investigator perceives depends much more on that which lies behind his sense-organs than on the object in front of them."

Now this universal danger in all branches of scientific inquiry is certainly emphasized in a Society like this; and the defence which Huxley indicates "against this tendency to the degeneration of scientific workers" has special reference to such objects and work as we delight to be engaged upon: "it lies in the organization and extension of scientific education in such a manner as to secure breadth of culture without superficiality; and on the other hand, depth and precision of knowledge without narrowness." In other words, and from our own point of view, exact and exhaustive research in the narrowest fields must be encouraged and fostered; we must have an increased ambition for it; but at the same time we must incite ourselves and all our fellow-workers to keep the small and special area closely linked to, and in the strong broad light of, the inconceivably vaster realm of which it is not a separated fragment, but an essential and inalienable factor.

It is, then—with this admonition in view—to special work that I shall venture to call your attention once more. And I do this with the deeper interest and assurance, because of the manifest relation of the results to the broader aspects of that branch of science to which as work it links itself.

We all know of the important, if minute, place occupied in modern physiology by the *cell-nucleus*. From the cell-wall to the cell-contents, and from these to the nucleus specifically, the attention and research of investigators has been directed; and the results are sought with equal eagerness by the students of vegetable and animal forms.

It would be beyond my purpose to attempt to summarize the work done in this relatively new field of research. It is, however, chiefly German, and has been obtained almost entirely as the result of careful and laborious study of nuclei of various cells under the influence of reagents; and therefore, of course, when vitality had ceased. But the results are so promising, so suggestive of other methods, and as I venture to believe so important, that some far-reaching issues may arise in the near future from a close, com-

petent, and patient pursuit of the study with our always improving optical resources. At least, small as my contribution may be, I am glad to add it to what I think so important an investigation.

Those of our Fellows who can in any way recall my successive work on the life-histories of certain monads—more or less relatively large septic organisms—will remember that from 1873 and onwards, I, in connection with my friend Dr. Drysdale, called attention to and described and figured the division of the nucleus belonging to these simple living forms. As our work progressed, nuclear division became a more and more noticeable and interesting factor. While in the two latest forms which I studied alone, the history of the former of which was read before the Royal Society in 1878, some very suggestive details were observed, which are to some extent indicated in the drawings accompanying that paper. But they were relegated for future and further examination, and in the well-founded hope of the production of finer lenses than we even then possessed. And it is to the immensely improved lenses which we now possess that my later results are mainly due. One may be fain to confess a weariness of reiterated comparisons of lenses based upon delicate diatomaceous striation or "dotting." At best, manipulation and the "personal equation" enter largely into the results. But it is not thus in the high-power observations with which for so many years I have been chiefly concerned. With lenses constructed from fifteen to ten years ago, I worked during those years with definite results. The lenses were the best that the science and art of the time could produce; and the organisms on which the researches were made were thoroughly known, and were examined through consecutive years under every variety of condition, optical and other; while the limits of disclosure were clearly known, and can be readily shown with the same lenses on the same objects to-day.

But during the following ten years, bringing us to the present time, there have been, as this Society has so efficiently shown, splendid improvements in our lenses.

It would divert our attention needlessly for me to attempt an historical account of these steady advances. Each year has had its optical trophy, English, German, or American. The highest and latest class of water-immersions, as made by Powell and Lealand, proved a large gain over all their predecessors in searching into minute living structure, and delicate organic changes; and their possession soon convinced me that by a further extension of what we now call N.A., much more was to be discovered in relation to these simplest and minutest organisms. Then followed the early homogeneous lenses of Abbe and Carl Zeiss, which showed great advance in the direction needed, and still greater potentiality and promise. What was required was the increase in these lenses of

the N.A., and the great gain in delicate results derivable from collar-adjustment.

Mr. T. Powell has constantly and in a *con amore* and laborious way, responded to my thirst for this enlargement of N.A. A 1/25 and a 1/50 with N.A. 1·38 were a triumph of some three years ago, accomplished at my earnest request. But in going over the best results attained by all my preceding lenses, I was able to see how much they were transcended by these beautiful instruments; that is to say, how much more clearly and certainly the more hidden and delicate results on which I had worked so long were attained, and how much more easy it was by their use to follow out the unknown and most difficult details which I had at this time begun to fairly grapple with, in the nuclear bodies of these minute organisms, and once more I used personal and delegated influence to obtain from Mr. Powell, if possible, a still greater N.A. The result is that I have received during the year just expired not only the 1/6 with a N.A. of 1·5, but also a 1/12 and a 1/20 of precisely the same N.A.

Now all the results I am about to record have been attained by these higher class lenses; and every point of detail, and disclosure of structure, has been either more or less largely indebted, or wholly due to the latter, and above all to the latest of these object-glasses.

The larger proportion of the septic organisms whose life-history we have thoroughly studied, were distinctly nucleated bodies. I know of no clear reason for concluding that they are either vegetal or animal; they possess in fact some of the characteristics of both, and certainly they represent the lowliest organization of either great line of organic life. Since the nuclei of such lowly and minute organisms would be likely to present nuclear phenomena in their simplest condition, and since from a complete knowledge of the history of the forms, there would be no difficulty in correlating nuclear with general somatic changes, I determined to do to the utmost what I could do in the study of any discoverable changes in these nuclei. The four forms selected for study are shown by plate VII. figs. 1–4. These are copies of my original drawings presented to this and the Royal Society between 1873 and 1875. The presence of the nucleus is sufficiently manifest in each, indicated by the letter *n*; but the certainty of this being such was found in the fact, that in all instances of fission, an act constantly repeated by each form and by a long succession of them, the nucleus from the first to the last stage in the act of cleavage, took part, and was itself entirely divided. That which greatly perplexed us in constant observation in the earlier researches on these forms was the origin of this nucleus. We were never certain when, in the growth of the organism from the germ, it actually arose, nor how it first made its appearance.

It was not until three years ago that a clear indication on this subject arose, and close observation has since completely established it. It will be remembered that each of these forms terminates a long series of fissions in what is practically a genetic fusion. The two last of a long chain of self-divided forms fuse into one, become quite still, and at length the investing sac bursts, and a countless host of germs are poured forth. Figs. 5–8, on plate VII., show the sacs of each of the four forms chosen, in the act of emitting germs.

Now the study of the behaviour of the minute bodies thus emitted was from one aspect by no means difficult, for they were inactive, and minute as they are, they are amenable to all our highest power lenses. But the only observation our most patient work could effect upon them, was as our papers show, simply growth—gradual enlargement—the ultimate, but as to time, uncertain appearance of the nucleus—the somewhat saltative appearance of the flagella—and the attainment of the adult size and condition.

It was noticed in every case that the germs when first thrown from the sac were semi-opaque. Light was transmitted but feebly, if at all, through them. But in from fifteen to thirty minutes they had become clearly hyaline and strongly refractive: at the same time they had grown most sensibly larger. One thing impressed us from our earliest observations on the growth of these germs, and it was that when the minute hyaline globule had grown to from the tenth to the eighth of the long diameter of the adult, there was a distinct pause, an apparent arrest of growth, suggesting in our earlier observations the death of the organism. This lasted sometimes forty or even fifty minutes. I am now able to fully interpret this. It is the nucleus, that grows to its limit of size, and the pause in outward action is employed in the internal development of the nuclear structure.

For illustration here I select one of the larger of the true septic organisms. It is figured by Ehrenberg, and known as *Polytoma uvella*, and is seen in plate VII. fig. 2. It is on an average the 1/1200 of an inch in length, and its germ and nucleus are relatively large. The germ grows to about the 1/5500 of an inch in long diameter in the course of three hours, becoming a beautiful long oval, with no discoverable structure, plate VIII. fig. 1. But at this point there is a distinct arrest in the outer growth, and it lasts from forty to fifty minutes.

It has been impossible, hitherto, to determine whether or not at this stage there is an investing wall to this hyaline globule: and by optical methods alone it is difficult at any stage to fully determine it. But by a one-and-a-half per cent. of acetic acid, to which varying quantities of methyl-green are added, it is clearly developed, by being run carefully in upon the living organism; or

even most markedly, if the thin film of fluid be allowed to partly evaporate while the object is carefully kept in the field and the acetic acid methyl-green be then run under. The investing membrane or wall is seen in plate VIII. fig. 2. At the same time, as well by subsequent similar treatment as by patient study of the living form, a distinct granular condition becomes apparent in what was the homogeneous hyaloplasm.

My deep desire was to study this change as it progressed in the living organism. Reagents and stainings are invaluable: but on minute structures such as these their action is too violent, and cannot with our present knowledge be accurately or with strict certainty interpreted. At least, if the study can be effected optically in the living form it is an additional advantage and control, and leads to more delicate and sure results. Fortunately the nucleus is in an absolutely inactive state; hence I could use homogeneous lenses, and every variety of illumination, without fear either of losing or injuring the object: and after the first twenty minutes of arrest of outward growth I was enabled to make out a distinct granulation, merging almost into a plexus during the next thirty minutes. Its delicacy is extreme, but there is a manifest difference in the refrangibility of the granular structure, and the general hyaloplasm of the nucleus. I do not for a moment assume that the full form of this plexus structure has been made out, but as well as I can represent so delicate a condition it is shown in plate VIII. fig. 3. It can be emphasized in one sense by the use of acetic methyl-green: but it is also distorted by a kind of coagulation, by means of which all its true character is gone. But by the use of the full aperture of the lens (1/20 1·5 N.A., 1/50 1·37 N.A., and 1/12 1·5 N.A.) and the employment of delicate means of illumination, upon which so much depends, it is possible to clearly see the growth in the living nucleus of the plexus-like or intertwisted structure seen in plate VIII. fig. 3. But it is not easy either to figure or describe the exact state of the nucleus that is disclosed. It is suggestive, however, of a complex weaving or plaiting; and runs throughout the contents of the nuclear body.

Now, it is when this condition of the nucleus is fully attained that the growth of the general organism recommences. A cloudy white film of extreme delicacy first presents itself outside the margin of the nucleus, as seen in plate VIII. fig. 4, and this rapidly widens, as in figs. 5 and 6, ibid., taking the normal form of the organism in a longer or shorter time, until the adult size is reached and motion commences.

But there was one other point of the deepest interest. It was that I was enabled to determine that the flagellum or flagella, in each instance, arose in the nucleus; and it was, or they were, carried outwards with far greater rapidity than the somatic sarcode,

so that when the time for motion came the flagella had attained their normal length.

This will be seen in plate VIII. figs. 4, 5, 6, where at *a*, *b*, *c*, the origin of the flagella in *Polytoma uvella* will be seen to be in the nucleus, and their relative growth will be found to be greater than that of the body-sarcode. This is a typical case. In each of the four organisms, the same facts were discoverable in the development of the nucleus, the origin of the flagella, and the growth of the body. They were best seen in *Tetramitus rostratus* and *Polytoma uvella*: not quite so well in *Dallingeria Drysdali*,* and least perfectly in *Heteromita rostrata*; but in all they were seen with sufficient clearness to leave no doubt.

Not less interesting and striking are the minute phenomena accompanying fission. In about five minutes after the adult stage is reached, on the average, the act of self-division commences, and, with about the same interval, each divided organism again divides for hours in succession. The first symptom that fission had begun was, up to about five years ago, discoverable by us only in the general body-substance. But with the lenses we can now employ it is clearly demonstrable that the earliest fissional activity takes places in the nucleus. In *Tetramitus rostratus*, for example, the first indication we could by any effort discover was an amœboid condition of the general sarcode as seen in plate IX. fig. 1. This was followed by a sudden slit at the root of the flagella, fig. 2 *a*, causing the four flagella to be divided into *two pairs*, which rapidly receded from each other; this slit was shared by the nucleus as seen at *b*, fig. 2, and from this time the nuclear division went on concurrently with that of the somatic sarcode, as seen in figs. 3 and 4, and more fully detailed in the paper read before you on this organism.

In like manner with *Dallingeria Drysdali*, one of the later, and most carefully studied forms, the first definite trace of the act of self-division was in the splitting of the beak and flagellum, plate IX. fig. 5 *a*; an incision almost constantly followed by a corresponding incision at *b*, fig. 6, and this was carried into the nucleus. Almost simultaneously with this, a white line appeared right through the dividing organism as seen at fig. 7, and as already recorded and figured.† But in all the four cases with which I am dealing, it can now be shown by the employment of the new lenses of great aperture, that it is the nucleus that is first, and very profoundly, affected.

It must be understood that to discover the facts in the living form is not by any process easy. All the finer properties of the

* Cf. Kent's 'Infusoria,' vol. i. p. 310 *et seq.*

† 'On the Life-history of a Septic Organism,' by Rev. W. H. Dallinger. Proc. Roy. Soc, xxviii. (1878) pp. 332–50 (2 pls.).

lens must be brought into action; and, as all manipulators and experts in the use of high-power lenses know, this is dependent upon careful centering and a delicate facility and power in the use of light. But exaggerated results that, although not to be relied on at all by themselves, are none the less valuable in a high degree as ancilliary means, may be obtained by the judicious use of acetic methyl-green.

It will suffice for my present purpose if I give you the details in two cases. In none are they more beautiful than in *Tetramitus rostratus* and *Dallingeria Drysdali*. I have already pointed out that the nuclei of these forms differ considerably in size. In the selection of the two I have named we have one of the largest, and although not the smallest, still a relatively very small one, if we take the group as a whole. The nucleus of *Tetramitus rostratus* averages the 1/10,000 in. in length; that of *D. Drysdali* averages the 1/20,000 in. For several reasons I give the results of examination with the same lenses, and the same magnifying power. If we examine *D. Drysdali* first, we shall see the problem in its most difficult form, and shall be the better able to appreciate the identity of behaviour in the nuclei of both. Indeed, in each of the four nucleated forms, if steadily followed from the time that they have attained maturity from the germ, it will be seen that the plexus-like state of the nucleus is being lost in certain parts of it, that is to say, that the plexus-like structure which had become diffused over the entire hyaloplasm of the nucleus, aggregates in definite parts, leaving other parts absolutely clear and transparent. In the case of *D. Drysdali*, it is the *lower part* of the nucleus that becomes thus hyaline.

On close examination and with carefully managed light, it may be seen with the 1/20 of 1·5 N.A., and with the 1/50 of 1·38 N.A., as drawn in plate VIII. fig. 7, where at *a*, *a*, *a*, a portion of the general somatic sarcode is seen, and at *b* the nucleus. Instead of the plexus-like structure being found everywhere in the nucleus, as it was in fig. 3 ibid., it is wholly wanting in that part of the nuclear body marked *c*, and is much denser than before in the part marked *b*. In this condition not a trace of fissional action is to be seen in the general substance of the body, nor any of its parts: but if the observation be continued it will be seen that there rapidly appears in the long axis of the nucleus, at first faintly then more clearly, a bead-like line seen at *d*, fig. 8, and two or three finer threads run from the plexus-mass *e* to this middle line. At this point it is that a minute disparting of the nucleus occurs at the point *d*, so slight as to require great care in observation, and this is immediately followed by a slight white line *d e*, resulting in the first incision of the body-substance as at *f*. The white line now widens, and extends the whole length of the body

of the organism as shown in fig. 9, *h, g*, and in plate IX. fig. 7, and is accompanied by an almost complete severance of the halves of the nucleus as at *h*, fig. 9, plate VIII., which is then quickly effected; and the whole organism separates into two perfect forms as we have before described.* When, however the fission is complete the congested condition of the plexus-like structure at *one end* of the nucleus is broken up by its diffusion, equally again, throughout the entire hyaloplasm of the nuclear body as seen in plate VIII. fig. 10, and in the next fission the same process is repeated.

Now it is only in minute particulars that any of the four forms before us differ from the mode of self-division here described. The differences indeed are determined only by the peculiar way in which the body-sarcode as a whole divides. In every case there is a loss in one part of the nucleus of the plexus-like structure, and a manifest thickening of it at other points of the nuclear body. There is also either a beaded or otherwise irregular line—really I believe a plate or disc—running along the entire line of cleavage of the nucleus, and an opening of the two halves of the nucleus to some small extent before the act of fission is participated in by the sarcode of the general organism. In *Polytoma uvella*, for example, the mode of fission differs from the above, by the fact that the sarcode divides into two, four, eight, and sixteen separate forms within the body-wall of the original organism.† In this instance it is the *middle* of the nucleus that becomes homogeneous, and the *opposite ends* that receive the plexus; and the white line of cleavage is exactly midway between them, as seen in plate VIII. fig. 11. But in all important details, in describing the phenomena in one, we have in effect described the behaviour of all these septic nuclei in the act of fission.

This will be instructively manifest in studying the larger nucleus of *Tetramitus rostratus*. In plate VIII. fig. 12 we have a drawing of this nucleus in the state in which it is arrested in growth for the development of its internal structure. It is magnified 8000 diameters, and the nuclear membrane or wall-like investment is made manifest. In fig. 13 the plexus-like structure of the whole interior of the nucleus is palpable; and this is the state in which it remains until just before the first indication of the commencement of the fissional state has displayed itself in the general substance of the body-sarcode.

It will be remembered that the first sign that fission was about to happen in the body was shown in the amœboid condition of the whole body of the monad,‡ as seen in plate IX. fig. 1. But by close study of the nucleus this state is now seen to supervene upon an

* Proc. Roy. Soc., ibid.
† Monthly Micr. Journ., xii. (1874) p. 261 *et seq.*
‡ Ibid., x. (1873) p. 53 *et seq.*

earlier activity in the nucleus. That is to say, that the *plexus-like* structure condenses or congregates at one end of the nucleus, so that there is a rapid transition from the condition of the nucleus seen in fig. 13 to the condition seen in fig. 14, where at *a* the hyaloplasm is clear, while at *c d* there is a thick gathering of what had before filled the whole nuclear contents, as at fig. 13. At the same time a faint division appears in the long axis of the nucleus, as at *a b*, fig. 14. And now it is that the amœboid condition of the whole body-sarcode begins and the process of fission rapidly proceeds.

With the splitting of the four flagella into two pairs (plate IX. fig. 2 *a*) there is a visible incision in the nucleus *b*, ibid.; this condition of the nucleus is shown at fig. 15, where the faint axial line seen at *a b*, fig. 14, has become strong and beaded; and two delicate beaded cords proceed from the plexus on each side to this strong line of cleavage, as seen at *e e*. In fig. 16 the process of division is more than half accomplished, and the fine beaded lines still retain their relative positions, as at *f f g*. At this point the division of the body of the organism is about half accomplished, and the nuclear fission is complete before the body divides. In plate VIII. fig. 17 we see the two nuclei a moment prior to actual separation; and in fig. 18 we have the nucleus a moment or two after total separation, in which it is plain that the plexus-like structure is again diffusing itself evenly over the nuclear contents.

The rapidity and continuity with which these fissions take place are remarkable. In a thoroughly healthy, vigorous field of *Tetramitus rostratus* from ten to twelve fissions will be effected in one hour if we steadily follow one of the two divided organisms successively in continuous divisions. There is but little interval between the complete separation of one divided organism from its fellow and the appearance in it of the earliest stages of the next fissional process. And this will continue for hours without cessation, causing a prodigious increase of the organism. It was extremely difficult indeed in some of these organisms to follow to the end this terminal act of fission and to demonstrate the relation borne by the last segmented forms to the genetic fusion and production of germs, which has been proved to characterize each of the specific organisms when exhaustively studied. They all divide rapidly by fission, and in the same field, without the slightest change or addition, there arise at given intervals forms that slightly differ from the prevailing form, and these go into a state of conjugation resulting in a still sac that ultimately pours out myriads of germs. But I have in three cases been able to see with completeness at what point the process of fission ceased and the genetic state arose.

I select two instances, both being nucleated forms. The first

of these is *Tetramitus rostratus*. When followed into the mature state from the germ it speedily exhibits the early nuclear symptoms of fission, and the process of division goes on in the one of the divided forms that we can follow, after each successive division, for from six to eight hours. In each act of fission an amœboid condition is set up, as we have seen, in the body-sarcode. But the organism retains its power to swim. When, however, the last link in the chain of fission has been reached, the organism that constitutes that link becomes an amœba almost entirely, as seen in plate VII. fig. 9, retaining only the characteristic forepart of the body, with the four flagella *a*. But it does not swim; precisely like an amœba, it progresses by pseudopodia.* There are always several such in a field of some age, and they are, apparently by accident, constantly coming in contact with each other as they creep, with the peculiar result that their respective sarcodes almost directly fuse into each other, until nucleus reaches nucleus and the two nuclei melt "either into other," and the whole of the blended bodies become a globular sac, which ultimately emits an enormous mass of germs.

For years we had been struck with the enlargement of the nucleus in forms that had entered this stage (plate VII. fig. 9) previous to blending. But I have now made out that the final fission form may be known and identified, before the strong amœba-like change arises, by a close study of the nucleus; which instead of passing from the stage seen in plate VIII. fig. 17, to that seen in fig. 18, ibid., gradually loses all trace of plexus-like structure everywhere, and becomes greatly enlarged, with a milky aspect, and in this condition it is unaffected by the acetic methyl-green. It is in this state of the nucleus that the organism ceases to swim, and if brought into contact with another in the same state fuses the general sarcode with it, almost as though two globules of mercury had touched. A figure of the act of blending is given at plate VII. fig. 10, where the nuclei are almost in contact; directly such contact is effected there is a distinct fusion, but no trace of structure can be seen anywhere throughout the blending nuclear bodies. Every artifice and device that could be tried, every method of illumination, and the employment of reagents, failed to reveal anything but the almost dazzling white substance as a whole of the nuclear bodies. Beale's carmine evenly and delicately tinted the nuclei, but that was all.

The blending is effected with varying rapidity, but is always quickened directly the two nuclear bodies are in actual contact with each other, and from that time the amœboid condition becomes less and less marked, until it wholly ceases, and we have a relatively large oval sac, extremely white, and although diaphanous, still not

* Monthly Micr. Journ., x. (1873) p. 53 *et seq.*

hyaline, and with just one point *a*, fig. 19, plate VIII., which is the last trace of the fusion. The nucleus, however, can be seen, as the figure shows; but with no discoverable structure, and only made visible with careful handling of light and lens.

Now if this blended nucleus be carefully watched in the living state, it will be seen to diffuse itself radially through the body-sarcode of the blended organism as seen in plate VIII. fig. 20, until every trace of the nucleus is gone; and the still globule of living matter becomes tight and glossy, but no trace of structure can be anywhere found in it. It remains in this condition for six hours, and as detailed in my former papers, bursts, pouring out immense numbers of minute germs (plate VII. fig. 7).

The other nucleated form of these organisms that I have successfully followed through the whole succession of continuous fissions into conjugation, is *D. Drysdali*. It is in this respect an extremely remarkable form.

In my account of this organism before the Royal Society,* I recorded that nine separate forms were followed at different times, from the first fission after maturity had been attained, through all successive fissions, to what was in each case the last. There were from seven to eight acts of fission in an hour, for the first four hours, and about five per hour during the next two hours, and then longer intervals ensued. But when the segmented organism was followed, as of course it could only be, in one division of each fission, and every link in the chain was thus completed, the one which was the product of the last act of fission *died* in six cases, but underwent metamorphosis preliminary to conjugation in *three* cases.

In the latter, almost immediately after the fissional act was completed, an amœboid condition, which is quite unknown in any other stage of its life-history, supervened. The aspect of the organism in this condition is seen in plate IX. fig. 8, where it will be seen that this organism, shown in nearly its normal state at fig. 5, ibid., is curiously amœboid throughout its sarcode, and that the trailing flagella *a a* have become "clubbed," and are fusing with the body; while the nucleus *b* has greatly increased in size and has become white. The changes are now very rapid; not more than seventy seconds elapse before the trailing flagella are wholly fused with the body-substance, and while the head-and-neck-like protuberance characteristic of this organism is retained, the body, having lost its trailing or lateral flagella, becomes oval, with an immensely developed nucleus, as seen in plate IX. fig. 9. In this state it swims with ease; and now a band of granules is formed as shown at fig. 9 *a*, and it swims into the midst of the closely

* Proc. Roy. Soc., xxvii. (1878) p. 336.

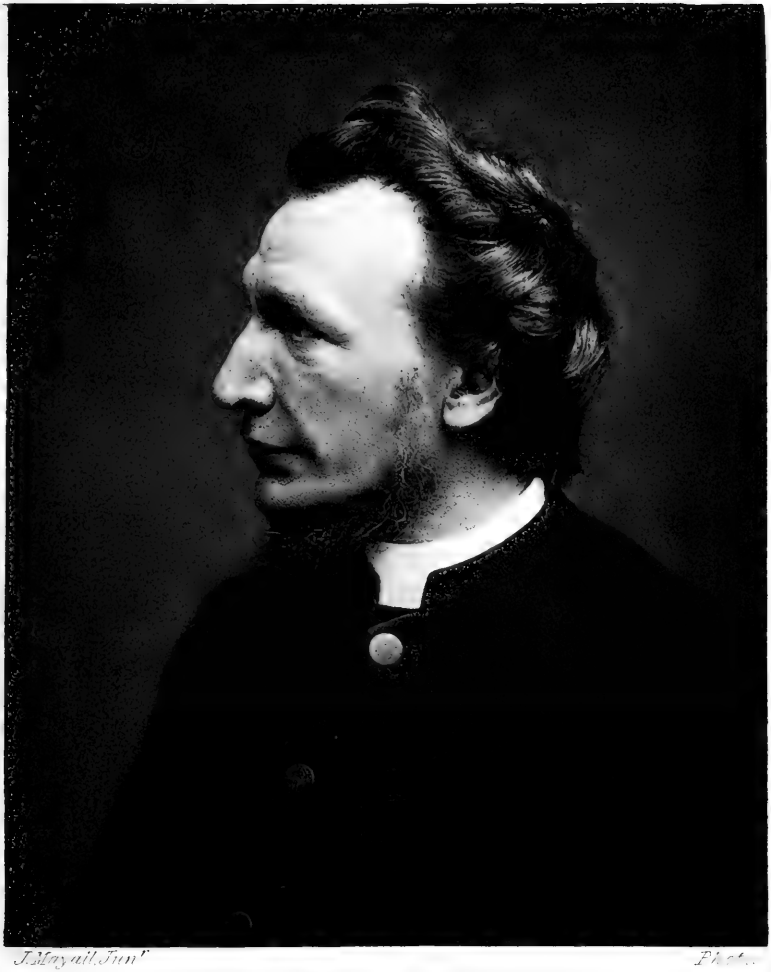
crowded gatherings of this organism which are "anchored" and springing upon, in order to break up, specks of decomposing matter.* It there firmly attaches itself to one of these active springing forms, which at once unanchors itself; and both together swim freely and vigorously about as seen in fig. 10. In the course of from thirty-five to forty-five minutes they become inert; the lateral flagella of the lower form fall upon and become fused with the mass of the body-sarcode; the front flagella become entangled and melt together, and during the whole time the two bodies are dissolving into each other. But there is a visible difference in the nuclei. The nucleus of the metamorphosed one remains large and retains its whiteness, as at *b*, fig. 10. That of the lower and ordinary one is small and highly refractive with a slightly brown colour, as seen at *a*, ibid.

When the uniting organisms reach the state shown in fig. 11, they are absolutely still, and the two nuclei coming into contact, fuse together: but the lower and smaller one becomes lost in, and takes the optical character of the larger, as it melts into it; but to the last that part of it which is not absorbed, as seen at *a*, fig. 11, retains its own character. But very soon the two nuclei become one—a pale white oval body—and the body-sarcode unites wholly together in a spindle or long oval form, as seen in fig. 12. The nucleus becomes fainter and fainter to every reagent and every form of illumination; but it can be seen, as in fig. 12, to be diffusing itself in a star-like or radial manner through the sarcode until it is no longer traceable, and we have a tight, glossy, whitish, spindle-shaped body, seen in fig. 13, from which, at the end of from three to four hours, the germs are emitted, from which a fresh host of this organism arises; shown in fig. 8, plate VII.

Now by my latest investigations I was able to demonstrate that in this case, as in the preceding, all the changes that arose in the last product of fission began in the nucleus. The first vital divergence from the normal form previous to fission was not the amœboid state shown in plate IX. fig. 8, but a change from the highly refractive and plexus-like condition of the interior of the nucleus, into the white, structureless, and much enlarged nuclear body seen at *b*, ibid.: and then follow all the changes I have described.

That we have in this union of the nuclei of two separate forms of the same organism, followed by a union of both body-sarcodes, a distinct act of fertilization, it would be almost idle to doubt. It is a curious fact that whilst in each of the earlier activities of the nucleus there was a discoverable structural condition, in this most important action in the life of the nucleus there is a loss of all differentiation. The whiteness is very striking, and the

* Proc. Roy. Soc. ibid.



J. Mayall Jun.r Phot.

EDWARD FORBES

F.R.S.

Curator of the Royal Museum of Practical Geology

diffusion of the nuclear substance, after nuclear fusion through the sarcode of the united organisms, is also full of interest.

One thing appears clear: the nucleus is the centre of all the higher activities in these organisms. The germ itself appears but an undeveloped nucleus; and when that nucleus has attained its full dimensions in size, there is a pause in growth in order that its internal development may be accomplished. When this is the case it becomes manifest that the body-sarcode is, so to speak, a vital product of the nucleus. Moreover, it is from it that the flagella originally arise. In the same way it is by a complex and beautiful series of delicate activities in the nucleus that the wonderful act of fission is initiated, and in all probability carried to the end. So too, all the involved changes that go with fertilization and the production of germs, are a series of correlated activities due, at the beginning at least, wholly to the nucleus.

We are, as I believe, by such an investigation as this, brought into close relation to the behaviour of the nucleus in the simplest condition in which it is at present possible to discover it. The phenomena made manifest are doubtless only the coarser and more amenable activities and changes. No doubt far profounder and subtiler changes are concurrently proceeding: but it is something to find ourselves on the way to the observation of living changes in the nucleus as they progress in the living form.

If our lenses are improved in the next ten years, as they have been in the last, in optical properties, I am convinced that remarkable advances in this problem of the nucleus may be made.

In thus coming closer to the delicate phenomena of nuclear activity we of course come no nearer to the solution of what life *is*. That is no part of the question. But to come any distance nearer to a knowledge of how the most living part of the minutest organisms in nature acts in detail, has for me, and for most biologists, an increasing fascination.

I had intended appending some practical remarks on the several and, so far as my experience goes, best modes of centering and illuminating these high-power lenses of great aperture; but I find it needful to delay this for some future occasion.

SUMMARY

OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.,

INCLUDING ORIGINAL COMMUNICATIONS FROM FELLOWS AND OTHERS.*

ZOOLOGY.

A. VERTEBRATA:—Embryology, Histology, and General.

a. Embryology.†

Special Physiology of the Embryo.—Prof. W. Preyer's ‡ most important general results on this subject are that mobility appears long before sensibility, and that the sense-organs and the parts of the nervous system connected with them are capable of functioning before it is at all likely that in normal embryonic life they have any proper functions to perform. By "mobility" is to be understood more especially the power of making spontaneous or "impulsive" movements. The presence of sensibility can only be proved by the existence of what is really a kind of mobility—that is, reflex mobility. When the appropriate reflex movements are obtained on stimulating the sense-organs, it is inferred that the corresponding kind of sensibility is present. Reflex movements are not only later in appearing, but can also be made to disappear more easily than impulsive movements. The movements that indicate sensibility can be suppressed (in the artificially extracted embryo of the rabbit) by applying chloroform to the skin; with more difficulty by causing chloroform to be breathed. In either case the anæsthesia passes off very rapidly. It is supposed that the chloroform in the first case acts directly, in the second case indirectly, on the nerves of the skin; that it only secondarily affects the spinal cord, and that it does not act at all on the brain. The movement of sensibility in the embryo gradually rises from its first appearance up to birth. In the embryo of the rabbit, the skin being irritated, two seconds may pass

* 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 processes of Evolution, Development, and Reproduction, and with allied subjects.

‡ xii. and 644 pp., 8vo, Leipzig, 1885.

from the contact to the reaction. The occurrence of respiratory movements is dependent on the power already present of reflex movement in response to stimuli on the skin, not the power of reflex movements on respiration.

Little has been ascertained with regard to the sense of temperature and the muscular sense; the fact that mobility is increased by warmth, and diminished by cold, of course proves nothing as to the sense of temperature properly so-called. The human fœtus gives signs of having feelings of taste two months before birth. The whole complex of parts belonging to the ear is functionless before birth, as are also the parts of the eye; but the power of raising the eyelid is present; the eyes are not closed in the human embryo after the sixth month. The conditions for the organic feelings are present several weeks before birth; pleasure and pain can be distinguished.

The author finally puts the question, What is the actual state of the embryo normally? He arrives by a series of arguments that seem pretty conclusive when taken together, at the result, that its state is normally like dreamless sleep or like the state of hibernating animals; it does not wake up from this state before birth except momentarily, and then only when strongly stimulated.*

Tail in Human Embryo.†—Referring to his previous communication as to the presence of supernumerary vertebræ in a human embryo,‡ Prof. H. Fol announces that by anatomical reconstruction of an embryo 8·1 mm. he has ascertained the existence of a backward prolongation of the intestine from the point where the anus will be formed. A similar condition has been found by Kölliker in the embryo of the rabbit. In man it is especially interesting, since the already distinctly marked position of the anus prevents any mistake as to the fact that this "caudal intestine" is a transitory structure.

Spermatogenesis in Mammals.§—Herr Benda reports the existence of Ebner's spermatoblasts in all the mammals (rat, dog, guinea-pig, rabbit, &c.) which he has examined.

The lobate spermatogenetic elements are connected with a cell which lies in the wall of the seminal tubule; this condition appears to be preceded by one in which elements whose nuclei are marginal are connected with a "foot-cell," and this by a stage in which round cells formed by cell-division lie on the processes of the "foot-cell." Herr Benda differs from Merkel and Sertoli, who regard the "foot-cell" as a fixed supporting cell, for he finds between the phase in which the elements are separated from the "foot-cell," and that in which new elements lie on these cells, a period in which the generative columns derived from the wall-cells are alone developed. The processes can only arise at the commencement of every spermatogenetic period. In opposition to Merkel he finds that the essence of the change consists

* Cf. Amer. Natural., xx. (1886) pp. 80–1, from Mind, No. xxxvii. p. 152.
† Arch. Sci. Phys. et Nat., xiv. (1885) p. 566.
‡ See this Journal, v. (1885) p. 781.
§ Arch. f. Anat. u. Physiol. (Physiol. Abth.) 1886, pp. 186–7.

in the active division of the "foot-cell," which is perhaps a kind of nutrient organ for the seminiferous elements, if these lose their cell-individuality by the metamorphosis of their nucleus. The active life of the "foot-cell" is spoken to by the retraction of its processes. This will alone explain the protrusion of the conical pole of the seminal cells towards the wall of the tubule.

Ovary of Echidna.*—Mr. F. E. Beddard gives a short sketch of previous papers on this subject, and after mentioning Mr. Poulton's † observations on the ovum of *Ornithorhynchus* in greater detail, gives his own results, with figures, of work on the ovary of *Echidna*.

He summarizes these results, which agree in the main with Poulton's, as follows:—(1) the follicular epithelium remains as a single layer of cells round the ovum, till it leaves the Graafian follicle, as is the case with lower Vertebrata; (2) the ovum completely fills the follicle; (3) the ovum is very much larger than in other mammals; (4) the ovum is invested *only* by the vitelline membrane, which becomes very thin or atrophies on maturity; (5) the ovum consists of a central mass of yolk, surrounded by a finer granular layer; (6) the nucleus lies excentrically, just below the peripheral layer of protoplasm.

Influence of Shocks on the Germs of the Fowl's Egg.‡—M. C. Dareste has made some observations on the contradictory results obtained in some experiments on the eggs of fowls. He directs again attention to what he calls the individuality of the germ, which is the dominant fact in teratogeny; this will explain why some embryos are normal and others monstrous, after having been submitted to the same shocks. The nature and mode of action of the shocks is also an important element, and they affect the egg differently according to its position. In other words, experiments may be largely varied. He has operated with an instrument which gives 1620 shocks a minute, and he has thus been able to give from 24,800 to 97,200 shocks; as a result he finds that the number of shocks is of no influence; an effect once produced is not increased by further action. On the other hand it is quite possible to alter the position of the eggs acted on, and this has been found to be of very great importance. Eggs affected when the position of the long axis was vertical and the more acute pole superior, generally gave rise to monstrous forms, while when the axis was turned upside down, or set transversely, the embryos were ordinarily normal, and in some cases chicks appeared.

Peptone in Hens' Eggs during Incubation.§—Dr. W. Fischel, as the result of the examination of forty-two eggs at various periods of incubation (2nd to 19th day), found peptones in eight cases, both in the embryonic tissues and in the yolk, in one embryo as much as 54 mgrm. being present. Peptones were never found before the 15th day, and in some cases not even after that date.

* Proc. R. Phys. Soc. Edinburgh, 1885, pp. 354–62.
† Quart. Journ. Micr. Sci., xxiv. (1884) pp. 118–28 (1 pl.).
‡ Comptes Rendus, ci. (1885) pp. 834–6.
§ Zeitschr. f. Physiol. Chem., x. (1885) pp. 11–3.

Spawning of Bufo vulgaris.*—M. Héron-Royer refers to Van Bambeke's five layers which surround the egg of a Batrachian. These are (1) the thin vitelline membrane; (2) the chorion; (3) the internal transparent capsule; (4) the external capsule; and (5) the thick, jelly-like envelope by means of which the eggs are fastened together, and fixed to submerged objects. He then describes the passage of the eggs through the oviduct, and the changes that take place therein, their expulsion from the cloaca, and their fertilization by the male. The attitude of the male during fertilization, and the arrangement of the eggs in their envelopes in various Anura, are figured.

In *Pelobates fuscus* the eggs are scattered in the jelly without any definite arrangement. *P. cultripes* rolls its string of eggs round plants. In *Bufo vulgaris* the external and internal capsules form a tube, inclosing a number of eggs in a common chamber. These two layers are spherical in Ranidæ and Hylidæ, as well as in Discoglossidæ. They appear to be absent in *Pelobates*. In *Axoloil* two or more eggs are laid in a common external capsule, each egg having its own internal capsule; the groups of eggs are placed end to end, and surrounded by the jelly-like layer. During the development of the embryo, these various layers, in all these forms, fuse with one another. The author supposes that the external capsule of these eggs is more apparent than real; that the very short part played by it is simply to prevent a mixture of the neighbouring layers; and that its disappearance precedes the free-swimming stage.

Yolk-globules in the intracapsular fluid of Fish Ova.†—After discussing the various opinions which have been held in regard to the passage of water through the porous capsule of fish ova, Prof. B. Solger maintains that the process occurs independent of fertilization, before or after, or contemporaneously.

By the entrance of water, the capsule in *Leuciscus* ova was seen to be stretched and tense thirty hours after fertilization, and remained so till, shortly before the liberation of the embryo, a large intracapsular space was formed. In studying the contents of this space, Solger found that the colourless internal fluid is at first (from the second to the ninth day after fertilization) very readily affected by water, becoming at once white and turbid, acting just like the yolk-substance of the ovum. In examining the intracapsular fluid, formed elements were discovered which closely resembled yolk-globules, though apparently in process of breaking up. Precautions were of course taken to prevent any injury to the wall of the yolk-sac. Professor Solger points out the two possibilities—either the globules originate from outside, just as His derives the yolk-globules themselves from the granulosa, or, which seems to him the more probable, they originate from the yolk before it is completely surrounded. He notes Eimer's interesting observation that the further entrance of water is prevented at a definite period by the development outside the porous capsule

* Bull. Acad. R. Sci. Belge, x. (1885) pp. 597–607 (1 pl.).
† Arch. f. Mikr. Anat., xxvi. (1885) pp. 321–33 (1 pl.).

of villous-like processes ("Zöttchen,") which Eimer derived from extruded yolk-material.

Formation of Mesoblast and Persistence of Blastopore in the Lamprey.*—Mr. A. E. Shipley finds that the mesenteron of the lamprey is present from the first sign of invagination, and that so far it resembles *Amphioxus* and differs from the frog. The mesoblast first appears by the differentiation of two bands of those yolk-cells which lie in the angles formed by the invaginated mesenteron and the epiblast; at a very much later stage it is completed ventrally by the down-growth on each side of the mesoblastic plates, which proliferate cells at their edge.

The author agrees with Schultze and Calberla that the blastopore persists as the anus; as the same phenomenon has been demonstrated for various Amphibia by Miss Johnson (newt), Gasser (*Alytes*), and Spenser (frog), its persistence in the Cyclostomata leads to the view that it is a primitive feature retained in those eggs which have not become much modified by the presence of a large mass of yolk; a re-examination of *Amphioxus* as to this point would be very instructive. Behind the anus, and at a point corresponding to the front lip of the blastopore, there is a mass of indifferent tissue, into which there pass representatives of all three germinal layers, and which appears to represent the primitive streak.

Breeding of Salmon from Parents which have never visited the Sea.†—Dr. F. Day reports on experiments made at Howietoun, from which he concludes that (1) male parr and smolts may afford milt competent to fertilize ova, but when from fish of the second season, or up to thirty-two months old, it is (? always) of insufficient strength for strong and vigorous fry to be raised. (2) Female smolts or grilse may give eggs at thirty-two months of age, but those which are a season older are better capable of producing vigorous fry; for the purpose of developing ova a visit to the sea is not a physiological necessity. (3) Young male Salmonidæ are more matured for breeding purposes than are young females of the same age. (4) Although females under twenty-four months of age may give ova, such are of little use for breeding purposes, as the embryos do not become well developed or vigorous, and the young when hatched are frequently malformed. (5) Older Salmonidæ, as a rule, give larger ova than younger or smaller ones; but the size of the egg varies with age and condition. (6) Among the produce of every female fish there may be found variations in the size of the eggs. (7) From larger ova finer and more rapidly growing fry are produced; consequently races may be improved by the selection of the breeders.

Hatching the Eggs of Cod.‡—Mr. J. A. Ryder, after describing a new apparatus for hatching cod's eggs (allowing of a slow up and down movement of the water, which seems to aerate the eggs and give better results than the usual rapid motion), observes that the larval

* Proc. Roy. Soc., xxxix. (1885) pp. 244–8.
† Trans. Linn. Soc. Lond., ii. (1885) pp. 447–68 (2 pls.).
‡ Science, vii. (1886) pp. 26–9 (1 fig.).

integument becomes raised above the head, forming a serous cavity—the "supra-cephalic sinus"—which appears to serve as a float, so as to keep the embryos at the surface of the water. The embryos swim horizontally, but when at rest have an oblique position, the tail pointing backwards and downwards. It is found that if the sea-water becomes less dense than normally, the eggs sink and die, showing that the cod's eggs, in order to live and develope, float at the surface.

Conditions of Bastard Fertilization.*—Profs. O. and R. Hertwig find that the success or non-success of bastardation does not exclusively depend on the degree of systematic relationship between the crossing species; this has also been observed by Prof. Pflüger for Amphibia. There does not seem to be reciprocity in the cross-fertilization of two species of Echinoids, any more than of Amphibians; there are also possible grades; thus, while ova of *Echinus microtuberculatus* are almost always fertilized by spermatozoa of *Strongylocentrotus lividus*, the reverse is hardly ever successful. Ova of *S. lividus* are not to be fertilized by spermatozoa of *Arbacia pustulosa*, but the eggs of the latter are often fertilized by the sperm of the former. The condition of the products is of importance, fresh ova being often less successfully bastardated than those whose vital energy has been lowered by some means; there is, in fact, a *minimum* and an *optimum* of capacity for bastardation; this was well seen by dividing the ova into groups, and fertilizing them under different conditions. In Echinoids there is no visible difference in the form of spermatozoa, and the causes of failure or success must be looked for elsewhere; it depends on the constitution of the genital products; complete fertility or sexual affinity only obtains between products of one and the same species; there reside in the egg-cell regulative forces, which guarantee the normal course of fertilization; these diminish in power with the vital energy of the cell.

Continuity of the Germ-plasma considered as the basis of a theory of Heredity.†—Prof. A. Weismann's essay ‡ on germ-plasma is reported on by Prof. H. N. Moseley; it deals with the fundamental question, "How is it that a single cell of the body unites within itself the entire tendencies of inheritance of the whole organism." Prof. Weismann answers this question by supposing that the germ-cells arise as far as their essential and characteristic substance is concerned, not at all out of the body of the individual, but direct from the parent germ-cell. The germ-plasma is regarded as a substance of peculiar chemical or even more special molecular composition which passes over from one generation to another; at every ontogenesis a portion of the specific germ-plasma which the parent egg-cell contains is not used up in producing the offspring, but is reserved unchanged to produce the germ-cells of the following generation; in fact the germ-cells are regarded as separate from the entirety of cells composing the body, and are related to one another as are a series of

* Jenaische Zeitschr. f. Naturwiss., xix. (1885) pp. 121–65; and Supp., i. (1885) pp. 72–6.

† Nature, xxxiii. (1885) pp. 154–7.

‡ 8vo, Jena, 1885, 122 pp.

generations of unicellular organisms derived from one another by a continuous course of simple division into two.

The author divides his essay into three chapters, the first of which deals with the germ-plasma. Fecundation is regarded as the union of the nuclear substance of the maternal and paternal individual but this substance is not the same as Nägeli's idioplasm, for it does not extend through the whole body. The view is discussed and support for it drawn both from the animal and the vegetable kingdom.

In the second chapter a new theory of the meaning of the polar vesicles is advanced; their extrusion is regarded as the getting rid of histogenetic plasma, in order to leave the germ-plasma free to act; it is, in fact, the removal of ovogenous nucleo-plasma. The third chapter treats of parthenogenesis, and in a postscript to it the discovery of a polar vesicle in the parthenogenetic summer eggs of Daphnidæ is announced; this strikes at the root of Balfour's theory, and an explanation of parthenogenesis must be looked for in the quantity of contained germ-plasma; when there is a certain mass the segmentation nucleus proceeds to the process of ontogenesis; in the ordinary sexual process it is the increase of the nucleus which gives the stimulus to segmentation, the disposition to which was there already. "Sperm-nucleus and egg-nucleus do not differ in their nature," and in certain algæ Von Berthold has discovered not only a "female, but also a male parthenogenesis" (*Ectocarpus, Scytosiphon*). It can hardly be doubted that conjugation is the sexual reproduction of unicellular organisms.

Attack and Defence as Agents in Animal Evolution.*—Mr. C. Morris thinks he perceives four successive ideas emerging into prominence in the development of the animal kingdom. In the primeval epoch it is probable that only soft-bodied animals existed, when the weapons of assault were the tentacles, the thread-cell, the sucking-disc, and other unindurated weapons. At a later period armour became generally adopted for defence, and the tooth became the most efficient weapon of attack. Still later, armour was discarded and flight or concealment became the main method of escape, and swift pursuit that of attack, while claws were added to teeth as assailing weapons. Finally, mentality came into play, intelligence became the most efficient agent in both attack and defence, and a special development of the mind began; this has found its culmination in man, side by side with whom we have in existing conditions of life an epitome of the whole long course of evolution.

β. Histology.†

Cells of the Epidermis of Batrachian Larvæ.‡—Prof. F. Leydig thinks that the cells lately described by Kölliker § as being provided at their free end with fine processes, are the same as what are already

* Proc. Acad. Nat. Sci. Philad., 1885, pp. 385–92.
† This section is limited to papers relating to Cells and Fibres.
‡ Zool. Anzeig., viii. (1885) pp. 749–51.
§ See this Journal, v. (1885) p. 977.

known as glandular cells. It is pointed out that each cell consists of a lower portion from which a short stalk or process is given off, and of an upper or neck-like portion; in frogs and toads this upper end is filled with a soft finely granular matter, but in the land salamander there is a body which looks like a cork to the tube. These organs are not distributed over the whole of the body, but are specially developed on the ventral side of the larva. They vary somewhat in size, and are pyriform in shape; their protoplasm is rather more coarsely granulated than that of the surrounding cells, and around the nucleus there is a cavity; in larvæ 25 mm. long there were no filaments, but only a slightly conical process, which has the appearance of a soft substance, and exhibits longitudinal striation. As the legs begin to appear the cone becomes reduced, the orifice diminishes in size and a rounded soft "cork" appears. Prof. Leydig again insists on the relation of sensory to glandular cells, and concludes by recommending a special study of the structure and metamorphoses of the epidermis of the tadpole and the frog.

Cells of the Vitreous Body.*—Herr H. Virchow finds in the merino sheep that there are richly branched cells with one or several nuclei on the surfaces of the vitreous body; they are regularly distributed over the whole surface, and form a single layer. In the fowl there are delicate cells which are either fibrillar or spindle-shaped; some have several processes and form a single layer over a large part of the surface of the vitreous body; these were found in two fowls, but were absent from a third and from three ducks. In the frog there are (1) cells with a wide delicate body, as a rule connecting two vessels; they are cells which are formed adventitiously on the outer side of the vessels; (2) granulated cells which are either rounded or elongated; (3) round cells with a round nucleus and a small quantity of protoplasm (? leucocytes); and (4) polymorphous cells (? also leucocytes) which are either broadened out into thin irregular plates, or produced into thin processes.

Nuclei of Secreting Milk-gland Cells.†—Since according to Hammarsten, casein is a nucleo-albuminate, and since nuclein is, as far as is yet known, confined to the nuclei, Herr F. Nissen was led at Heidenhain's suggestion to investigate the behaviour of the nuclei during milk-secretion. His research has revealed the interesting fact of the degeneration and disruption of the nuclei, which, therefore, in all probability go to form the casein of the secretion. Within the milk-cells the nuclei are observed to multiply, perhaps indirectly, since, in hundreds of preparations, no mitosis was seen. The nuclei towards the inner end of the cell separate themselves off, surrounded by a portion of the protoplasm, and, in the lumen of the alveoli, or less frequently in the cells themselves, undergo degeneration. The normal nuclear structure disappears, the chromatin collects in separate segments at the periphery, and the segments break up into a coagulation. The result is probably the casein of the milk. Herr

* Arch. f. Anat. u. Physiol. (Physiol. Abth.), 1885, p. 563.
† Arch. f. Mikr. Anat., xxvi. (1886) pp. 337–42 (1 pl.).

Nissen compares the milk-gland, and colostrum gland; in the latter there is no such wealth of nuclei, nor degeneration of the same. He also reports the independent observation of a disruption of the nucleus in the granulosa-cells of the rabbit ovum, which has also been noted by Flemming.

Accessory Nuclear Body.*—Herr G. Platner describes the origin and history of the recently much discussed accessory body or "Nebenkern," which has been discovered in the protoplasm of various cells. His material consisted of the hermaphrodite glands of *Helix*, which, in various stages of development, were fixed, according to Flemming's method, in chrom-osmium-acetic acid for at least half an hour, afterwards hardened in alcohol, imbedded in celloidin, and stained with hæmatoxylin or safranin. He emphasizes the importance of not using animals which have been kept in captivity.

(*a*) The sex-cells at first exhibit homogeneous nuclei within the protoplasmic meshwork; clear, round, intranuclear clefts and cavities appear, and the contents become divided, from the centre outwards, into granules. The resulting chromatin-granules are to some extent connected by fine threads. The nucleus becomes gradually surrounded by a narrow fringe of finely granular protoplasm, which is broader at one portion. (*b*) At this point the "Nebenkern" appears as a peculiar, distinct element, resulting from a roundish protrusion of the nucleus, and possibly preformed within it. It at first consists of a simple loop, but becomes more coiled and complicated. (*c*) Increasing to about half the size of the nucleus, it separates from it as an apparently closed coil. The spermatogonium then consists of a membraneless, amœboid cell, whose nucleus exhibits chromatin-granules, filamentous meshwork, and hyaloplasma, and is surrounded by a special protoplasmic envelope. The protoplasm exhibits a network structure, and contains the accessory body.

(*f*) The process of division is introduced by the disappearance of the nuclear network; the chromatin-granules unite in round balls, most of which lie peripherally; these balls divide repeatedly, and form the microsomata. From these, persisting nucleolar elements are readily distinguished by their larger size and more intense staining. (*g*) The microsomata arrange themselves in definite rows, in returning curves round an excentric pole, defined by the accessory body, which has now approached and *united with the nucleus*. The nuclear loops exhibit for a while a half-moon disposition, with the concavity turned away from the "Nebenkern." (*h*) The latter soon decreases in size, and along with the nucleolar remnants utterly disappears, *being apparently used up in the formation of the nuclear coil*, which soon afterwards loses its excentric polar position, and occupies the centre.

(*i*) The nuclear coil assumes the appearance of a many-rayed star; this is succeeded by the formation of an equatorial plate with large granules, and by two poles with fine radiating filaments. These spindle filaments extend to the equator, and without discontinuity

* Arch. f. Mikr. Anat., xxvi. (1886) pp. 343–69 (1 pl.).

in the other direction, beyond the pole, into the protoplasm, where they divide and end in the fine protoplasmic network. (*j*) The chromophilous balls of the equatorial plate divide in the plane of the spindle axis, and the daughter segments again divide. The results of this longitudinal division recede towards the poles, describing in so doing a turn round the transverse axis, and finally fuse together to form the polar plates. (*k*) The spindle filaments, at first somewhat convex, are stretched as the polar plates recede. The protoplasm of the cell constricts, the cylindrical form is replaced by that of an hour-glass, and at length complete division occurs.

(*l*) In the half-moon-shaped new nucleus, rows of microsomata become gradually distinct. Finally a regular coil is formed, whose loops all start from one excentric point. At this point *a new "accessory body" is rapidly budded out* into the protoplasm. As it becomes more defined, the coil breaks up, and is replaced by a rounded off nucleus with protoplasmic membrane, nuclear network, and chromatin-granules. (*m*) Herr Platner follows the history of the "Nebenkern" still further, through the spermatocytes, to the spermatides, or undifferentiated sperms. A large portion of the nucleus of the spermatide goes to form the last "Nebenkern," which is an irregular polygonal body like a ring compressed from various sides. It persists for a time along with the spermatide remnant, which clings to the side of the developing axial filament, and *probably helps to form the spiral membrane* which envelopes the latter.

The relative observations of other investigators are briefly reviewed, and those of Gaule criticized, in regard to which Herr Platner communicates the results of some further observations on the "accessory bodies" of the pancreatic cells of *Anguis fragilis*.

Amœboid Movement of Cell-Nucleus.*—Messrs. S. H. and S. P. Gage, in studying the blood of *Necturus*, find that the nucleus of the white corpuscle executes distinct and vigorous movements, quite independently of those of the corpuscle. The white corpuscles are very large in this animal, and the observers hope, by studying these, to elucidate various questions as to the membrane and division of nuclei.

Unicellular Glands in the Epithelium of Bladder of Amphibians.†—Dr. J. H. List finds unicellular glands (goblet-cells) in the epithelium of the bladder of various Amphibians (*Triton, Rana, Bufo, Bombinator, Hyla*); they contain two different substances, one in the form of a network which fills the theca, which may be called the filar mass, and an interfilar mass which lies between the cords and is apparently homogeneous. The filar mass consists of thin apparently homogeneous cords, which form polygonal or rounded meshes; the nucleus is always found at the base of the cell, and appears to be in no case directly connected with the filar mass. The interfilar, unlike the filar, takes up staining reagents with great difficulty. The secretion from these cells depends on a process of swelling, which gradually extends downwards; they are not confined to secreting once only. The goblet-cells are independent structures,

* Science, vii. (1886) p. 35. † Biol. Centralbl., v. (1885) pp. 499–502.

presenting many analogies to the gland-cells of mucous glands. The smallest kinds are found in the cystic epithelium of *Triton cristatus;* aggregates, such as are seen in *Rana*, and especially in *Bufo*, do not seem to be there present. In *Bufo vulgaris* and *Bombinator igneus* they are very abundant; in *Hyla arborea* they are also numerous, but more scattered than in toads.

Nerve-terminations in the Cutaneous Epithelium of the Tadpole.*—Mr. A. B. Macallum summarizes the results of his research thus:—Certain fibres of the nerve-network, situated below the corium, and known as the fundamental plexus, give origin to fibrils which enter the epithelium and terminate in comparatively large beadlike bodies between the cells. From a network of fine fibrils below the epithelium and forming meshes, each narrower than the surface covered by an epithelial cell, arise other excessively fine fibrils, which end either within or between the cells, or after branching, in both fashions. One, commonly two, often three or more, nerve-fibrils terminate in the interior of each epithelial cell, near its nucleus. The so-called figures of Eberth, which are found during larval life only, which are easily isolated from the cells containing them, and which were regarded by their discoverer as intracellular nerve-terminations, appear to Mr. Macullum to be sheaths for such terminations. The epithelium was hardened with Erlicki's fluid, or solutions of chromic acid of different strengths; for staining, nigrosin and safranin, as well as, of course, gold chloride were used.

Phenomena of Muscular Contraction in Primitive Striated Fibres.†—M. F. Laulanié has studied the hyoid muscles of the frog with the aid of the myoscope, and finds that the contraction of the primitive fibres of the hyoid muscles of the frog produce no change either in the character of the striation or in the relative situation of the parts of the contractile segment. The author thinks that this result justifies us in rejecting all theories as yet proposed to explain the muscular contraction, all of which imply a change either in the distribution of the parts, or in the situation. It is further found that the disc and the clear bands flatten and enlarge without altering in volume, and it is concluded that the contraction of the fibrils of the primitive bundle is the summation of the changes of form (flattening) undergone by the thick discs and the clear bands. The heterogeneity of the fibril can as yet be only explained by the theory of M. Ranvier that the fragmentation of the contractile substance offers a very large surface for chemical changes, and so insures their rapidity.

γ. General.‡

Organs of Flight.§—M. P. C. Amans sums up an extensive survey of the organs of flight of the animal kingdom by distinguishing two principal types of the machine—the insect and the vertebrate.

* Quart. Journ. Micr. Sci., xxvi. (1885) pp. 53–70 (1 pl.).

† Comptes Rendus, ci. (1885) pp. 705–7.

‡ This section is limited to papers which, while relating to Vertebrata, have a direct or indirect bearing on Invertebrata also.

§ Ann. Sci. Nat.—Zool., xix. (1885) pp. 9–222 (8 pls.).

In the former the principal part is formed by the meso- and meta-thorax; in each segment the endosternum forms the longitudinal axis of the floor; the flanks are sustained by three vertical pieces, and the upper edge by two; the roof of each segment is formed by two parts, which are concave below, and its lateral edges form an obtuse angle, open below and without. The framework of the wing is formed by six primary nervures and their ramifications, which are alternately related to the sides or the roof; the general form of the wing is that of a biplanar triangle, with the base centripetal and the apex centrifugal. The base is formed of an anterior and a posterior plane, the latter being the more developed; the base of the wing is united to the flanks and to the roof of each segment by as many articular pieces as there are nervures. The apparatus of formation is constant, and may be considered as consisting of an anterior piece, which forms a movable pivot, separated by an articular cavity from the fixed pivot. The wing is able to undergo torsion, thanks to the articulations of the anterior and subanterior nervures with their basal terminations. The line of torsion is a curve which passes through the basal head of the posterior nervure by a special commissure, and through the basal extremity of the proanterior process when it is stretched. The centrifugal extremity of the wing follows in air, and during ascent, the course of a sinuous line. The wing is never comparable to a simple lever; it is most nearly so in the Pseudo-Neuroptera; the basilar pieces (including the roof) may be grouped under three sides of a cone of revolution, and the muscles are grouped according to these; the muscles vary greatly in direction, and it is not correct to speak of exclusively vertical or horizontal muscles.

The bat and the bird are the types of the vertebrate machine; in them the hard pieces are internal, the motors external, and this is the fundamental difference between the two types. The general form of the machine, and of the wing, and the distribution of consistency to the surface, as well as the rotation of the anterior edge, is comparable to what is seen in insects.

Influence of Galvanic Currents on Organisms.* — Herr L. Hermann has made some experiments on fourteen-day-old larvæ of frogs; a current being passed through the water in which they were placed, it was found that they moved, and all took up a position in which the head was directed towards the anode and the tail towards the cathode; in other words, with sufficiently strong currents these animals place themselves in the lines of the current, and against it. If they are forced to lie with their heads towards the cathode they appear to be restless. These phenomena are not observed with dead larvæ, and they are therefore vital phenomena.

If the spermatozoa of frogs or mammals are placed on a slide and a strong current sent through them, the head of the spermatozoon turns towards the anode, but this is to be explained by purely physical laws. The author makes some suggestions as to further experiments on this subject.

* Arch. f. d. Gesammt. Physiol. (Pflüger), xxxvii. (1885) pp. 457–60.

Blue Colour of Animals.*—Prof. F. Leydig says that a blue granular pigment is rarely found in animals; in the crayfish, for example, there are blue crystals. The blue colour is more often due to interference, owing to the presence of lamellæ, or to the fibrils of connective tissue, as in the tapetum fibrosum of the eye of Ruminants; the corium of the living larva of *Pelobates fuscus* is similarly blue. A dull material overlying black pigment produces blue, as in the case of blue eyes, which are due to the uvea shining through the non-pigmented iris, and in some frogs. Dark chromatophores have a like effect, as has too the swelling of the corium consequent on the filling of the lymph-spaces.

In conclusion, the author discusses the tegumentary secretions, which are of various colours, and which can be washed away; an example is to be seen in the celestial blue colour of the abdomen of *Libellula depressa*, and, perhaps, the "bloom" of the pupa of the Apollo butterfly. On the other hand, the colouring matter may be in cells of the epidermis, as is the case with the rosy colour of *Tetrao urogallus*, and can then, of course, only be removed after the destruction of the tissue which contains it.

Perception of Brightness and Colour by Marine Animals.†—Herr V. Graber has made some further experiments on marine animals with the divided box already used by him. He finds that the common star-fish is an eminently leucophilous or light-loving animal, for the bright division of the box always contained 2·2 as many individuals as the dark; they avoid red, or are erythophobes, three times as many seeking a dark-blue compartment. The common jelly-fish (*Medusa aurita*) was neither specially sensitive to brightness or to colour; but it is possible that the results might be different with larger aquaria. *Idotea tricuspidata* is very sensitive to light at the maximum differences in brightness, for 6·3 as many individuals sought the white as the dark compartment; but they are quite insensitive to less marked differences. They object to red and like blue. *Gammarus locusta* does not seem to be affected by light or shade; *Rissoa octona* dislikes the dark, and is sensitive to less marked distinctions; it again, in the proportion of 103 to 2, liked blue and avoided red. *Gasterosteus spinachia*, like fresh-water fishes, prefers darkness in the proportion of 78 to 6, and *Syngnathus acus* gave somewhat similar results.

B. INVERTEBRATA.

Colouring Matters of the Integument.‡—M. P. Girod has investigated the chlorophyll-pigment of *Hydra viridis*, the pigment of the skin of Cephalopods, and the ink-bag of these molluscs.

The author is of opinion that the chlorophyll of green *Hydræ* plays an important part in their economy, by furnishing them with

* Zool. Anzeig., viii. (1885) pp. 752–8.

† SB. K. Akad. Wiss. Wien, xci. (1885) p. 129. See Naturforscher, xviii. (1885) pp. 486–7.

‡ Comptes Rendus, ci. (1885) pp. 1371 4 (Report on Prize Essay).

the necessary carbon; this carbon may be utilized solely by the chlorophyll-corpuscles themselves.

M. Girod agrees with those zoologists who describe a membrane around the chromatophores of the Cephalopoda, and he assigns to its elasticity the function of reducing the extent of these structures; he gives a full account of the structure and development of the ink-gland, and shows that its secretion must be ranged with cuticular formations; he has not been able to find copper in the ink, although it is present in the blood, but there is iron, as in mammalian pigments; the "ink" is nothing more than slightly modified hæmocyanin; he doubts whether these pigments are derived from the colouring matter of the blood.

Physiological Action of the Salts of Lithium, Potassium, and Rubidium.*—M. C. Richet has experimented with the chlorides of lithium, potassium, and rubidium on various animals. A weak dose kills crayfishes, because an injection is always intra-venous and not only subcutaneous; the large doses required to kill a slug are explained as due to the extreme vitality of the tissues; for most animals, however, the toxic dose is much the same, and the mean is for lithium 0·10, for potash 0·50, and for rubidium 1·00; this relation the author regards as pretty much the same as the atomic weights of these three metals, 7, 39, and 85. By dividing the numbers obtained in his experiments by the atomic weights he gets a mean of 0·0128, and he proposes the following formula. If P be the atomic weight of an alkaline metal, the quantity necessary to kill an animal weighing one kilogramme will be $P \times 0{\cdot}0128$. It is concluded that the toxic is identical with a chemical action, and that a molecule of the salt is necessary to poison the same weight of a living animal.

Tactile Organs of Insects and Crustacea.†—The Grand Prix des Sciences Physiques has been awarded to Dr. J. Chatin for his essay on the Tactile Organs of Insecta and Crustacea; he has examined all the parts of the mouth-organs, and has compared their homologous regions; the antennæ have likewise been investigated, and the structure of the nerve-filaments and the constitution of the subcutaneous plexus is described. The percipient hairs have been studied, and the function of the so-called soft cones is reconsidered.

Mollusca.

Development of Genital Organs of Hermaphrodite Gastropoda.‡—M. H. Rouzaud has studied the development of the genital organs of some hermaphrodite Gastropods; he finds that, in the Pulmonata, however complex its constitution may be in the adult, the apparatus always arises from a homogeneous and massive cellular bud, which may be called the primitive bud; it ordinarily appears just before the

* Comptes Rendus, ci. (1885) pp. 707–10. † Ibid., pp. 1368–71.

‡ 'Recherches sur le développement des organes génitaux de quelques Gastéropodes hermaphrodites,' 8vo, Paris, 1885. Cf. Rev. Sci. Nat., iv. (1885) pp. 517–24.

embryo becomes free; it is at first of the shape of a rounded bottle with a very short neck, but in a few days it has the form of a club with a long handle; the point of attachment of the handle to the body-wall represents the seat of origin of the primitive bud, and it is just here that later on there is developed the common external orifice of the genital apparatus (Helicidæ), or the opening of the female ducts (Lymnæidæ); the swollen part of the club-like organ is free, and separates more and more from its point of attachment, in such a way that the primitive bud soon becomes filiform, and has its superior end hidden in the lobes of the liver; this end forms, later on, the site of the sexual elements. On the basal or peripheral part a secondary bud—the penial bud—appears, and at the same time the surface of the primitive bud presents a peripheral muscular differentiation, the elements of which are all arranged along the long axis of the bud; a similar differentiation soon appears on the penial bud. Clefts appear in the median part of the primitive bud; one, which extends towards the base and reaches the penial bud, has been called the utero-deferent cleft, and it separates the two cords, one of which becomes the oviduct and the other the efferent canal. Another extends towards the apex, and, as it separates off the copulatory pouch, it may be called the utero-copulatory cleft. Further proliferations of the primitive bud give rise to the albuminiparous gland and the diverticulum. The free tip then proliferates and begins to give rise to the hermaphrodite gland. A fresh bud now appears on the primitive one, which may be called the sagittal bud; this will ultimately form the dart sac.

The observations of the author demonstrate the continuity of all the parts of the genital apparatus from the first stages of development, and utterly oppose the doctrine of fusion promulgated by Eisig; the genital apparatus of the Helicidæ arises, as a whole, from a single primitive outgrowth.

The further development of the parts is described, and in conclusion there is an account of the male and female products; the ovules have a degenerated and transitory follicle which goes to aid the store of nutriment of the egg, and its elements arise from the perinuclear protoplasm; the male ovules give rise to proto- and then to deuto-spermatoblasts, the latter forming each a packet of spermatozoa.

Post-embryonic development of Najades.*—By infecting fishes with the parasitic larvæ of *Anodonta*, Herr F. Schmidt was able to study the as yet but little known post-embryonic development of these forms.

In regard (I.) to the *anatomical structure* of the ripe embryo, Herr Schmidt (*a*) corroborates the statement of Forel and Schierholz, opposed by Rabl and Flemming, that the *posterior end* of the young mussel is that at which the two lateral pits, the "Mittelschildtasche" of Flemming, and the ciliated patch are situated. (*b*) Between the two laterally placed pits lies the foot-pad, in front of this Flemming's "Mittelschildtasche," and behind it the ciliated patch. In cross

* Arch. f. Naturgesch., li. (1885) pp. 201–34 (2 pls.).

sections the enteric cavity is seen, with two flat lateral dilatations representing the liver, and surrounded by a thick mass of indifferent mesoderm-cells, from which, on each side, a *strand of cells* extends backwards almost to the posterior margin of the shell. These strands, probably identical with those described by Flemming as the lateral wings of the anterior pad, and regarded by Schierholz as ganglionic rudiments, are shown by Schmidt to have no connection with the nervous system, but to represent the rudiment of the future organ of Bojanus. (*c*) He describes a pair of peculiar, large, flat *muscle-cells*, stretching, one on each side, across the body-cavity, connected at the one end with the middle of the shell by means of numerous fine processes, and at the other with the large cells of the so-called embryonic mantle. These two flat mesoderm-cells lie parallel to the longitudinal axis of the embryo, exhibit a fine longitudinal striping, and undoubtedly serve, in closing the shell, to draw inwards the hooked processes, and thereby to secure the firmer attachment of the larvæ.

II. *The development of the parasitic embryo.*—(*a*) As Schierholz has shown, the rudimentary foot increases greatly in size, assuming a blunt conical form, and gradually presses the "Mittelschildtasche" and the oral invagination ever further forwards; while by this growth of the foot, the external margins of the two lateral pits (the rudimentary branchiæ) are drawn out longitudinally and separate into several knob-like elevations. (*b*) The often noted early disappearance of the byssus organ is accompanied also by that of the sensory cells, the embryonic shell-shutting muscle, the great part of the embryonic mantle, and the above described muscle-cells. The adult adductors are entirely new structures. (*c*) He confirms Braun's interesting observation that the large conical cells of the mantle gradually contract into a "mushroom-shaped" body, which lies in close proximity to the fin-ray, and is concerned with the dissolving and absorbing of the lime-salts required by the young mussel for the growth of the shell. (*d*) The endodermic archenteric sac enlarges along the middle line of the body, and comes into communication with the now anterior oral invagination, while posteriorly, an anal opening is formed by rupture and not by invagination. From the "Mittelschildtasche," not only the mouth-opening, but the whole fore-gut arises, and is therefore, unlike the other portions of the canal, of ectodermic origin. The comparatively inconspicuous diverticula of the archenteron, which represented the liver, increase greatly in size, and grow out into two cylindrical sacs, lying parallel to, and afterwards enveloping the alimentary canal. (*e*) The whole nervous system is developed from the ectoderm; the ganglia arise independently, and at different epochs, as solid thickenings of the epithelium; the pedal are at first in connection with an invagination which forms the *byssus-gland*. Herr Schmidt first observed the auditory sacs on the ninth or tenth day of parasitic life as invaginations of the external epithelium on each side of the foot, afterwards sinking inwards to the pedal ganglia as round masses, in which a distinct lumen is, at a later stage, recognizable. (*f*) The origin of the *gills*

and of the *organ of Bojanus* has been already indicated. A number of cells arranged round the rectum in vesicular form, afforded at the end of the parasitic life an indication of the future *heart.* (*g*) The single-layered embryonic mantle passes at the margin of the shell into a zone of several layers of small cells which form the future mantle. The compression of the large, cylindrical or conical, mantle-cells into the mushroom-shaped body has been already referred to. He confirms Braun's description of the origin of the permanent shell.

III. *Comparison with other Mollusca.*—In comparing his results with the ontogeny of other molluscs, Herr Schmidt notes the impossibility of homologizing the so-called byssus-gland of the Glochidium with the similarly named organ in many Lamellibranchs. The former is a special larval organ, adapted to the mode of life, and might, Herr Schmidt suggests, be conveniently designated "Klebfadendrüse." He observed what Braun had previously recorded, that in the absence of fishes, the mature embryos may remain for weeks, or even months, in the branchiæ of the mother mussel. He emphasizes Schierholz's demonstration that the *posterior* ciliated patch could not be the rudiment of the velum, and attributes the peculiar posterior situation of the gills, the foot, and the alimentary canal to the great development of the embryonic adductor. In summarizing the peculiarities of Najad development, e. g. in the mantle, he lays special emphasis on the completely ectodermic origin of the nervous system, which does not readily harmonize with Hertwig's theory.

Development of Vermetus.*—Prof. W. Salensky reports the result of his study of the development of *Vermetus.* In the young unfertilized ova a small "protoplasmic" and larger "deutoplasmic" portion are readily distinguished; the segmentation resembles that of other molluscs, the "micromeres" appearing at the formative pole by separation of the "protoplasmic" portion of the "macromeres." When sixteen of these have thus been formed the epibolic gastrula formation begins; after about two-thirds of the egg has been surrounded by the slow multiplication of these cells a small hollow, representing the archenteron, is formed on the ventral surface. The round blastopore, at first in the centre of the ventral surface, gets shunted gradually backwards, becoming oval, and ultimately forming the mouth-opening. Meanwhile the macromeres are dividing, at first posteriorly, and the small cells thus resulting form the future endoderm, and displace the undivided macromeres which go to form yolk. *The mesoderm* appears much later, at first as a single layer of cells, arising from the ectoderm round the rim of the blastopore, but subsequently exhibiting several layers, splitting to form the body-cavity, &c.

The rudiment of the *foot* is seen at the time of mesoderm formation, as an axial row of ciliated cells stretching from the blastopore backwards, and with slightly larger ectoderm cells on each side. A similar ciliated ridge occurs at the cephalic portion of the embryo

* Biol. Centralbl., v. (1885) pp. 564–8.

between the two lobes of the velum, which also appear as two ridged arcs of large ciliated cells.

The cephalic ganglia appear independent of and long before the pedal, in the form of two ectoderm plates in front of the velum, and separated by the above-mentioned anterior ciliated ridge. These thicken and sink in to form at once the ganglia and the eyes, which remain always in close association. The ganglia consist at a median stage of two blind rods, with a narrow lumen and external opening; the blind ends form processes which meet and grow together, and meanwhile the cerebral rods have become solid. The separation of the ganglia occurs at a late stage.

The auditory sacs appear before the pedal ganglia as small ectodermal pits on the margin of the foot, becoming afterwards constricted off into sacs. Soon afterwards, at each side of the ciliated ridge of the foot, two ectoderm thickenings appear; they are slowly modified, and at length become neural plates of several layers, which are afterwards separated from the ectoderm and grown round by mesoderm.

Two distinct large *glands* are formed in the foot; the posterior, formerly described by Lacaze-Duthiers in the adult *Vermetus*, appears as a sac-like deepening of the ectoderm, and occupies the whole posterior portion of the foot, the anterior consisting of a compact cell-mass with a cylindrical duct of some length. Its history is uncertain.

The mesoderm remains partly unsplit behind the foot and this portion forms the rudiment of the *musculus columellaris*, while a continuation of it seems to form the rudiment of the *pericardium* which appears at an early stage, on the right side of the embryo, as a thin mesoderm sheath, which soon splits to form a cavity obviously homologous with the body-cavity. In the posterior corner of the cavity the splanchnic layer becomes raised from the endoderm, and *the cavity of the heart* is thus formed between the two layers. The œsophagus and radula-sac are formed from the inbent margins of the blastopore; the hind-gut appears as an ectodermal plate, which projects conically, becomes hollow, and acquires an anal opening.

Prof. Salensky notes how the development demonstrates the homology existing between certain portions of molluscan and annelid nervous systems, thus the molluscan cephalic and pedal ganglia are the equivalents respectively of the annelid supra-œsophageal and first ventral ganglia.

Anatomy of the Marine Rhipidoglossata.*—In his second essay on these Mollusca, Dr. B. Haller deals with the texture of the central nervous system and its investments. The methods of examination adopted were to remove the nervous system from the living animal, and to harden it in pure alcohol, chromic acid solution, or hyperosmic acid; these suited various tissues in different degrees; for isolation a mixture of glycerin, acetic acid, and distilled water was used.

1. The ganglionic cells; the author finds that the process arises

* Morphol. Jahrb., xi. (1885) pp. 321–430 (8 pls.).

either from the cell-body or its nuclei; in many cases from both. The process may be a connecting process, directly uniting one cell with another, or a plexiform process, when it breaks up in the nervous plexus in the central part of the central nervous system, or a trunk-process when it is directly continuous with a nerve-fibre. The large cells found in the ganglionic masses are called triangular; their form is best seen in the Haliotidæ and Trochidæ; the two upper processes of the cells are always directly united with cortically placed smaller cells; the lower one is either a plexiform or a trunk-process. Another well-marked form of cell, which is especially found in the Trochidæ, is small, pyriform, and always unipolar. The giant-cells which are seen in the Pulmonata and the Opisthobranchiata are, like the extremely small cells, always wanting in the Rhipidoglossata. Others, which are known as central cells, have no processes. The nucleus is, when fresh, always rounded and never, as in the Pulmonata, reniform in shape; the nucleolus is also round, is coloured very intensely, and is highly refractive; it is very rare for more than one nucleolus to be present.

2. The connective tissue in and around the central nervous system: the ganglionic cells of the central nervous system always have true cell-membranes; these form a thin layer, consisting of a homogeneous membrane, in which there are scattered oval nuclei, surrounded by a finely granular protoplasm. Between the protoplasmic particles there is a yellowish-brown pigment, which, like that of the ganglionic cells, is extracted by alcohol. In satisfactory examples it is possible to see that the membrane is a saccular process of the nerve-covering, in which the cell lies embedded. The author comes to the conclusion that the nervous investment forms a single envelope around the whole central nervous system, which is continued from the neurilemma. It is attached to the central system and serves as a certain support for it, inasmuch as it sends processes into the nervous tissue. This relation of the connective to the nervous tissue is regarded as being a primitive one, uncomplicated by the relations which obtain in higher forms.

After describing the differences which obtain in different forms, the author remarks that the tissue has a different structure in various parts of the central nervous system of one and the same species; and he looks upon this as enforcing the views of Brock as to the great variability of the connective tissue of molluscs.

3. The central nerve-plexus: the author here enters upon a close inquiry into the views of preceding writers, and concludes that in the nuclear portion of the central nervous system of the Rhipidoglossata we find neither the so-called dotted substance, nor neuroglia, but that the whole is filled by a delicate ("subtile") nervous plexus, which has its origin in the ganglionic cells.

4. Topography of the pedal cords, and the origin of their nerves: in all the forms examined the pedal cord of either side was seen to have a lateral groove which extends throughout its whole length; it is shallow in *Fissurella*, deep in the Haliotidæ and Trochidæ; by the aid of this groove each cord may be divided into an upper and a

lower half; it is only a useful mark, and has no morphological significance. The cords are formed of an inner nuclear, and an outer cortical layer; the peripheral nerve-fibres arise either separately or in bundles. This part of the subject is entered into with great detail, and is illustrated by diagrams.

5. The cerebral ganglia: in *Fissurella* these have undergone, during evolution, a concentration, which has not, however, affected the texture of the cerebral ganglia throughout the Rhipidoglossata generally. The large pyriform and triangular cells which were seen in the pedal cords, and especially in their pleurocerebral portion, are here absent, and the largest cells are not larger than those of medium size in the pedal cords.

Speaking generally it may be said that this paper demonstrates that the central nervous system and the peripheral ganglia of the Rhipidoglossata consist of marginal ganglion-cells and of a central plexus, which is formed from the processes of the ganglion-cells, and in which the neurilemma takes no part. The peripheral nerves arise from the cells and from the nerve-plexus. What changes may obtain in more complicated nervous systems, which are phylogenetically younger and in which there is great concentration and consequent elongation of the trunks, does not seem to really oppose the view that the nerves have everywhere a double mode of origin. Where the ganglia are more compressed a process seems to have been going on by which the larger cells have become grouped in outer cell-layers; their continuations have been pushed downwards, and they have anastomosed partly with one another, and partly with smaller cells.

Constitution of the Egg and its Envelopes in the Chitonidæ.*—Prof. A. Sabatier disagrees with the views put forward by Dr. Ihering in 1878, in which the shell was regarded as being formed by the structureless membrane which the earlier writer called the follicular membrane, believing rather that the structureless membrane belongs to the walls of the ovary and that the nuclei which Ihering regarded as part of it are merely nuclei formed directly by the protoplasm of the ovule, and eliminated peripherally. The author's observations confirm the ideas of Fol, Roule, Balbiani, and himself as to the general origin of the cellular elements which form a follicle for the egg; and they seem also to confirm his special views as to the intravitelline genesis of these elements, which he regards as being formed by a kind of crystallization or condensation in the protoplasm of the egg, and not as arising by direct expulsion from the contents of the germinal vesicle.

In the egg of *Chiton polii*, Sabatier observed a large number of germinal vesicles, each of which had a single large refractive nucleolus, which was homogeneous and very strongly coloured; it was more or less excentric in position, and the central part of the vesicle was occupied by a more or less voluminous aggregation of chromatin-grains which belonged to the nuclear plexus. A more or less large number of rays were given off from this mass, and ended in the

* Rev. Sci. Nat., iv. (1885) pp. 429–44 (2 pls.).

superficial layers of the vesicle where they spread out into small cones; in rarer cases the rays do not reach the surface, and in others they are wanting, when the central mass has an irregular spherical form. Prof. Sabatier says that he has not been able to make out a distinct relation between the form of this chromatic plexus and the genesis of the vitelline corpuscles; but he concludes that the nucleolus and the nuclear plexus are not composed of identical substances, and that the latter, even when in a spherical condition, is still distinguished from the nucleolus, which cannot, therefore, be considered as an agglomeration of the substance of the plexus.

Odontophore of Limnæa.*—Dr. W. Dybowski, who has already reported on the dentition of *Ancyclus*, *Physa*, *Amphipeplea*, and *Planorbis*, now gives the fifth type represented in the fresh-water pulmonate gastropods—the formula is 1–19–15–15. The species examined was *L. stagnalis* var. *vulgaris;* the radula is 4 mm. long, and 2·2 mm. wide; there are from 100–102 rows.

Notes on Gymnosomatous Pteropoda.†—Dr. J. E. V. Boas, in anticipation of his monograph on the Pteropoda, notes that d'Orbigny's genus *Spongiobranchæa* contained two species, *S. elongata* and *S. australis*, which are by no means allied; the former is a *Clione*, the latter the type of a very well-marked genus, which is most closely allied to *Pneumodermon*, and to *Dexiobranchæa*. The latter is a new genus which differs more from *Pneumodermon* than does *Spongiobranchæa* and is characterized by its lateral gill, and by the complicated sucking apparatus; it contains four species, one of which was called *Pneumodermon ciliatum* by Gegenbaur, while the others are new.

The author recognizes six well-marked genera in the group of the Gymnosomata; these are *Pneumodermon*, *Clione*, *Haplosyche*, *Cliopsis*, and the two already mentioned; the genus *Cirrifer* of Pfeffer is founded on an injured *Pneumodermon*, and all the rest are either so badly described as not to be recognizable, or are formed on species which belong to one of the six recognized genera.

Molluscoida.

β. Polyzoa.

Fresh-water Polyzoa of Bohemia.‡—Herr J. Kafka gives an account of the five species of fresh-water Polyzoa already known from Bohemia, and describes eight others, amongst which *Plumatella hyalina* and *P. lophopsidea* are new. The first of them is allied to *P. vesicularis* by the transparency of its tubules, which arise radially from a centre, and branch dichotomously at some distance from it; the second has at first some resemblance to *Lophopus*, but the gelatinous investing mass is an ectoblast-membrane, while the organization of the cells and polypides is that of *Plumatella*. Contrary to what ordinarily obtains on the continent of Europe, and like what is seen in England, *Fredericella sultana* is common in Bohemian

* Bull. Soc. Impér. Moscou, lx. (1885) pp. 256–62 (1 pl.).
† Zool. Anzeig., viii. (1885) pp. 687–91.
‡ SB. K. Böhm. Gesell. Wiss. Prag, 1884 (1885) pp. 229–40 (1 pl.).

waters, where two varieties are found, one of which forms tuft-like colonies, while the other branches but little. For a long time the author was unable to convince himself of the locomotor powers of *Cristatella mucedo*; *Alcyonella fungosa*, like some other Polyzoa, has two kinds of statoblasts. One of the commonest species in Bohemia is *Plumatella repens*; a third variety of this well-known form is noticed.

Monograph of Fresh-water Polyzoa.*—Dr. J. Jullien has an extended paper on the Polyzoa of fresh-water illustrated by 250 woodcuts intercalated in the text.

He recognizes two sub-classes, the first of which is that of *B. lophopoda* (Dumortier), in which there are two tribes; the first is *B. loph. caduca*, with the two families *Pedicellinidæ* and *Loxosomidæ*; the second *B. loph. perstita*, with the families *Plumabellidæ*, *Lophopusidæ*, and *Rhabdopleuridæ*; the second sub-tribe, *R. infundibulata*, (P. Gervais), contains the two families *Paludicellidæ* and *Hislopidæ*. The author gives definitions of the families, genera, and species. A new genus, *Hyalinella*, is instituted for *Plumatella vesicularis* Leidy. A full description is given of the woodcuts, but the manner in which the author has given his "synonymy" seriously interferes with the usefulness of the work for systematic zoologists.

γ. Brachiopoda.

New Rhynchonella from Japan.†—Dr. T. Davidson describes *Rhynchonella döderleini*, a new spinose form from Japan, which he regards as the most noteworthy of all living Rhynchonellidæ. The spines, which project from each rib, are arranged in regular rows, and exhibit, therefore, an interesting survival of a form of shell ornamentation which formerly prevailed among the Palæozoic Productidæ, &c., and the oolitic Spiriferidæ and Rhynchonellidæ. No spinose Brachiopod is known from the cretaceous or tertiary periods, and this is the first example of the kind among living species.

Arthropoda.

α. Insecta.

Morphology of Insect Ovaries.‡—Prof. A. Sabatier refers to a previous paper, wherein he suggests that the nutritive cells in the ovary of insects are nothing more than eliminated elements, representing true egg-follicle cells. There are three varieties of ovaries in insects: (1) where each ovum is surrounded by nutritive cells; (2) where all these cells are at the blind end of the ovarian tubule; (3) where these cells are absent. In the present paper he describes only the first variety of ovary, which occurs in Lepidoptera, Diptera, Hymenoptera, and some few of the other orders. The ovarian tubule consists of a structureless membrane, which encloses a cavity filled

* Bull. Soc. Zool. France, x. (1885) pp. 91–207 (250 figs.).
† Ann. and Mag. Nat. Hist., xvii. (1886) pp. 1–3.
‡ Comptes Rendus, cii. (1886) pp. 61–3.

with a homogeneous mass of protoplasm, with scattered nuclei. At the blind end of the tubule these nuclei multiply by fission. In *Forficula*, where the ovum possesses only a single nutritive cell, the process is most easily seen. At a short distance from the blind end a mass of protoplasm arranges itself round each nucleus; from each of these ovarian cells thus formed, the "follicle-cells" are derived by groups of granular refringent particles passing out of the protoplasm, and arranging themselves around the cell; these follicle-cells then increase by division. The "nutritive cell" is formed by a similar process; a mass of granular protoplasm, from the neighbourhood of the germinal vesicle, passes towards one end of the oval egg-cell: it gets nipped off here, and forms a nutritive cell, which is, together with the ovum, surrounded by the follicle-cells. Thus both the follicle and nutritive cells are portions eliminated from the egg-cell.

In a second paper* M. Sabatier describes the second variety of ovary—that in which the vitellus remains at the blind end of the tubule, as in Coleoptera and Rhynchota. The terminal filament consists of a mass of pyramidal cells surrounding a lumen, and enclosed by a membrane. Beyond this is the ovarian swelling, which consists of four layers: (1) a thick layer of large nutritive cells; (2) within this a mass of delicate fibres arranged longitudinally, suspending the ovules, and connecting them with the nutritive cells; (3) the ovules in the lower central region; (4) a network of small (follicle) cells, which separate the ovules from one another. The development of this ovary was traced in *Nepa cinerea*.

At first the ovarian swelling has the same structure as the terminal swelling; at the base of each primitive ovule, nutritive cells are formed by endogenous division, and at the same time follicle-cells are also formed. As the ovum enlarges, it pushes its way into the central lumen, and carries with it a small prolongation or cord of nutritive cells; thus, as in the first variety of ovary, both nutritive and follicle cells are eliminated elements. The difference between these two varieties appears to be that in Lepidoptera, &c., the ovary remains solid, and the ova surrounded by their nutritive cells; whereas in Coleoptera, &c., a central cavity is present, in which the ovules are suspended, and are thus able, by elongation of the suspending cords, to be removed from their nutritive cells.

Gustatory Organs of Insects.†—Herr F. Will, after a short historical introduction with regard to the gustatory organs of insects, as to which our knowledge is still in a very elementary condition, gives an account of his own experiments. He commenced with bees, wasps, and ants, which he first kept for some time without food so as to make them hungry; he soon found that hungry Hymenoptera make very little choice, and he was therefore obliged to alter his plan of experimentation; he made use of pulverized sugar, alum, and crystalline dolomite; the alum was found to be nasty by bees, who took it at first when it was put in the place of the sugar, but tried to

* Comptes Rendus, cii. (1886) pp. 267–9.

† Zeitschr. f. Wiss. Zool., xlii. (1885) pp. 674–707 (1 pl.).

wipe it off their tongues. The author came to the conclusion that at least the Hymenoptera and Diptera are provided with a gustatory sense. The tongue and the neighbouring mouth-parts are fully described, and the conclusion is come to that the pits or goblets on the base of the tongue, and on the lower side of the maxilla, are the end-organs of the gustatory apparatus. The nerve ends on the surface, and is thus accessible to direct chemical stimulation, the parts can be washed with saliva, while the supply of hooks and setæ partly retains the saliva for cleansing purposes, and partly defends the delicate ending of the nerves. The terminal setæ on the top of the tongue may also be regarded as gustatory organs; this is indicated by the part played by the tip of the tongue in the early stages of the ingestion of food, by the observation of the mode of feeding adopted by these insects, and by the structure of this region. The terminal sensory hairs do not project freely, so there is no reason to suppose that they are tactile organs; they are rather carefully protected, both by the hooks and setæ of the tongue, and by the thick circlet of supporting hairs. In ants the goblets at the tip of the tongue are formed exactly on the plan of those which are found at its base.

The author's observations lead him to deny a gustatory function to the nerve-end-organs which are found in other parts of the mouth, for they all fail in the preliminary condition of being able to come into direct contact with the food; all the numerous pits which are found elsewhere have very fine pale hairs, none of which are provided with a groove or perforated at their extremity.

Mid-gut of Insects and Regeneration of Epithelium.*—Dr. J. Frenzel follows up his recent research† on the histology of the crustacean gut, by a detailed study of the mid-gut ("Mitteldarm") of insects, and of epithelial regeneration there and elsewhere. His material consisted of sixty different species selected from all the seven great groups of insects; for hardening purposes, he found that a mixture of alcoholic solution of sublimate and nitric acid gave the most satisfactory results. The memoir is introduced by a general anatomical description of the alimentary canal, and especially of the mid-gut in its various modifications.

General histology.—(*a*) The innermost layer of the mid-gut is composed of an *epithelium* of large, almost cubical cells, which passes out into the diverticula if such exist, and which may, though frequently quite equal and uniform, exhibit numerous regular internal villi, or sometimes pads. (*b*) Round the epithelium lies a sheath of connective tissue, in the form of a loose meshwork of fibres and nuclei, filling up the spaces between the villi, or between the epithelium and the musculature, or else represented by a distinct basement membrane, also without recognizable cellular composition. (*c*) Further out lie the muscular layers, circular internally, and longitudinal externally. Their main effect is the shortening of the gut; a narrowing of the lumen can also be effected. The muscles are

* Arch. f. Mikr. Anat., xxvi. (1885) pp. 229–306 (3 pls.).
† See this Journal, v. (1885) p. 994.

almost wholly confined to the canal proper, not passing into the villi, sacs, &c. Sometimes the circular muscles are compacted into a sort of membrane, while the longitudinal strands have a looser course, or the reverse may occur; in *Bombus* the circular muscles seem to lie outermost. In most larvæ, the circular bands are less strongly developed; in the adult forms, the longitudinal. The cylindrical elements of the longitudinal muscles frequently enclose at intervals a cavity, in which a long nucleus lies. There is no special "serous" membrane outside the muscular layer, though the external bands are frequently bound together by the loose connective tissue.

The epithelial cells.—(1) The internal epithelium may present a flat surface, or exhibit villi and other elevations. The crypt-like glands first noted by Basch are described, and the various occurrence of two distinct kinds of cells—cylindrical and mucous—in the apparently homogeneous epithelium of caterpillars is specially noted. (2) The secreted material inside the epithelial cells occurs in three different forms, in different groups; (*a*) not definitely characterized either in colour or form; (*b*) colourless, but of definite form; (*c*) with a more or less bright colour, and with definite form and disposition within the cells. The mid-gut of the bee larva is described with reference both to its histology and physiology, and the various changes of the epithelium are noted. Epithelial cells with colourless, but definitely formed, mostly spherical secreted substance, &c., are next discussed, and finally those of the third type. The distribution and structure of the *mucous cells*, characteristic of the caterpillar mid-gut are noted, and special attention is directed to the "theca" or "secretraum" which occupies so large a part of the cell.

The hair-fringe.—The author maintains firmly his previously expressed opinion as to the structure of the cell-fringe, which he believes to be composed of fine hairs. This he has observed not only in these epithelial cells, but in the cells of the so-called liver of Crustacea and Mollusca, on a Gregarine and elsewhere. Leydig has also observed a similar fringe, but has interpreted it as a cuticle with pores. Dr. Frenzel affirms the frequent occurrence of the fine hair-fringe, and since he believes that the hairs are mobile, proposes to distinguish under the general term *Wimper-zellen*, those with cilia strictly so-called, and those possessing the hair-fringe. As to their physiological import, he suggests that they serve as a protective cuticle, in some cases physically, to prevent hard food-particles coming into direct contact with the cells; in other cases, perhaps chemically, to prevent the injurious influence of other secretions, in fact to prevent self-digestion.

The nuclei of the mid-gut epithelium.—An interesting description is given of the varied nuclear structure of the epithelial cells. The typical nuclear network, described especially by Flemming, is frequently exhibited; often complicated however by the presence of "nucleolids" or nucleolus-like bodies. The chromophilous substance in such nuclei takes the form of granules arranged peri-

pherally, united by fine threads with one another, and with the more internal granules, the knots of the network, so that the central nucleolus is woven round on all sides. In the nuclei of the larva and imago of *Tenebrio*, a crystal-like body is present—a phenomenon in animal histology which was till lately unique. In the larvæ of Muscidæ the typical network is absent, and the roll-of-money-like nuclear bands are observed. In caterpillars, and probably in all Hymenopteran larvæ, the nucleus appears as a vesicle, containing a homogeneous fluid, in which true nucleoli, nucleolids, and minute granules are imbedded. Fine processes are observed passing from the *nucleolid bodies*, which are therefore perhaps united in a sort of network. The minute *granules* are all of the same size, and are perfectly spherical and free, and when they are retracted from the periphery of the nucleus, a pale loose network is sometimes revealed.

The regeneration of the cells.—In continuation of his former research on the epithelial regeneration in Crustacea, Dr. Frenzel describes that in the mid-gut of insects. The epithelial cells, whether "cylindrical" or "mucous," both in the canal itself and in its diverticula, reproduce themselves by direct ("amitotische") division, while the specifically glandular cells of the crypts exhibit in their division karyolytic phenomena. The prevalence—indeed the predominance—of the direct method of division in epithelial cells is maintained, and the extreme position which denies its existence is criticized.

The physiological import of the cells.—After pointing out that the main work of digestion must be discharged by the mid-gut, and that in the absence of pseudopodic processes, intracellular digestion is out of the question, the author maintains that in most cases, at least, the whole epithelial cell perishes in discharging its secreted substance. Except in some cases where the secreted material is not so abundant, or definitely and firmly formed, and where consequently the substance might be discharged and replaced piece-meal, the sacrifice of the whole cell seems the only alternative. The opinion that the "secreted substance" might be the result of absorption is sharply criticized. The problem of absorption is discussed, but in face of such difficulties as that of ascribing the absorptive function at once to mid-gut and hind-gut, Dr. Frenzel prefers to confess the absence of any definite knowledge of the process. He maintains the absence of liver-like organ or bile-like secretion.

Bees and Bee-keeping.*—Mr. F. R. Cheshire, whose researches on bees and their diseases are so well known to the Fellows of the Society, has embodied the results of his investigations in a book which cannot fail to be highly appreciated by all naturalists who are interested in bees, and even more so by those who regard bees less from their scientific than from their commercial aspect.

The first volume now issued deals with the scientific part of the subject, and is intended to be followed by a second "practical"

* Cheshire, F. R., 'Bees and Bee-keeping, Scientific and Practical,' vol. i. Scientific, 336 pp., 8 pls. and 71 figs. 8vo, London (L. Upcott Gill), 1886.

volume, which will include the question of bee diseases. The author certifies that a very large part of his matter is in all respects absolutely new, being the issue of researches, dissections, and experiments, which have occupied no inconsiderable fraction of many years of a busy life.

The first volume deals with the anatomy and physiology of the bee itself, the peculiarities of the sexes, the principles of comb-structure, and the relation of bees to flowering plants. It is divided into sixteen chapters, which treat separately of various structural points (such as the tongue and mouth-parts, the organs of special sense, wings in flight, and organs of the drone), the differences between wild and hive bees, the economy of the latter, the relations of bees to flowers, and their functions as fertilizers, florists, and fruit producers. The illustrations, nearly all of which were drawn by the author, are excellent. Those on the plates deal with the digestive system, the head and tongue, and details of tongue structure, of the eyes, of the legs, of the sting, &c.

Geometrical Construction of the Cell of the Honey Bee.*—Prof. H. Hennessy gives the following directions for constructing a model of the bee's cell, with the aid of a pair of compasses :—

1. Inscribe an equilateral triangle in a hexagon; a side of this triangle is the long diagonal of the lozenge; bisect this, and the diagonal of a square erected on the half is the shorter diagonal of the lozenge.

2. Draw six parallel lines at distances equal to the side of the hexagon, and a straight line perpendicular to them from the second of the parallel lines; "inflect a straight line" equal to a side of the lozenge above constructed, and repeat this process until six trapezia are formed.

3. On folding these trapezia a hexagonal prism is formed, into which three lozenges equal to that constructed will accurately fit, and the entire structure will be completed.

Labium of Hymenoptera.†—M. J. Chatin shows that the very much modified labium of *Anthophora* can be derived from that of the Orthoptera by the comparison of a series of forms, *Cimbex*, *Cynips*, *Acœnites*, *Stizus*, and *Vespa:* this last has a labium more nearly like that of the *Orthoptera* than the former genera.

Phosphorescence of Luciola italica.‡—Prof. C. Emery supplements his previous research on the luminous organ of *Luciola italica* by a study of the phenomena in the living insect. When the organ is observed in function, under low power, the eye is at first dazzled, and only a bright yellowish uniform light is seen. The intensity soon diminishes, however, and the luminous area is seen to be interrupted by numerous dark circles regularly disposed. As the brightness continues to decrease light rings are observed round the dark spots, and outside the rings an irregular shade. The bright

* Proc. Roy. Soc., xxxix. (1885) pp. 253 and 254.
† Comptes Rendus, cii. (1886) pp. 222-4.
‡ Bull. Soc. Entomol. Ital., xviii. (1885) pp. 351-5 (1 pl.).

rings are the last to disappear, and gradually the whole becomes dark. Here and there, however, several bright points remain long in activity.

If the separated abdomen of a healthy insect be excited by slight pressure a flash of light can likewise be observed. It is, however, less intense and the process is slower. The bright rings persist for a considerable time round the dark spots, and they often appear irregular and interrupted. In the already darkened portion numerous luminous points are seen, which sometimes join together and form new rings, which again break up and vanish.

The difficulty of both these modes of observation, owing to the movement of the living insect in the one case, and of the mechanical excitation in the other, led Prof. Emery to poisoning the insect with vapour of osmic acid. In such cases he was able to observe round the dark spots of the portion in full light smaller, fainter, sometimes unconspicuous spots, arranged with a certain regularity.

Comparing these observations with preparations stained with carmine, or hardened with alcohol and clarified with caustic potash, it was seen (1) that the large round spots represented the central portion of the "digitiform acini" of T. Tozzetti, or the "Tracheenendzellen" of M. Schultze; (2) that the luminous portion represented parenchymatous cells, and the smaller dark spots the nuclei of the latter.

The bright portions, i. e. the parenchymatous cells, are observed to become discontinuous and to fade gradually, sometimes leaving bright persistent points. The contours of the cells and the nucleus within are sometimes distinctly visible. Prof. Emery gives figures of the various phenomena. He is thus able to affirm with certainty that the light of the *Luciola* originates in the parenchymatous cells, and withdraws his previously expressed opinion that the luminosity originated mainly in the cells of the cylindrical lobes formed from the matrix of the tracheæ. In full luminosity the dazzled eye cannot detect any differences of intensity; the uniformity is perhaps due to reflection, or it may be that the cells of the deeper layer have also to a less degree the power of luminosity. During medium luminosity, at any rate, the combustion is exclusively confined to the parenchymatous cells of the transparent superficial layer of the organ.

Researches on the Meloidæ.*—M. H. Beauregard communicates the first part of a detailed study of the Meloidæ.

In discussing (*a*) the *integument*, he maintains the probability that its *softness* is for the most part due to the small quantity of salts in proportion to organic matter, as is suggested by the results of analyses. The varied and often brilliant *colours* are due either (1) to the phenomena of interference, or (2) the presence of special pigments, or (3) to the effect of coloured or uncoloured hairs. (1) The brilliant green of the common Cantharid, which has been sometimes referred to the presence of a green oil due to the chlorophyll of the leaves eaten by the insects, is, however, visible in young

* Journ. Anat. et Physiol. (Robin), xxi. (1885) pp. 483–534 (2 pls.).

larvæ which have not eaten chlorophyll, and is due, as Pocklington has also shown, to the fine markings of the elytra and the resulting interference. (2) In many forms, however, there is no metallic, but only a dull colour, due to non-granular pigment in the cuticular layers of the elytra. (3) The hairs may contain oily or granular colouring matter, they are generally longitudinally striated, and may in various ways modify the colour. The very manifold ornaments of the integument are also noted.

(*b*) *Skeletal system.*—Two different types of head are described—triangular and compressed (*Cantharis*), and more spherical, with a thickness measuring almost as much as the transverse diameter (*Meloe*, *Mylabrum*, *Macrobasis*). Four types of labrum with an anterior margin varying from deeply concave to convex, are figured; the double nature of the epicranium is demonstrated in all the larval forms observed and in many adult forms. In general, however, the structure of the head resembles that of the Coleoptera generally, and the description need not therefore be summarized. The antennæ of the males in some genera differ markedly in shape and in larger size from those of the female forms. In describing the various modifications of the thorax M. Beauregard notes the correlative reduction of the tergal arches and entothorax of *Meloe*, in proportion to the more or less rudimentary state of the wings.

The hitherto unrecorded structure of the elytra is described at length. They are formed of two plates, united at their margins; each plate consists of a cuticle and of a subjacent chitinous dermal layer. With few exceptions it is only the cuticle which is coloured. The free space between the superior and inferior plate is occupied by hypodermic cells, and is traversed by the blood and by the tracheæ. From the superior plate transverse pillars pass down into the dermal layer of the lower plate. They consist of a central zone continuous with the cuticle, and a peripheral sheath derived from the chitinous lower layer. He notes the distribution of nervures and the automatic folding mechanism of the wings. In a section through a wing, where traversed by a trachea, M. Beauregard distinguishes (1) a thick external chitinous layer, with transverse striæ, and of a more or less distinct brown colour, especially exteriorly; (2) an endothelium-like layer, with ovoid nuclei regularly arranged in longitudinal rows; (3) blood, tracheæ, and nerves.

The appendages are described in detail, and special attention is directed to a small accessory structure situated between the claws of the tarsus, and named by Kirby and Spence the *plantula*. It seems constant among the Meloidæ, and attains in some cases a remarkable development. It consists of a pale brown chitinous sac, usually of a flask-like shape, with a long thin neck, terminated by one or more stiff, sharp, dark-coloured hairs. The body of the flask is contained within the last joint of the tarsus; the neck protrudes between the claws. In *Meloe* and *Nemognatha* it is feebly developed, atrophied, and naked; in the *Mylabra* it is strongly developed, and covered with a large number (specifically constant!) of long hairs. The other *Meloidæ* possess *plantulæ* between the two extremes. M. Beauregard

describes the histology and relations of the structure, and inclines to regard it as a superadded joint of the tarsus, perhaps connected with the presence of internal claws.

Meromyza saltatrix and Elachiptera cornuta.*—Prof. K. Lindeman gives an account of the life-history of these two destructive Diptera. The larva of *Meromyza saltatrix* is white with green shining through; the supports for the cephalic stigma are short and fungiform; the knob-like end contains seven terminal tracheal tubes which open on some low warts; the two cephalic hooks are large, black, and armed inferiorly with two large blunt teeth. The pupa is almost colourless and distinctly constricted; this stage is only of a fortnight's length, and the whole period of development not more than seven weeks. The imago, when it first appears, is almost colourless also, but soon becomes completely coloured. The larva of *Elachiptera cornuta* has a remarkable resemblance to those of *Oscinis*, but differs in the form of the supports for the cephalic stigmata, while the cephalic hooks are markedly serriform.

Parthenogenesis of Chironomus Grimmii.†—Prof. A. Schneider confirms the discovery of Grimm as to the parthenogenesis of a species of *Chironomus*. The larvæ live as usual in tubes formed from the secretion of the spinning gland, plus sand-grains and portions of plants. At the periods of skin-casting the tube is shortened and closed. In the imago within the larval envelope the sexual organs are well developed, and the eggs are laid immediately after, and occasionally before liberation, but only by the imago and not by the pupa, as Grimm stated. The eggs are laid viâ the vagina, and not, as in Grimm's account, viâ two lateral elliptical openings on the posterior part of the body.

Immediately after the eggs are laid, they begin to develope, and even in some cases when artificially removed from the ovary. No males were to be seen, and the receptaculum seminis was always empty. Such parthenogenetic generations succeed one another through the whole winter, and on till the middle of June. It is probable that males are developed in summer and that fertilization then occurs. Schneider differs from Grimm as to the development of the ova and ovaries, but a discussion of this is reserved to a future communication.

New Parasite on Iulus.‡—Dr. E. Haase describes a larval parasite found by him (in 1880–81) on the head of *Iulus fallax*. The yellowish-white oval egg measured 1·2 mm., was superficially hexagonally marked, and fastened anteriorly very closely to the *Iulus*, while the posterior pole of the lower surface exhibited a shallow, round, sucker-like hollow. Two larval forms were observed, of an obviously insect character; the first very young, with about twelve segments, with much yolk still persisting; the second derived from the first by a skin-casting, covered with the short triangular spines characteristic of Diptera, with little persistent yolk and with well

* Bull. Soc. Impér. Moscou, lx. (1885) pp. 251–5.
† Zool. Beitr. (Schneider), i. (1885) pp. 301–2.
‡ Ibid., pp. 252–6 (1 pl.).

developed tissues. Dr. Haase describes two superficial sensory pits on the head; the strong oral organs and associated musculature; the characters of the eleven segments behind the head; the two stigmata, situated medianly behind the anus on the last segment; the tracheæ traversing the body with simple coils, &c.

The egg is presumably fixed by a somewhat large mother insect, and by means of a rapidly hardening acid secretion; the larva probably eats its way with its powerful jaws into the *Iulus* and there undergoes further development, since empty egg-envelopes were sometimes found without any visible external opening. He was unfortunately unable to rear the larva, which was referred by Prof. Brauer to the *Tachininæ* or *Dexinæ*, though differing in some points from all dipterous larvæ as yet known.

Alimentary Tract of Phylloxera.*—M. V. Lemoine describes the digestive tract of *Phylloxera punctata* as a tube, bent upon itself, with two dilatations upon it, and numerous glands anteriorly. The mouth, placed amongst the buccal appendages, leads into a pharynx supplied with chitinous valves, acted upon by muscles: thence the œsophagus leads into a large stomach—the first dilatation, from which a short, narrow intestine passes to the posterior intestine—the second dilatation. The fatty, glandular structures on the narrow intestine seem to represent Malpighian tubules. Various other glands are present which are much more highly developed in the young forms, appearing very early in development. In the sexual forms the alimentary tract is functionless.

Tracks of Insects simulating Vegetable Impressions.† — M. Zeiller describes impressions found in the Oxford clay at Villers-sur-mer, scarcely distinguishable from those of plants, but which have unquestionably been made by insects. These insects must have made galleries in the soil 0·015 m. in diameter, and 0·005 m. deep, parallel to the surface and branching repeatedly in a series of galleries, which lead off from the main gallery alternately to the right and left at an acute angle. The insect producing these was probably a mole-cricket, *Gryllotalpa vulgaris;* the resemblance is remarkably close to the undoubted impressions of conifers belonging to the genus *Brachyphyllum.*

β. Myriopoda.

Anatomy of Sphærotherium.‡ — Mr. G. C. Bourne describes several points in the anatomy of this Diplopod, which have been overlooked by previous writers. The genus differs from *Glomeris* in the position of the antennæ in a deep fossa. Corresponding to each of the twenty-one pairs of legs, is a pair of "tracheal plates" placed between the attachments of the appendages. The first three pairs belong to as many segments, while of the remainder, like the legs, two pairs belong to each segment; there is also a nerve-ganglion to each

* Comptes Rendus, cii. (1886) pp. 220–2.

† Bull. Soc. Geol. France, xii. (1884) pp. 676–80 (1 pl.). See Bull. Soc. Bot. France, xxxii. (1885) p. 173.

‡ Journ. Linn. Soc. Lond., xix. (1885) pp. 161–72 (3 pls.).

segment. In the male there are three extra pairs of appendages, copulatory in function; two pairs of these bear stridulating organs, which have not been previously noticed in this genus; besides the chitinous ridges on these appendages, there are similar ridges on the inner surface of the large terminal tergite.

The tracheal system differs from that of most other Diplopods in having very well developed branching tracheæ. Each tracheal plate carries a stigma, which opens into a "tracheal sac"; from this sac two main tracheal trunks pass out, each of which breaks up into a number of smaller branches. The author considers the tracheal sacs homologous with those of *Peripatus*, from which form these branching tracheæ are derived. The antennary sense-organs are conspicuous. An error is pointed out in the description of their histology by Bütschli, who mistook certain cells, in the connective tissue surrounding the nerve-bundles, for ganglion-cells. An auditory organ is presupposed by the existence of a stridulating organ; the cavity opening to the exterior by a small pore below the eye, is regarded as such an organ; it is lined by a sensory epithelium, supplied by nerve-fibres from the cerebral ganglion.

Anatomy of Myriopoda.*—Mr. T. D. Gibson-Carmichael, after referring to Plateau's paper on the digestive tract of the Chilopoda,† describes that of *Lithobius*, and compares it with that of *Geophilus longicornis* and *Himantarium Gabrielis*. He finds pure uric acid in the two Malpighian tubercles of the first form, but could find no saliva in the so-called "salivary glands."

γ. Prototracheata.

Fertilized Ovum of and Formation of Layers in Peripatus.‡—Mr. A. Sedgwick finds that the fertilized ovum of *Peripatus capensis* has a large nucleus, of which three different stages are described; in the first it is a spherical structure (diameter 0·04 mm.) made up of a fine spongework of very pale fibrils which are continuous with the nuclear membrane, and the septum formed by it; the membrane and septum appear to be precisely similar in structure with the strands of the external protoplasmic reticulum, and the latter are continued directly into the former; in the second form the chromatin of the nucleus instead of being, as in the first, aggregated into a number of small masses, is diffused through the nuclear reticulum; in the third the nucleus is divided into chambers by a number of septa, which are continuous externally with the extra-nuclear protoplasmic reticulum. In the spindle form of the nucleus, the spindle was of enormous size and appeared to be composed of the ordinary reticulum. Mr. Sedgwick thinks that these observations confirm Dr. Klein's view of the continuity between the reticulum of the nucleus and that of the extra-nuclear protoplasm.

The fully segmented ovum is found to be a syncytium in which there are not, and have not been at any stage cell-limits. The at first

* Proc. R. Phys. Soc. Edinburgh, 1885, pp. 377–81.
† Mem. Acad. R. Sci. Belge, xlii. (1878) 94 pp. (3 pls.).
‡ Proc. Roy. Soc., xxxix. (1885) pp. 239–44.

solid gastrula is also a syncytium, and the blastopore, until quite late in development, is traversed by protoplasmic strands, which anastomose with similar strands projecting from the protoplasm lining the large central vacuole or gut; the gut arises as a vacuole in a multinucleated mass of protoplasm. In describing the origin of the mesoderm, the author states that at the commencement of the formation of the somites the ovum is still a syncytium.

Mr. Sedgwick points out that these facts explain, morphologically, the connection between the nerve and muscles and sensory epithelial cells, for the primitive continuity has never been broken; there is no essential difference between ducts with perforated cells and ducts with so-called cellular walls.

"If the protoplasm of the body is really a syncytium, and the ovum until maturity in the ovary a part of that syncytium, the separation of the generative products does not differ essentially from the internal germination of a protozoon, and the inheritance by the offspring of peculiarities first appearing in the parent, though not explained, is rendered less mysterious, for the protoplasm of the whole body being continuous, changes in the molecular constitution of any part of it would naturally be expected to spread, in time, through the whole mass."

"Shortly, these facts, if generally applicable, reduce the adult body to a syncytium—to a multinucleated vacuolated protoplasmic mass, and embryonic development to a multiplication of nuclei and a specialization of tracts in this mass."

δ. Arachnida.

Heart in Gamasidæ.*—Prof. C. Claus describes the heart of the Acaridæ for the first time. It is best seen in the transparent larva of *Gamasus fucorum*. It is placed in the posterior region of the body, and consists of a single chamber with a slit-like valvate aperture on each side; anteriorly it gives off an aorta. It is thus similar to the heart of *Daphnia*, and is probably degraded from a multilocular heart, such as is found in the other Arachnoidea, just as that of *Daphnia* is degraded amongst the Entomostraca. He considers *Limulus* and its Palæozoic allies to be more nearly related to the Arachnida than to the Crustacea, and points out that the aerial respiration of the former is not such a stumbling-block as some authors consider it, since different forms may have taken to aerial respiration in different ways.

Both the Crustacea and the Xiphosura, with the Gigantostraca, have arisen from an ancestral Protostraca: amongst the Crustacea the Nauplius-form and the doubled antennæ persist, whilst in the second group the anterior pair of antennæ has disappeared, and other changes have taken place. The third group of the Arthropoda Prof. Claus regards as having arisen from some form like *Peripatus*. The characters of the three sections—Sect. I. Crustacea; Sect. II. Arachnida and Gigantostraca; Sect. III. *Peripatus*, Hexapoda and Myriapoda—are given.

* Anzeig. K. Akad. Wiss. Wien, 1885, pp. 250–3. Cf. Ann. and Mag. Nat. Hist., xvii. (1885) pp. 168–70.

Mexican Species of Argas.*—M. P. Mégnin gives an account of three Mexican species of this spider: *Argas turicata*, *A. talaje*, *A. megnini*; the first of these does not limit its attacks to pigs, but affects also the human subject, where it is found in the auditory meatus, and sometimes produces severe illness. *A. talaje* is likewise very irritating, and both species seem to have a secretion analogous to that of the *Tarantula*. *A. megnini* appears to be a far less troublesome parasite.

ϵ. Crustacea.

Blood of Crustacea.†—Dr. W. D. Halliburton's observations on the blood of Crustacea have been made on the more common decapods; it was obtained by making cuts in the soft ventral integuments or in the claw; from a large lobster nearly half a pint can ordinarily be obtained. It is at first nearly colourless, or of a reddish colour, and is milky from the presence of numerous amœboid corpuscles; but this soon disappears owing to the almost instantaneous occurrence of coagulation. After a few minutes' contact with the oxygen of the air it gets an indigo-blue tinge, due to the oxygenation of a proteid body which is dissolved in the plasma, and has been called hæmocyanin by Frédéricq. The specific gravity varies between 1025 and 1030, and the reaction is always faintly alkaline. The author describes in detail the phenomena of spontaneous coagulation, and finds that it is in nearly all respects similar to that of vertebrate blood.

The proteids of the blood-plasma are the already mentioned hæmocyanin, and fibrinogen; the serum contains only the former, which resembles serum globulin in certain points, but differs from it in containing copper, in coagulating at 68° C. or seven degrees lower; it is more difficult of precipitation from its solutions by saturation with salts, and it is completely precipitated and coagulated by strong acetic acid.

Crustaceous fibrinogen resembles generally that of vertebrates, but differs by coagulating at 65° C. or 9° higher, and in not being precipitated by sodium chloride completely, unless the solution be saturated with that salt.

The colouring matters of the blood are the blue hæmocyanin, and a red tetronerythrin; the former is the oxygen carrier. Though the author thinks that the latter pigment may have respiratory functions, he does not base this view on the arguments advanced by Merejkowski.

Dealing with the comparative aspects of crustacean blood, Dr. Halliburton reminds us that in some there is hæmoglobin, and that hæmocyanin is found in Cephalopods, Gastropods, and Arachnids. In an appendix he gives a useful list of the animals in which these two colouring matters, chlorocruorin, hæmerythrin, chlorophyll, and tetronerythrin have been found.

* Journ. Anat. et Physiol. (Robin), xxi. (1885) pp. 460–75 (2 pls.).

† Journ. of Physiol., vi. (1885) pp. 300–35 (1 pl.).

Moulting of the Lobster.*—Dr. A. S. Packard has made some observations on the mode of moulting of the lobster.

According to the lobster fishermen, the creature moults but once a year. Shortly before the moult the parts between the segments are much swollen, and have a livid colour. Meanwhile the inner side of the flattened basal joints (three to five) of the large claws become soft, the lime on the crust partly disappearing, leaving an irregular oval solid portion; in this way the contents of the large hand or claw can be drawn through the basal portion of the limb. The first step in the ecdysis is the splitting or partial separation of the two halves of the carapace; it may entirely separate posteriorly, or the two halves remain together, and the animal withdraws its body out of the sutures between the thorax and first abdominal segment. The integument of the legs is moulted last, and when, owing to rough handling, the process is delayed, the extremities of the legs slough off. The entire integument, with all the appendages of the head, thorax, and the abdomen, are moulted as a whole, but the abdominal legs are moulted before the thoracic ones. Dr. Packard found all the parts of the crust connected, and floating in the "lobster car," even including the lining of the proventricle or stomach, and the apodemes of the head and thorax. After the moult the soft and flabby lobster lies nearly motionless, occasionally, if disturbed, giving a flap with its "tail." It remains inactive for nearly or quite a week, until the new crust becomes hard. He is convinced that the deformities in the big claws as well as other parts, occur at the time of moulting, as after disturbing the symmetry of the claws in a specimen, the deformity persisted.

Cyrtophium calamicola.†—Mr. G. M. Giles gives a description of the structure and habits of *Cyrtophium calamicola*, a new tubicolous amphipod found about the Palmyra shoal and mouth of the Dhamra river on the Orissa coast. The tube is considerably longer than the animal, is of a deep golden brown colour, banded with zones of dark and lighter tint; it consists of coarse, and apparently structureless, fibres, beneath which there is a transparent layer. This latter consists of a layer of hexagonal thick-walled cells, with an outer layer of long quadrilateral cells; and the whole structure leaves no doubt as to its vegetable nature; it is apparently part of a grass or reed. Inside and out the tube is covered by a hardened secretion, and in some cases the vegetable portion is altogether wanting. The dactylopodite of the second gnathopod is adapted for cutting purposes, and would serve to trim the grass or sever the thread of secretion; the author has been unable to satisfy himself as to the position of the secreting gland, but there are glands both in the propodites of the gnathopods and at the bases of the thoracic limbs; that on the second gnathopod is probably the seat of the membrane-forming secretion.

Terrestrial Isopods.‡—Mr. G. Budde-Lund has written a monograph of the terrestrial Isopoda which he divides into four families—

* Amer. Natural., xx. (1886) p. 173.

† Journ. Asiatic Soc. Bengal, liv. (1885) pp. 54–9 (1 pl.).

‡ 'Crustacea Isopoda Terrestria per familias et genera et species descripta,' 8vo, Havniæ, 1885, 319 pp.

Onisci, Ligiæ, Tylides, and Syspastidæ. In the first there are fourteen genera, three of which (*Eubelum*, *Cylloma*, and *Scleropactes*) are new; in the second, four are described, and the remaining two contain each a genus. The total number of species described is 404 or 410, of which 312 or 316 are good species, and 92 or 94 are unknown to the author or are reported species.

Gammarus pulex var. subterraneus.*—Dr. R. Schneider gives an account of the subterranean variety of *Gammarus pulex* which is found at Clausthal. The first point of interest is its pale colour, pigment being so completely absent from its body that it is milk-white and transparent; even the fat-cells, which are intensely red or orange-yellow in the ordinary *G. pulex*, are quite white. In the second place the eye is not normally developed, but is in the first stage of reduction; the crystalline cones show signs of degeneration, and the whole eye exhibits that "megalophthalmy" or proportionately greater size which is so often the first indications of loss. The pigment has also begun to be reduced, and is of a dirty black, instead of a brownish colour. The anterior pair of antennæ exhibit elongation, owing to the increase in the number of the joints.

There is, as compared with the ordinary forms, a considerable increase in the amount of calcareous deposits; and there is always a considerable amount of iron-oxide in the contents of the intestine, whence the iron makes its way to various parts of the body.

Anatomy of Chloremians.†—Some points in the anatomy of *Siphonostoma diphochætos* are described by M. E. Jourdain.

There are two varieties of peculiar papillæ in the network of the mucous tube, attached to the body by long peduncles. One variety consists of a mass of glandular cells. The second kind are fusiform, accompany the setæ, and consist of ciliated cells; there are tactile organs. He considers as a vascular organ the "problematic organ" of Horst.‡ This consists of a peculiar dorsal cæcum of the alimentary tract, the glandular lining of which is continued into it, whilst its walls are transformed into a great blood sinus; its rhythmical contractions suggested to him its circulatory functions.

Nervous System of Peltogaster.§—M. Y. Delage describes the central nervous organ of *Peltogaster* as consisting, like that of *Sacculina*, of a single ganglion; it is placed within the mesentery which connects the cloaca with the pedicle, and almost between the two cement-glands; it is only separated from the exterior by half the thickness of the mantle. It is elongated in form, and about 1/10 mm. in size; it is really simple, that is, does not consist of two fused halves; it contains small fusiform peripheral and large multipolar central cells; it gives off a number of very fine nerves, the distribution of some of which is described.

Peltogaster may be regarded as being derived from *Sacculina*, and

* SB. Akad. Wiss. Berlin, 1885, pp. 1087–1104 (1 pl.).
† Comptes Rendus, cii. (1886) pp. 270–2.
‡ See this Journal, v. (1885) p. 457.
§ Comptes Rendus, c. (1885) pp. 1010–2.

in the changes which various parts have undergone, the nervous system has not remained fixed; it has followed the cloaca and mesentery, and particularly the cement-glands; in such a position also we must look for the nervous system of other Centrogonida, until and unless we find a type in which the cement-glands have become widely separated from the mesentery and the cloaca; in such a case it will be interesting to discover what the nervous system has done.

Vermes.

Dorsal Pores of Terricolous Oligochæta.*—Herr H. Ude investigated the pores and the histology of the dermo-muscular tube of earthworms by the method of sections; the worms were killed in dilute (1/2 per cent.) chromic acid, and hardened for eight to ten hours, washed in water, and placed in 70 per cent. alcohol; Hamann's neutral acetic acid carmine was used as a colouring agent. This method destroys the longitudinal muscles, the relations of which must be studied by killing in boiling water, hardening in a mixture of one part concentrated picro-sulphuric acid and three parts distilled water, then extended on a cork for eight hours. Grenacher's borax-carmine may be used as the staining agent. If the animals are to be preserved in absolute alcohol, they must be stupefied by chloroform vapour.

The diameter of the pores varies from 1/100 to 1/106 of the circumference of the body in the six species examined; the pore appears to increase with the growth of the body; as a rule, to which *Allolobophora mucosa* is an exception, the pores disappear in the clitellar segments, when the clitellum becomes developed. The muscular fibres of the circular layer form a special complex around the pores, and appear to have the function of closing them; the longitudinal muscles, on the other hand, seem to have a duty in relation to opening the pores. The author gives a detailed account of the histology of the dermo-muscular tube, and enters into a close comparison of his results with those of other observers.

Notwithstanding the abortive results of his predecessors, the author thinks he is able to show that the dorsal pores have a definite arrangement; the first pore may, when a number of species are compared, be found to be pushed back gradually from the fourth to the thirteenth intersegmental groove; and the species may be arranged in groups in which the first pore has a constant position, and this may be regarded as an indication of affinity. The existence of a peritoneal cœlom is necessary for the presence of dorsal pores, but, on the other hand, there are tracts of the body which possess this cœlom but no pores; there does not seem to be any relation between the pores and the nephridia. It is doubtful whether the pores are really absent from such terricolous Oligochætes as have been said to be without them; but they seem to be always wanting in the Limicolæ.

At certain times, and under certain conditions, the perivisceral fluid and its elements may be passed out by the pores, which, there-

* Zeitschr. f. Wiss. Zool., xliii. (1885) pp. 87–143 (1 pl.).

fore, may be regarded as the orifices of the peritoneal cœlom, which itself is perhaps excretory in nature.

The essay concludes with a classification of earthworms, in which the new species *Allolobophora longa* and *hispanica* are described.

Hyodrilus coccineus.*—Herr A. Stolc has a preliminary report on this annelid, which is to be regarded as a contribution to the anatomy of the Tubificidæ. There are two kinds of dorsal setæ, hair-like or forked, and of the latter there are again two forms, some being slightly and others strongly curved; the ventral setæ are generally of the last-mentioned form. The cerebral ganglion has a very characteristic form; it is slightly rounded off anteriorly and has a small process in its middle; posteriorly there are two external and two internal lobes; the inner are conical, and are attached to the body-wall by cerebroparietal muscles; the outer are larger, and give off inferiorly the œsophageal commissures; there are a large number of peripheral nerves. The anterior brain-process gives off a few nerve-branches which break up on their peripheral course; the ventral cord forms a ganglion in each segment, and this is ordinarily marked by three constrictions; the peripheral nerves are given off regularly from each ganglion, and there are three pairs in each segment, and a fourth which is sent to the dissepiment of the neighbouring segment.

The vascular system is complicated, and is especially remarkable for the well-developed system of tegumentary vessels; the lateral loops connecting the dorsal and ventral vessels are not as enlarged as in *Tubifex* or *Psammoryctes;* they give off fine branches which traverse the integument in all directions, so as to form a delicate plexus, which is connected by anastomoses with the tegumentary plexuses. Just in front of the hinder dissepiment of every segment a pair of vessels is given off from the dorsal trunk; these too make their way into the integument and give off capillaries.

The ciliated infundibulum of the nephridium is considerably thickened, and produced into a lobe which is thickly covered by cilia; the duct of the glandular portion is not simple, but broken up into a special plexus of canaliculi. The male organs have no penis, cement-gland, or spermatophores, but genital setæ are present; the ovaries are of the type of the Naidomorpha. On these grounds the author proposes to form for *Ilyodrilus* a subfamily of Tubificidæ—Ilyodrilini; the second subfamily Tubificini may be characterized by the absence of genital setæ, as well as of the other just-mentioned male organs, while the female apparatus is on the type of that of the higher Oligochæta; of the third subfamily—Telmatodrilini—we can only as yet say, with Eisen, that there are a large number of cement-glands.

Golfingia macintoshii.†—Prof. E. Ray Lankester describes a new genus of Sipunculids from the coasts of Scotland; one specimen alone was found; this was five inches long, and cylindrical in form; at either end of the cylinder a hard dark brown spout is found; these

* Zool. Anzeig., viii. (1885) pp. 638–43, 656–62.

† Trans. Linn. Soc. Lond., ii. (1885) pp. 469–74 (2 pls.).

may be called the scleropyge and the sclerorhynchus; they are modifications of peculiar structures found in *Aspidosiphon;* the scleropyge is probably used in burrowing in sand, and has the body-cavity continued into it, but is imperforate; the stout sclerorhynchus is open anteriorly to serve as the orifice of invagination of the proboscis. After some notes on the internal organs, in which the continuous nature of the long muscles of the body, the presence of four retractor muscles to the introvert (proboscis), and the absence of bush-like organs on the rectum are reported, the author gives a definition of the Sipunculoidea, slightly altered from E. Selenka, and concludes with a key to the genera of the group. *Golfingia* is not far removed from *Aspidosiphon*, but differs in the form of its sclerites, in the disposition of the retractor muscle, and in the character of the oral tentacles.

Polychæta of Dinard.*—M. de Saint Joseph endeavoured, while at Dinard, to fix the local fauna, and to describe new or imperfectly known species. He has found 186 species of Polychæta, 44 of which are as yet known only from that locality, 87 are found in the Mediterranean, and 42 in the northern waters. A number, especially of the larger forms, were found to be stationary. Among the new species found, but here only very briefly indicated, are *Paractius mutabilis*, which preserves the larval form when adult, and though only 3·80 mm. long has about 800 denticles on its jaw; *Labrorostratus parasiticus* g. et sp. n. is a small Lumbrinereid which lives parasitically in the body of several Syllideæ; *Leptonereis vaillanti; Sclerocheilus cæcus.* The author has been able to prove that *Eurysyllis* reproduces by a single stolon, and that *Myrianida maculata* may have fifteen male stolons; the so-called T-shaped glands of Syllideæ appear to be not glands, but water reservoirs. *Autolytus* was found to reproduce thus: there is first a single male or female stolon formed by fission, which has three regions; there then appears a second and perhaps other similar stolons, and then others, which are shorter, and divisible into two regions, and finally, a chain of several stolons, placed end to end.

Worms in Ice.†—Prof. J. Leidy describes some worms found in ice which was full of bubbles of air and water. He considers that the worms remain in a torpid condition in the water-drops. When the ice was melted, the worms soon died. He gives the name *Lumbricus glacialis* to the worm (though the description indicates some other genus, if not a limicolous form). Length 4 to 6 lines. Genital organs between the segments four and seven; setæ in four bundles of three each, in every segment after the first.

New Mode of Development in Nematodes.‡—Dr. O. v. Linstow fully describes a new Nematoid which is found in the intestine of *Triton alpestris*, and more rarely *T. cristatus;* its life-history may be divided into seven stages—the embryonic form, the water-larva, the

* Comptes Rendus, ci. (1885) pp. 1509–12.
† Proc. Acad. Nat. Sci. Philad., 1885, p. 408.
‡ Zeitschr. f. Wiss. Zool., xlii. (1885) pp. 708–17 (1 pl.).

young lung larva, the half grown lung larva, the fully grown lung larva with boring teeth, the same with three lips, and the sexual form.

The Nematohelminths exhibit no less than fourteen different modifications of developmental history:—

1. The embryos develope, without any larval stage, in one medium; they may live in fresh, salt, or brackish water, in plants, on the earth, or in decaying substances (*Dorylamius*, *Enoplus*, *Plectus*, *Rhabditis*, &c.).

2. The larva lives in earth, the sexual form in plants (*Tylenchus tritici*, &c.).

3. The larva lives in animals (worms) after the death and decay of which they become free and in earth develope into sexual forms (*Rhabditis pellio*).

4. The worm lives bisexually in earth, the fertilized female passes into animals (bees) and there produces descendants (*Sphærularia bombi*).

5. The larvæ live in earth, the sexual forms are developed in a vertebrate (*Dochmius*, *Strongylus*).

6. The worm lives as a hermophrodite in an animal, while the progeny are developed by alternation of generation sexually in earth (*Rhabdonema*, *Angiostomum*).

7. A sexually differentiated fertilizing form developes by alternation of generation another bisexual form which lives parasitically in a snail (*Leptodera appendiculata*).

8. The egg developes in earth into the embryo, and this passes into an animal where it becomes sexually differentiated (*Trichocephalus*, *Oxyuris*).

9. The larva lives in insects, the adult in earth or water (*Mermis*).

10. The larva is encapsuled in an animal and passes passively into another species where it becomes matured (*Ascaris*, *Filaria*, *Cucullanus*).

11. One form lives for a short time bisexually in the intestine, whence it produces larvæ which bore through the enteric wall, and become encapsuled in the muscles (*Trichina spiralis*).

12. The sexually mature form lives in the trachea of birds, the females produce eggs, which contain the developed embryo; these are ejected by the host in coughing; in the earth the embryo becomes mobile, and is now taken up by the bird with food; in the stomach and œsophagus the embryo loses its investing membrane, to wander into the air-sacs and bronchi, whence the grown larva passes into the trachea (*Syngamus trachealis*).

13. There are two larval forms, the first of which is found in mollusca, the second in aquatic beetles and Orthoptera, while the sexual form is found in water (*Gordius aquaticus*).

14. There are two larval forms, one of which lives in water, and the other in the lung of an Amphibian, whence it wanders into the intestine to differentiate and develope its sexual organs (*Nematoxys longicauda*). This last, which is new to science, corresponds to the mode of development of *Polystomum integerrimum* among Trematodes. The only rule which we can deduce is that Nematoids found in living

animals never go through all the phases of their development in one and the same organ.

Notes on Nematoids.*—Dr. J. G. De Man divides his paper under three heads. First, the Netherlands, whence he describes a new species *Monohystera dintheriana*, which is interesting on account of its having quite bilaterally symmetrical female organs, an arrangement not known in any other terrestrial and in only one marine of the many species of this genus; there are notes on other forms. The second deals with Mid-Germany (the neighbourhood of Weimar), where thirty-eight species were found; of these *Dorylaimus ettersbergensis* and *oxycephalus* are new. The third heading is Russia, whence Moscow sends thirty-three species; of these *Dorylaimus zograffi* is new; it is most like *D. bastiani*.

Sphærularia Bombi.†—Prof. A. Schneider continues his investigation of this singular parasite. Contrary to his former opinion that the *Sphærularia* embryos were liberated on the death of their humble-bee host, he now maintains that they find their way into the intestine and are expelled along with the fæces. They were observed abundantly not only within the intestine, but in process of passing through the wall. The great mortality among the embryos which he tried to rear is therefore probably to a large extent due to the fact that only those which spontaneously find their way out are able to develope, or to resist the attacks of fungi.

Prof. A. Schneider has at length been able to bring about artificially the immigration of female *Sphæruliæ* into the bumble-bees. Young sexually mature *Sphæruliæ* which had been reared were deposited in damp flower-pots, on which under cover ten queen *Bombi* were imprisoned. The young Nematodes continued healthy, keeping on the surface of the earth or sand; in a short time most of them had cast their skins, after which they exhibited a longer and stronger prickle. Most of the queen-bees died from Schizomycetes; in the sixth four very young *Sphæruliæ* were found, all with evaginated uterus, which had in one case about the thickness of the ripe Nematode just before the evagination, and in another one-fourth of the thickness of a *Sphærularia*-sheath in spring. In one of the remaining humble-bees two parasites were again discovered.

The life-history, according to Schneider, may be thus summarized. The *Sphærularia* lays eggs in spring, which develope in the body-cavity of the humble-bee. The ripe embryos wander into the intestine and thence out. They live for five months a free life in the ground, without food and without visible change; in the middle of September they cast their skins twice, and become differentiated into males and females. They remain a while within the sloughs, but finally freeing themselves, find their way in the middle of October into the queen humble-bees. Immediately after the immigration the uterus is protruded, incorporating the ovary and a coil of the alimentary canal.

* Tijdschr. Nederl. Dierk. Vereen., i. (1885) pp. 1–26 (3 pls.).
† Zool. Beitr. (Schneider), i. (1885) pp. 247–51.

Schneider compares this *Sphærularia*, which he proposes to rename *cunctatrix*, with the *Simondsia paradoxa* described by Cobbold, in which a similar protrusion of the uterus occurs. He corrects a former description of the tail of the male form, and adds a note in reference to a recent communication by Leuckart.*

New Nematodes and Trematodes.†—Dr. O. v. Linstow communicates a series of notes, chiefly of systematic importance, on various Nematodes and Trematodes. He defines the following new species:—(*a*) *Ankylostomum perniciosum* from the tiger, *Ascaris Thymalli*, *A. Lotæ*, *Filaria conoura* in *Anguilla*, *F. Glomeridis*, *F. Vesperuginis*, *Agamonematodum Bombinatoris*, *Oxyuris Glomeridis*, *Trichosoma filiforme* in *Triton*, *Distomum Anguis*, and *D. Limnææ ovatæ*. Most of the specific names indicate, as usual, the habitat. Descriptions of the specific characteristics of more than a dozen previously observed forms are given. The skin-casting of the larval *Dorylaimus stagnalis* is briefly noted, and it is, from analogy, maintained that Perroncito's description of a larval encapsuling, and not skin-casting, in *Anguillula stercoralis* and *Ankylostomum duodenale* is a misinterpretation.

Von Linstow outlines the embryology of *Holostomum cornucopiæ*. (*a*) The germinal cell or true ovum is inclosed in a yolk-mass, which is either merely granular or composed of small nucleated or non-nucleated cellular elements. (*b*) A morula-mass of a few nucleated cells is soon formed, inclosed by the now wholly cellular yolk. (*c*) The next stage is that of the blastula-formation, the cells of which exhibit a peculiar very lively molecular movement of the granules. (*d*) An epiblast and hypoblast appear, the latter surrounded by the yolk-cells. (*e*) The germinal layers increase at the expense of the yolk-cells. Within the granular cells of the yolk-mass granular nuclei are formed, which become free, acquire almost the dimensions of a cell, form a central nucleus and nucleolus, which eventually take up an excentric position, and so result in bodies not unlike the sperm-cells of many Nematodes. The boundary between the epiblast and the unused yolk remainder becomes indistinct. (*f*) From the epiblast granular ciliated cells are formed; the cells of the embryo and the two dark eye-spots can be seen within. (*g*) About a month after the first observation the embryo is seen moving, lying somewhat bent within the egg; the crescentic eye-spots, the four movable ciliated tufts, and the motion of the cuticular cilia are soon recognizable. The yolk remnant is reduced by the motion of the embryo to a granular mass, and the Tetracotyle-like organism is soon liberated. Its further history was described in a previous research.

Post-embryonal Development of Trematoda.‡—Herr W. Schwarze first deals with *Cercaria armata* from *Lymnæus stagnalis*; he has been able to detect the ending of the finest vessels in ciliated infundibula;

* See this Journal, v. (1885) p. 810.
† Arch. f. Naturgesch., li. (1885) pp. 235–55 (3 pls.).
‡ Zeitschr. f. Wiss. Zool., xliii. (1885) pp. 41–86 (1 pl.).

he carefully describes the very peculiar mode of connection of the tail with the body; the tail is inserted into a deep pit which is placed at the hinder pole of the trunk, but this tail is not attached by the whole of its anterior surface, but only by two lateral thin fibrous cords; there is a space between the hinder wall of the pit and the anterior part of the tail. The sporocysts have a cuticular dermal layer, which is, however, really cellular and not cuticular in structure; the fine diagonal muscular bands, which are very regularly arranged in young, are completely obliterated in older sporocysts. In describing the histological development of the *Cercariæ* the author applies the term of primitive parenchymatous or meristem-cells to those which first appear on the cleavage of the germinal cells. The origin of the muscles from the dermal layer is spoken to by the fact that the early formed rhombic scales have a tendency to form local, regular protoplasmic thickenings. After describing in detail the development of the various organs of the *Cercaria*, the author sums up the first stages in histological differentiation thus; the germ-cell by irregular cleavage gives rise to a number of meristem-cells, whence all further differentiations arise; the peripheral cells by gradual metamorphosis and fusion become the cuticle-like dermal layer. In the centre a solid mass of genital cells is formed, from which the ovary, testis, and efferent ducts are later developed. At the anterior pole of the body the meristem-cells are regularly grouped to form the primitively solid rudiment of the fore-gut, the lumen of which arises by the absorption of the axial cells. The enteric limbs arise secondarily from the fore-gut. The space between the integument and the genital mass is filled by meristem-cells, from which the excretory organs, nervous system, &c., arise. A comparison of the first phenomena in the development of the *Cercaria* with those of the embryo leaves no doubt of their homology. From this it is clear that we must not, with v. Siebold, regard the embryo as an ovarian investment capable of becoming an animal, but as a *Distomum* which has remained at an early stage of development; the "germ-cells" of the embryo are the "genital cells" of *Cercariæ;* and the mode of development is not strict asexual reproduction, but true parthenogenesis. The whole cycle of development in the Trematoda has an interesting analogy in *Cecidomyia* among insects.

The history of *Cercaria ornata*, which is found in *Planorbis corneus*, is next considered; it is very near to *C. armata*, differing chiefly in the size of the suckers, which instead of being subequal are in the proportion of five (oral) to three (ventral); the cyst-glands are more sharply defined, the muscular limbs of the central vascular system are nearer in size to the true unpaired vesicle, and the parenchymatous elements are more delicate in structure.

Cercaria echinata is found in *Lymnæus stagnalis*, and differs from most in that the young are found in May and June, instead of in the winter months; by a little pressure on the living animal the nervous system, testes, and ciliated infundibula can be detected; the dermal layer and subjacent muscle are only feebly developed, as is also the pharynx; the gut has no lumen; the cell-layer around the nervous

mass has more distinctly the character of a nerve-sheath than in the other forms described. The body parenchyma is largely represented by a special tissue, which forms a very strong layer extending from the pharynx along the whole dorsal surface; the constituent cells are greatly elongated in a vertical direction, and their ground-substance contains a number of refractive yellowish granules.

Cercaria spinifera, from *Planorbis corneus*, stands very close to *C. echinata*.

Entozoa of Sharks and Rays of the Bay of Naples.* — Dr. L. Orley reports that the Selachians are generally poor in entozoa, that they are ordinarily found only in the intestine, that Cestodes are more common than Nematodes, and these than Trematodes. Seven round-worms are mentioned, of which *Ascaris affinis* (from *Mustelus lævis*) and *Spiropterina elegans* (from the rare *Hexanchus griseus*) are new. *Distomum megastomum* is the only Trematode mentioned. The Cestodes are remarkable for their small size, never being more than 10 cm. in the largest shark. *Orygmabothrium dohrni* (from *Heptanchus cinereus*) is new; the commonest species is *Acanthobothrium coronatum*.

Pelagic Animals from Fresh-water Pools in Alsace and Lorraine.†—Dr. O. E. Imhof gives a list of the pelagic animals which he has found in various fresh-water pools in Alsace and Lorraine. In addition to seven species of rotifers which are already known he has found two which appear to be new; these are a species of *Brachionus* which is intermediate between *B. bakeri* and *B. polyacanthus;* he proposes to call it *B. lotharingius;* the generic position of the other remains at present undecided, but it approaches *Triarthra* and *Polyarthra*.

Tube of Melicerta.‡—Mr. T. S. Smithson describes an unusual form of tube made, in two cases which he observed, by *Melicerta ringens*.

The young *Melicerta* began by building half a course in the usual way with apparently solid pellets, but instead of continuing to do so, it suddenly commenced to heap up, in a most erratic manner, pellets of the ordinary shape, but composed of transparent gelatinous matter with a few particles of carmine imbedded in it, giving the tube a somewhat mottled appearance. The walls of the tube, owing to the loose way in which they were made, were about double the thickness of those constructed in the usual manner.

The author suggested that want of material is the primary cause of this mode of building, while Mr. A. D. Michael thought there was some uncertainty as to whether the variation resulted from the fact that the trough did not contain suitable matter for building, but only some kind of flocculent matter likely to swell, or whether it was a variety as to the building of the tube. It is a matter of frequent observation that, in spite of the extreme regularity of the tube under

* Temn. Füzetek, ix. (1885) pp. 97–126 (Hungarian), 216–220 (German) (1 pl.).

† Zool. Anzeig., viii. (1885) pp. 720–3.

‡ Journ. Quekett Micr. Club, ii. (1886) pp. 221 and 244–5.

ordinary circumstances, it does vary considerably in confinement, because the creature is then obliged to use such material as it can get.

Balanoglossus.*—M. A. F. Marion has a preliminary notice of two new species of *Balanoglossus*, one from Yokohama, which he calls *B. hachsi*, and the other from near Marseilles—*B. talaboti*. The former has its trunk remarkably flattened, the cartilaginous skeleton of the branchial apparatus is simple, and the intestinal portion of the digestive tube has no hepatic projection. Horizontal sections of the dorsal groove show the presence of a trunk which corresponds to the dorsal nervous axis seen in the *Balanoglossi* of Naples. *B. talaboti* has the body almost regularly cylindrical, the proboscis is conical and short, the branchial skeleton simple, and there are hepatic dorsal prolongations; as in some other species, the mucus given off by the hypodermis has a penetrating odour. The cartilage of the axis of the proboscis is not homogeneous, but contains in its midst cellular fusiform bodies, which call to mind the true cartilages of the Chordata.

Balanoglossus sarniensis.—M. R. Kœhler discovered † this new species of *Balanoglossus* on the shore of Herm. Its length is about 35 cm.; it is yellow and orange anteriorly, green in the hepatic region, and colourless posteriorly. There is a deep median, dorsal groove behind the collar, which extends up to the hepatic region. This species secretes a quantity of mucus which has a strong odour of iodoform. His study of the proboscis confirms Bateson's descriptions. The proboscis-gland is described, and the author concludes that it has a very intimate relation to the circulatory system, analogous to that of the madreporic gland of Echinids. He was unable to find the central canal in the anterior part of the nervous system, such as Bateson has described; the nerve-cord, posteriorly, gradually approaches the epithelium of the dorsal surface of the body, and the canal, which is here present, opens to the surface. The nerve-fibres in the ventral part of the cord extend to the anus. He regards the pore as the remnant of the invagination by which the nerve-cord is formed. Anteriorly, at the junction of the collar with the proboscis, the nerve-cells gradually pass into the epidermis, and the fibres form a sub-epidermal layer upon the proboscis. The branchial apertures are the same as in *B. clavigera*.

This is no doubt the same species as that exhibited to the Zoological Society of London, on November 17th, by Prof. F. J. Bell.

M. G. Pouchet considers ‡ that the species of *Balanoglossus*, described by Kœhler as new, is probably the same as that studied by various previous observers. Amongst others, Quatrefages, Lacaze-Duthiers, and Bateson. He draws attention to the green phosphorescence of this species, which is caused by the slightest excitement.

* Comptes Rendus, ci. (1885) pp. 1289–91.
† Ibid., cii. (1886) pp. 224–7.
‡ Ibid., p. 272.

Echinodermata.

Echinoid covered with Compound Eyes.*—Drs. C. F. and P. B. Sarasin have found at Trincomalee an echinoid (probably *Diadema setosum*) covered with rows of blue spots; one of these when examined by the Microscope shows on the surface a mosaic of irregular hexahedra or (more rarely) pentahedra, which are so disposed as to call to mind the eye of an arthropod; each polyhedron corresponds to a pyramid of very highly refractive substance, the blunt end of which is invested in pigment; the pyramid is about 1/8 mm. long, and at its base is 1/20 mm. broad; there may be one hundred or as many as one or two thousand pyramids in one spot. Over all of them the body-epithelium forms a thin ciliated layer, which may be regarded as the cornea; each pyramid consists of a number of vesicular cells with quite hyaline contents, and in many of them there is a distinct nucleus; this region may be regarded as that of the lens and crystalline body. The distal surface and the distal parts of the lateral surfaces of the pyramids are invested by a low epithelium, which may be regarded as the matrix of the vesicular cells; similar epithelial cells are to be found at the proximal end, but the latter are only found in the best developed eyes or those which lie nearest the apical pole. All the pyramids have their lower half covered by a layer of pigment, which is composed of pigmented connective-tissue-cells; the youngest eyes have, however, no pigment; they are all set on the nervous plexus of the skin, where there is a uni- or multilaminate ganglionic investment; the nervous band is broken through at various points.

It is clear that the authors have discovered an optic organ composed of a number of separate eyes, without indeed an optic nerve, but directly placed on a ganglionic plexus; many hundreds of these eyes are present. If a hand is directed towards a point where these eyes are developed the surrounding spines are seen to turn towards the spot; even if the creature is only able to perceive light and shade, it does it so well as to have a very considerable organ of defence in these eyes.

The authors have been able to detect flask-shaped gland-cells in the integument, and give a short account also of a system of vessels which they have been able to make out.

Wandering-cells of Echinoderms.†—Herr E. Metschnikoff, in the fifth of his studies on comparative embryology, deals with the wandering-cells of Echinids and Asterids; they appear to be cells which break off from the endoderm or the portion of the blastoderm which forms that layer, and to pass into the cleavage-cavity, where they fulfil various functions. This mode of development agrees with what is seen in adult sponges, and also with the mode of mesoderm-formation seen in Acalephæ and in *Rhopalonema;* it is a comparatively low process, which attains a higher grade in Ctenophora (see p. 256).

* Zool. Anzeig., viii. (1885) pp. 715–20.

† Zeitschr. f. Wiss. Zool., xlii. (1885) pp. 656–71 (1½ pl.).

If we review the facts known about the formation of the mesoderm in the lower Metazoa we see that the two-cell theory does not apply; for the higher Metazoa, where it does apply, we must suppose that the double-cell-rudiment is the expression of an early differentiation, but the mode of formation by the wandering of amœboid cells is rather a primitive character. This theory agrees with the part taken by these cells, which most constantly appear as phagocytes, or, in other words, retain the function which they have so prominently in the lowest Metazoa—the sponges.

Influence of Gravity on the Division of Cells.*—Prof. Hertwig has selected the ova of Echinoids for study, as they exhibit equal cleavage and consist almost exclusively of protoplasm; his experiments led him to conclude that gravity exerts no direct influence on the position of the plane of cleavage of animal ova, for in some that were in no way affected the first plane was vertical, in others horizontal, and in others again oblique. He objects to Pflüger's conclusions, inasmuch as in them and the reasoning therefrom the position of the fertilized nucleus was not taken into consideration. This depends on the external form of the egg-material, and on the way in which the formative and nutrient yolks are distributed in the cell. When the cell-substance is homogeneous the nucleus occupies a central position in the egg, but when one is richer in protoplasm and another in yolk the nucleus tends to pass into the former. The relation of the nucleus to the protoplasm is such that the former always tends to occupy the centre of the active sphere. This leads us to the law which governs the course of the first plane of cleavage; the direction of the plane is dependent on the position of the axis of the nucleus which sets up division. The position of this nuclear axis is, again, dependent on the form and differentiation of the protoplasm which surrounds the nucleus; in a sphere the axis tends to lie in the direction of any radius, but in an elliptical body in its longest diameter. When the protoplasmic disc is circular the axis of the nucleus lies parallel to the surface along any diameter.

Where the constituents of an ovum are of different specific gravities gravity will, of course, have an influence; but that which it has on the planes of cleavage is an indirect one.

Perignathic Girdle of Echinoidea.†—Prof. P. M. Duncan describes minutely the anatomical structures in the families *Cidaridæ, Temnopleuridæ, Echinidæ, Echinometridæ,* and *Diadematidæ,* and the suborder *Clypeastridæ,* to which the muscles, acting on the "jaws," are attached; these structures are termed by him "perignathic girdles." In two plates he gives numerous figures of the arrangements in various genera belonging to the above families.

Apical Area of some Cretaceous and Tertiary Echinids.‡—M. Munier-Chalmas has studied the arrangement of the aquiferous

* Jenaisch. Zeitschr. f. Naturwiss., xix., Suppl. (1885) pp. 70–2.
† Journ. Linn. Soc. Lond., xix. (1885) pp. 179–209 (2 pls.).
‡ Comptes Rendus, ci. (1885) pp. 1074–7.

pores on the surface of the genital and pseudocular plates. The rule that in secondary and living Echinids the water-pores are limited to a single plate (madreporite) has some remarkable exceptions; Cotteau has already described in *Micropedina cotteaui* the presence of three perforated genital plates; and, likewise, *Discoidea infera* has pores on all the five genitals. There is an analogous arrangement in *Echinococcus*, one, two, three, or four genital plates being perforated; in *Hemipneustes* the pores are small, and are found not only on two or four genital, but also on the three anterior ocular plates. The author concludes that when the pores are found on one plate only this is not because they are there concentrated, but because they have disappeared from the other plates.

The arrangement of the genital apertures is next discussed, and genera with only three (*Isaster*, *Pericosmus*, &c.) or two (*Ditremaster*) are cited; when one genital pore disappears it is the madreporite that is affected, and next that which is found opposite to it, or on the left side.

Deformities of Fossil Crinoids.*—Prof. L. von Graff gives an account of the various deformities produced in recent Crinoids by the presence of parasitic Myzostomida, and enumerates the instances of deformities in fossil forms which seem to indicate that they also suffered from these parasites. He concludes that the Myzostomida existed in the carboniferous period, and are, like their hosts, among the oldest of known animal organisms.

Revision of the Palæocrinoidea.†—In the third part of their revision Messrs. C. Wachsmuth and F. Springer discuss the classification and relations of the brachiate Crinoids, and conclude the generic distinctions. The authors find that the interradials are represented in all groups of the Palæocrinoids, were early developed in the larva, attained at once large proportions, and were later on either persistent or absorbed; they extend as far as, or even cover over the proximals, and they are more extravagantly (not in number but in size) developed in the earlier groups. The orals appear to be represented only by the central plate.

The authors discuss the differences between the Palæocrinoids and Neocrinoids, and while agreeing generally with Dr. P. H. Carpenter (whom they seem to have somewhat misunderstood), they think that too much stress has been laid upon the asymmetry of the calyx, and that not sufficient value has been attached to the presence of interradials in the former. They propose their own diagnoses of the two groups. They regard the Pelmatozoa as a class of the Echinodermata, of which the Anthodiata and the Crinoidea are the two subclasses, and these they, likewise, diagnose. The Palæocrinoidea are divided into the suborders Camerata, Articulata, and Inadunata.

* 'Palæontographica,' xxxi. pp. 185–91 (1 pl.).

† Proc. Acad. Nat. Sci. Philad., 1885, pp. 225–364 (6 pls.). See also Dr. P. H. Carpenter in Ann. and Mag. Nat. Hist., xvii. (1886) pp. 277–89.

Cœlenterata.

Sexual Organs of Hydra.*—According to Prof. Milnes Marshall *Hydra* is an extremely modified, and not a primitive form, of Hydrozoa. Referring to the various conditions under which the gonads occur in *Podocoryne*, *Eudendrium*, *Cordylophora*, &c., he gives his reasons for considering the "sporosac," "disguised medusa," and "attached medusa" as due to arrested developments, rather than as stages in the progressive developments of the free-swimming medusa. His reasons for considering *Hydra* a derived form are summarized by the author as follows:—1. *Hydra* is hermaphrodite, which is probably a secondary condition in all animals in which it occurs. 2. *Hydra* is a fresh-water form; these are usually derived from marine forms. 3. The ovary is exceptional in that only one ovum ripens, out of many primitive ova. 4. *Cordylophora*, the other fresh-water genus, is one in which a great deal of shifting of the ova from their original point of formation takes place. 5. The ovary in *Hydra* differs from that of ordinary Hydrozoa, in consisting only of ectoderm-cells.

Gastrula and Mesoderm of Ctenophores.†—The fourth portion of Herr E. Metschnikoff's essay on comparative embryology treats of some points in the development of the Ctenophora; he finds that the gastrula is the result of invagination which appears to be simultaneously embolic and epibolic. The blastopore in the latter is oral but here the growth of the ectoderm does not proceed from the animal pole, but from a circular rudiment, and we have in consequence in addition to the true blastopore, an upper pseudoblastopore; this sooner or later closes, and forms the base of the sensory organs.

The Ctenophora appear to be the only Cœlenterates that have a mesoderm which arises as a special germinal-layer-like rudiment in the course of embryonic development. In Acalephs and Polyps the formation of the mesoderm is postembryonic, and the layer does not arise as a whole. The author discusses these facts in comparison with the cœlom theory of the brothers Hertwig, and points out that, on their view, the mesoderm of the Ctenophora is not a mesenchym; taken in conjunction with what he has observed in *Nais*, and Ranvier's observation that, in mammals, during an inflammation of the diaphragm some of the peritoneal cells are capable of taking up foreign bodies, he doubts whether we can speak of "a complete difference between mesenchym and mesoderm."

Anatomy of the Madreporaria.‡—In his first contribution to this subject Mr. G. H. Fowler gives an account of *Flabellum patagonichum* and *Rhodopsammia parallela*; a pair of mesenteries being defined as two mesenteries whose longitudinal muscle-fibres are ranged on their adjacent faces, the new term of *entocœle* is applied to such part of the cœlenteron as lies between a pair of mesenteries, and the likewise new term of *exocœle* to those chambers of which one lies between

* Proc. Manchester Lit. and Phil. Soc., xxiv. (1885) pp. 32–6.
† Zeitschr. f. Wiss. Zool., xlii. (1885) pp. 648–56 (1½ pl.).
‡ Quart. Journ. Micr. Sci., xxv. (1885) pp. 557–97 (3 pls.).

every two pairs of mesenteries; the septa lying in these two classes of chambers are similarly called exosepta and entosepta.

Previous observers, the chief of whom are Lacaze-Duthiers, v. Koch, and Moseley, seem to have settled that: (i.) the adult madreporarian polyp is built distinctly on the Actinian type, save when as in *Caryophyllia* the external body-wall is absent and replaced physiologically by the imperforate theca; (ii.) the corallum is a product of the ectoderm and is deposited outside the embryo; (iii.) this ectoderm persists in the adult as the layer of calycoblasts to which the continual growth of the corallum is attributable; the skeleton is thus morphologically external to the polyp throughout life; (iv.) between this layer and the cavity of the cœlenteron, and clothing every part of the skeleton, is a layer of mesoderm and endoderm, forming the internal body-wall; (v.) septa, when present, always lie between a pair of mesenteries, and sometimes also in the spaces intermediate between pairs of mesenteries; (vi.) tentacles may be exocœlic as well as entocœlic, but exosepta may be present without corresponding tentacles.

Flabellum patagonichum has a solitary conical corallum; the anatomy is essentially that of the Actinian, except in the absence of an external body-wall; the tentacles are simple hollow evaginations of the entocœles, and are covered by small prominences, each of which is a battery of nematocysts. The acontia are ejected through definite openings, and these are therefore directly comparable to the cinclides of *Actinia*. The ova are developed on all three orders of mesenteries and appear to resemble those of *Actinia;* as testes were not seen, *Flabellum* may be supposed to be dicœcious. The ectoderm of the mouth-disc has distinctly the appearance of a secreting layer; in the stomodœum the ectodermal cells are not modified as in the siphonoglyphs of Alcyonarians. The cœlenteron is lined by endoderm of cubical or columnar cells; at the point where it passes into the mesenterial filament its characters change, and the histological appearance bears out the physiological doctrine that the filament secretes a proteolytic fluid.

Rhodopsammia parallela is next described; it presents very simple histological characters.

Porifera.

Observations on Fresh-water Sponges.* — Prof. F. Vejdovsky finds that *Spongilla sibirica*, lately described by Dr. Dybowski, is identical with *S. fragilis* of Leidy; the following differences are, however, to be noticed; the groups of gemmules are generally but not always arranged in fours; isolated gemmules, or groups of 2, 3, or 6 are found; the last large number seems to be very rare; the horny membrane is always visible, and not obscured as in *S. fragilis*. The author observes that the polar air-tube in *S. fragilis* plays an important part in the life of the gemmules, for it is in direct connection with the upper process of the gemmule, which is generally

* SB. K. Böhm. Gesell. Wiss. Prag, 1884 (1885) pp. 167–72 (1 pl.).

regarded as an orifice by means of which the young escape; Prof. Vejdovsky offers no opinion on this view, but he says that he thinks it more probable that the polar process is completely closed by the horny membrane; the air-tubes of dried gemmules of *S. fragilis* are filled with large air-vesicles, just as in *S. carteri*. The North American genus *Carterius* is very interesting in having a high hollow tube which is always directed upwards when the gemmule is thrown into water. In *S. fragilis* the air-tubes are proportionately larger than in any species known to the author and must contain a large quantity of air.

Sponges from South Australia.* — Mr. H. J. Carter continues his account of sponges from Port Phillip Heads, South Australia. An extended diagnosis is given of the Axinellida, and a new family Pseudoechinonemida is instituted. Among the Renieridæ we have the new group Phlœodictyonina; the excavating sponges form a new family Eccœlonida, and a rearrangement of the Holorhaphidota is tabulated.

A new group, Suberitina, is formed to contain the former groups Cavernosa, Compacta, Laxa, and Subcompacta. Other new groups are Polymastina, Trachyina, Chondropsina (provisionally), and Stellettinopsina.

Siliceous Sponge-spicules from the Chalk.†—Herr P. Počta has a second paper on isolated siliceous sponge-spicules from the chalk-formations of Bohemia. He discusses the modifications of four-rayed forms caused by the shortening of one or more of the rays; where one is shortened we have, of course, three-rayed forms; if one ray is at the same time lengthened we get anchors with a dichotomous head; sometimes the persistent rays bifurcate. There are notes on quinque-radiate and sexradiate spicules, the former of which are wanting from his collections, while the latter are rather rare. The multiradiate or stellate spicules have not been observed by him, but nearly all the spicular spherules described by Zittel have been found in the Bohemian formations. The paper concludes with a list of species, four of which are new.

Sponge-Spicules from the Horn-stone of Brüsan.‡—The same author gives an account of ten species from the horn-stone of Brüsan, of which, in one case only (*Ligidium carteri* Hinde) was he able to distinguish the species.

Protozoa.

Nuclear Division in Protozoa.§—Dr. W. Pfitzner, after many unsuccessful attempts to perfectly colour the chromatic constituents of the nucleus, and at the same time to clear up all the other parts of *Opalina ranarum*, made use of the following method. He cut short

* Ann. and Mag. Nat. Hist., xvi. (1885) pp. 347–68, and xvii. (1886) pp. 40–53, 112–27.

† SB. K. Böhm. Gesell. Wiss. Prag, 1884 (1885) pp. 3–14 (1 pl.).

‡ Tom. cit., pp. 243–54 (2 pls.).

§ Morphol. Jahrb., xi. (1885) pp. 454–67 (1 pl.).

the lower end of the small intestine of a frog, and drawing out a little of the contents of the large intestine, placed them carefully in water on a slide; with a pair of fine forceps all visible particles were removed, and then a quite thin but not too small cover-glass was laid on. If the drop as spread out be thin enough, the large *Opalinæ* contained in the gut will be flattened out. As soon as satisfactory examples have been detected a margin of concentrated picric acid solution must be run round with a brush; when (after some days) this has passed beneath the cover-glass, the preparation is carefully washed until the *Opalinæ*, which will now be visible to the naked eye, are quite colourless. After a repetition of the washing, a very strong solution of alum-carmine must be used like the picric acid, and the slide again placed in the moist chamber; after some days (or if fresh hæmatoxylin be used instead, after some hours), the superfluous colouring matter is to be washed away. Pure absolute alcohol is then sucked through the preparation, and then a ring is made of oil of cloves. After a short time the alcohol evaporates, and the oil of cloves takes its place. If it be desired to preserve the preparation, which is otherwise now ready, xylol is used after the oil of cloves, and then a very thin solution of Canada balsam in xylol is allowed to enter.

In such a preparation the chromatin and the nucleoli will be found to be coloured, and all the rest colourless; the cilia are extended and well preserved, and there are no indications of any solution of continuity or shrinking of the cell-body. A series of forms must be studied and compared.

The resting nucleus exhibits the three constituents—chromatin, prochromatin, and achromatin, the parachromatin being obscured; the chromatin is in the form of a fine irregular plexus of fibres of varying thickness; the marginal layer is the most prominent, but there is a membrane composed of thicker portions of filaments; the greater part of the nucleus is very poor in chromatin; there are generally a number of relatively large nucleoli, which are sometimes arranged in a manner strikingly like those of the mature frog's ovum.

The commencement of kinesis is indicated by the formation of a coil of filaments of equal thickness; at first very finely filamentar and closely meshed, the filaments become thicker later on, the coils looser, and the whole extends beyond the limits of the nucleus. Segmentation then commences; the filaments shorten and thicken, and a central plate is formed. About this time the filaments are cleft longitudinally.

Metakinesis now ensues; the segments undergo such a rearrangement that the free ends lie towards the equator, and the convex sides towards the poles; it is not certain whether this change is directly connected with the longitudinal cleavage. The two segment-complexes, which result from the metakinesis, separate from one another, and gradually consolidate. The ground-substance of the nucleus exhibits a very interesting character, the chief point in which is that it becomes sharply separated from the cell-body. The resting nucleus

is always circular apparently, but probably it is much flattened; during the first half of karyokinesis it remains round, or becomes oval; its long axis, however, is not congruent with the axis of division, and is often, indeed, quite at right angles to it. Later on, a constriction appears in the nucleus, which deepens till at last the two daughter-nuclei are only connected by a thin filament, which breaks later. The nucleoli disappear gradually, and do not pass directly into the chromatic figure. It is important to note that in the daughter-nuclei they are separate from the chromatic figures.

It is clear, then, that in all essential points the process of nuclear division in *Opalina* is the same as in Amphibia and Mammalia, and such differences as there are are merely quantitative.

The question arises whether this may be made a generalization for all Protozoa; but it is one that cannot yet be certainly answered; it is very probable that it is so, and that is all that can be said at present.

Glycogen in Ciliated Infusoria.*—M. E. Maupas, referring to the doubt expressed by Prof. Bütschli as to the presence of glycogen in ciliated Infusoria, gives an account of some experiments by which he hopes he has demonstrated the presence in these Infusoria of a substance exactly comparable to the glycogen of higher animals.

Dialytic Properties of the Membrane of the Cyst of Infusoria.†—M. Fabre discusses the question of the function of the membrane of the cyst which forms around some Infusoria, such as *Colpoda* or *Vorticella nebulifera*, and comes to the conclusion that the membrane is really chitinous, is perfectly porous, and at the same time exhibits special elective properties for the passage of certain bodies; neutral salts pass through it less easily than acid solutions, and it thus delays or prevents the death of the individual from the possible concentration of the water in which it lives.

Temporary Encystment among Infusoria.‡—Mr. J. G. Grenfell records some observations on some hypotrichous infusoria, amongst which were a number of *Sphærophrya*. He found that when an infusorian was attacked by a *Sphærophrya*, it drew in its cilia, and commenced to form a cyst, at the same time allowing a small part of its protoplasm to burst. The infusorian would endeavour to leave the cyst, but withdrew back into it, if *Sphærophrya* was still present. Sometimes the animal leaves the cyst, on the side opposite to the *Sphærophrya*, as a motionless oval body instead of having the shape it usually has on leaving an ordinary spiked cyst, which is formed when the pond, &c., is drying up.

Ectoparasitic Peritrichous Infusorian.§—Dr. R. Blanchard describes *Apiosoma piscicola*, a new genus and species of ectoparasitic peritrichous infusorians which he found, especially on carp, in the fresh-water aquaria at Havre. The body is pyriform, and is attached to the surface of the epidermis of the fish by a kind of non-contractile

* Comptes Rendus, ci. (1885) pp. 1504–6.
† Ibid., pp. 1507–9.
‡ Science-Gossip, 1886, pp. 31–3.
§ Bull. Soc. Zool. France, x. (1885) pp. 277–80 (1 pl.).

peduncle, which is slightly broadened out at its base. The whole surface is very distinctly marked out by transverse striæ; there is a delicate crown of cilia at the point where the anterior passes into the posterior two-thirds of the body; these do not move regularly but intermittently. The nucleus is large and triangular, occupies the middle of the body, and contains one or more nucleoli; when there is one it is triangular, when there are more they are rounded. The author observed a stage of encystation, but was, unfortunately, unable to follow out the developmental history; in some young forms the crown of small cilia was completely wanting.

Peridineæ.*—M. G. Pouchet publishes a third contribution to the history of the *Peridineæ*, describing a number of forms which he has recently observed, viz. *Protoperidinium viride*, *Peridinium tabulatum*, *Gymnodinium crassum*, *Gymnodinium polyphemus*, and *Prorocentrum micans*.

In regard to *P. tabulatum*, he reports the occurrence of a quiescent phase of cell-life, observed in September, and lasting for several months, during which the organism exhibited an almost spherical form, a thick inner, and a delicate outer cuticle, granular protoplasm apparently collected in small spheres, a constant mass of red pigment, and only an indistinct trace of the nucleus and of the grooves. He comes, however, to no conclusion as to the physiological import of this resting stage.

He corroborates his former descriptions of *G. crassum*, and figures a beautiful preparation of the nucleus (due to M. Fabre-Domergue, and fixed by a mixture of osmic acid and methyl-green) in which the coiled nuclear filaments are seen somewhat contracted, leaving a clear space between them and the thick double-contoured nuclear membrane.

He compares the *G. polyphemus* observed with that described in a former report, and notes several peculiarities—the twisting of the axis, the all but invisible nucleus, the very marked, terminal, cap-like plate, &c. He emphasizes the differences in size, and in the presence or absence of the cyst, which obtain among these *Polyphemi* or *Peridineæ* with eye-spots. He figures two individuals within a cyst, apparently resulting from a fissiparous division. The eye was observed as a hyaline rod, having the anterior or oral end plunged in a cylindrical mass of granular, black pigment.

Great numbers of *Prorocentrum micans* were found, uninjured, among the excrement matter of a *Comatula*, and in these M. Pouchet was able to corroborate his previous observations of this species, in its encysted and cyst-changing stages. He contrasts the pear-shaped, escaped form, with that observed within the test. The formation of the new test, and the resumption of the characteristic features are described.

Peridinium and other Infusoria.†—Dr. A. C. Stokes confirms Klebs' statement that the equatorial groove of *Peridinium* contains a

* Journ. Anat. et Physiol. (Robin), xxi. (1885) pp. 525–33 (1 pl.).

† Journ. Trenton Nat. Hist. Soc., i. (1886) pp. 18–22.

single, long, coiled flagellum, and not a row of numerous cilia as previously supposed. The author considers the same arrangement probably obtains in *Ceratium*, though he has not observed the flagellum.

A few notes are added concerning various Infusoria. In *Spirostomum teres* (C. and L.) the author has observed conjugation to be followed by transverse fission. In *Stichotricha secunda* Perty, the anus was discovered to be near the posterior extremity, and the granular condition of the mucilaginous sheath is said to be caused by the animal's excrement. *Chilodon caudatus* divides transversely; the lip is developed afterwards on the posterior half.

He considers the form *Laguncula piscatoris* of Fisher to be a species of *Trachelomonas—T. piscatoris*—the characters of which are, Lorica cylindrical, covered with short spines; anterior aperture situate at the end of a long neck; frontal border denticulate, bearing a row of small spines; flagellum about twice as long as the lorica. The author is unable to confirm Fisher's results as to the separation of the spines from the lorica by the aid of potash, nor as to the calcareous nature of the lorica by testing with hydrochloric acid.

New Infusoria.*—Dr. A. C. Stokes describes some new forms of American fresh-water Infusoria, forming five new genera:—

Clostonema, belonging to the family Spheno-monadidæ of Saville Kent: the bodies are fusiform, naked; persistent in shape, with two unequal flagella; pharyngeal passage, apparently communicating with a contractile vesicle. *Cyclanura* is somewhat like *Phacus*, but without the caudal prolongation. *Diplomastax* is holotrichous; elongate ovate, with tail-like prolongation; oral aperture on ventral surface, enclosing two vibratile membranes; it belongs to Kent's family Ophryoglenidæ. *Histiobalantidium:* heterotrichous; setose hairs abundant on the ovate body; mouth ventral and central, with a vibratile membrane on its right border; it leads into a tubular passage. The author places it between Saville Kent's Spirostomidæ and Stein's Bursaridæ. *Balanitozoon:* free-swimming form; subpyriform body; long cilia anteriorly, none posteriorly; oral aperture apical; pharynx present; single long seta posteriorly. It connects the Holotricha with the Peritricha.

The following are new species:—*Heteromita variabilis*, *Paramonas alata*, *Chrysopyxis urceolata*, *C. dispar*, *Urotricha platysoma*, *Tillina campyla*, *Amphileptus monilatus*, *Loxophyllum vorax*, *Colpidium putrinum*, *C. striatum*, *Rhabdostyla pusilla*, *Vorticella lemnæ*, *Vaginicola ampulla*, *Uroleptus sphagni*.

New Ciliated Infusorians.†—M. P. Fabre-Domergue gives a list of Ciliated Infusorians found by him in the Bay of Concarneau. The list includes two new genera and three new species.

(*a*) On the outside of *Asterias glacialis*, especially on sickly specimens with tegumentary excoriations, a parasitic infusor was found in

* Ann. and Mag. Nat. Hist., xvii. (1886) pp. 98–111 (1 pl.).
† Journ. Anat. et Physiol. (Robin), xxi. (1885) pp. 554–68 (2 pls.).

great abundance. For this the new genus *Philaster* is founded, and the species is named *P. digitiformis*. It is allied to *Paramœcium*, from which it differs, however, in general form and in the possession of a long, rigid anal cilium. (*b*) A magnificent species of *Nassula* (*brunnea* nov. sp.) was found, characterized by its large size and its diatomine-like brown colour, and distinguished from other species by the absence of a pre-buccal furrow, by its long, cylindrical, terminally rounded, somewhat S-shaped nucleus, by its simple contractile vesicle, &c. (*c*) *Pleuronema marina* Duj. is described; the pharynx is not turned upwards, as has been hitherto figured; in the peripheral layer, below the outer membrane, trichocyst-like rods were seen; the contractile membrane is, when fully extended, almost as large as the body proper. (*d*) A new species of *Lembus* (*striatus*) was especially characterized by the very fine, diatom-like, transverse as well as longitudinal, striation of its vibratile membrane. (*e*) A new genus *Certesia* is established for a form distinguished by its twelve lateral, and its enormous transverse setæ, as also by the restriction of the marginal setæ to one side of the body. In the development of marginal setæ it approaches the Oxytrichidæ, while it resembles the *Euplotidæ* in its consistence and in the horseshoe-shaped arrangement of its nuclei. In front, just below the anterior end, there is a peculiar, small, membranous plate, rounded, transparent, and capable of slight movements. In this form (*C. quadrinucleata*) the contractile vesicle seems to be absent. (*f*) A new species of *Aspidisca* is named *crenata*, on account of the bluntly toothed contour of the posterior margin of a clear tegumentary fringe which surrounds the body. (*g*) A very full description of *Styloplotes appendiculatus* Ehr. is given, and, in correction of Maupas, the presence of a contractile vesicle and of prebuccal cilia is maintained.

Microthorax auricula.*—M. P. Fabre-Domergue describes this new species of the hypotrichous infusorian *Microthorax*, which has been found in a cultivation of algæ from the Seine; the specific name is due to its remarkable ear-like form. It is C 03–0·04 mm. long, has a depressed, reniform, non-contractile body about twice as long as wide; the cilia, which are confined to the ventral surface, are delicate and rigid, separated by a somewhat considerable space about 10 μ long at either end and 8 μ long on the rest of the body. *M. auricula* runs about on its ventral surface among the algæ on the decomposition of which it lives. It differs from the two species described by Engelmann—*M. sulcatus* and *M. pusillus* by wanting the dorsal groove, and by possessing a semicircular and three posterior bourrelets.

New Rhizopod.†—M. P. Hallez describes a new Rhizopod—*Arcyothrix Balbianii*—found in cultures of the eggs of *Ascaris megalocephala*. Its irregular globular body has a flattened "pedal-disc"; from the body two varieties of pseudopodia are given off: a single blunt process, which serves to seize prey, and two long, delicate filaments, which hold the prey. The locomotion is not assisted

* Ann. Sci. Nat.—Zool., xix. (1885), No. 6., 1 p.

† Mem. Soc. Sci. Lille, xiv. (1885) pp. 323-5. Cf. Bull. Sci. Dép. Nord, 1885.

by these processes. There is a mere flowing of the protoplasm, as in *Amœba*. No nucleus was to be seen, and only one specimen has been observed.

Spontaneous and Artificial Division.* — Prof. M. Nussbaum describes the structure and history of *Opalina ranarum* and *Gastrostyla vorax*, with special reference to spontaneous and artificial division. On his results he bases a number of generalizations, and adds a critical review of several recent researches on the cell.

I. *Opalina ranarum.* (*a*) The division of *Opalina*, which seems to cease during the hibernation of the frog, but which rapidly recommences if the host be warmed or fed, is effected by a cleft, which, as it deepens, divides the body into two frequently unequal parts. These remain slightly united by a delicate connective filament till separated by a voluntary twist of the infusorian. The numerous nuclei exhibit no special phenomena and no division during this process, but mitosis was during other periods abundantly observed in the nuclei of *Opalinæ* of the most varied size. The structure of the ciliated and encysted phases is described. (*b*) Nussbaum's attempts to effect artificial division were unsuccessful, which was doubtless in great part due to the difficulty of keeping the *Opalinæ* alive outside their host.

II. *Gastrostyla vorax.* (*a*) In noting the habitat of this new species the author lays special emphasis on the vitality of infusorian cysts, which he has sometimes kept latent for two years. The structure of *Gastrostyla*, the encystation, the behaviour of "nuclei" and "nucleoli," and the phenomena of division are discussed at considerable length.

(*b*) In his experiments on the artificial division of this form Prof. Nussbaum demonstrated the continued vitality and rapid reconstruction of the portions which contained nuclear substance. The portions without nucleus either rapidly degenerated or persisted for a while—without growth or reconstruction.

The following generalizations are formulated and fully discussed by the author. (1) Nucleus and protoplasm can only live in conjunction; if isolated, death follows more or less rapidly. (2) For the preservation of formative energy the nucleus is essential, though Grüber has shown that certain histological differentiations may not be hindered by its removal. (3) Every energy exerted by the cell is indissolubly associated with a divisible substratum. In this connection the author discusses the relation of polynuclear cells to artificial division, the suggestive observations of Fol and others as to polygastrulation, &c., and maintains that the cell represents a multiple of possible individuals, which in the Protozoa are always alike, though frequently different in the Metazoan cell. The subject of polar globules is finally discussed, in regard to which, after an investigation of fresh material, Nussbaum criticizes Van Beneden's account of polar globule-formation in *Ascaris*, and maintains as before the occurrence of ordinary nuclear division.

* Arch. f. Mikr. Anat., xxvi. (1886) pp. 485–538 (4 pls.).

Sarcosporidia.*—Dr. R. Blanchard, after a somewhat lengthy but useful historical account of our knowledge of these Sporozoa, describes a new type which he found in *Macropus penicillatus*, and of which an account has already appeared in this Journal.† He concludes his paper with an essay on the classification of the Sarcosporidia, which he proposes to divide into two families; the first—*Miescheridæ*—contains those which are found in striated muscles; the enveloping membrane is either delicate and structureless as in *Miescheria*, or thickened and traversed by fine canaliculi as in *Sarcocystis*; the second—*Balbianidæ*—are found in connective tissue, and in the only known genus—*Balbiania*—the envelope is delicate and structureless. The author thinks that the time has not yet arrived for us to define the species of each genus. The Sarcosporidia are intimately connected with the Coccidia, and more particularly with the polysporous forms (*Klossia* = *Benedenia*), from which they only differ in size and habitat. At the same time Dr. Blanchard recognizes that there is no absolute distinction of locality between the Coccidia and the Sarcosporidia, statements to the contrary notwithstanding.

New Sarcodine.‡—M. J. Künstler applies the term of *Dumontia opheliarum* to a Sarcodine which he regards as the type of a new sub-class; it was found in the perivisceral cavity of *Opheliæ*, and was when first described spoken of as a Rhizopod.§ It varies greatly in size, has an axial internal skeleton, which may be equivalent to the central capsule of Radiolaria or to the shell of Rhizopods; it is very closely united with the protoplasm of the cell. During life it reproduces itself by gemmation, and finally the individual breaks up into a number of fragments, each of which is provided with a bud of the axis; each fragment forms a new individual, which recommences the same cycle. The areolated structure of its protoplasm recalls that of the Heliozoa; the pseudopodia are not fine like those of most Radiolarians, and not obtuse as in many Rhizopods, but rather intermediate in structure. The possession of the central axis allies it again to the Radiolarians, from which it differs in other points. Is it possible that it is a Rhizopod, the test of which has become a central axis, or that the axis has no relation either to the test of Rhizopods or to the central capsule of Radiolarians? On the whole, its characters are such as to give it a separate place among the Sarcodinæ, between the two great orders of Rhizopods and Radiolarians.

Pathogenic Role of Certain Psorosperms.‖—M. P. Mégnin, from his observations on certain diseased fishes, is led to support the view of Prof. Balbiani that psorosperms are the cause of the tuberculosis of the liver, from which rabbits are often found to suffer. He has himself studied some barbel from the Meurthe, near Nancy, which are subject to a disease that decimates them; the disease is characterized by the development on the surface of the

* Bull. Soc. Zool. France, x. (1885) pp. 244–76 (1 pl.). † V. (1885) p. 820.
‡ Bull. Soc. Zool. France, x. (1885) pp. 309–36 (1 pl.).
§ See this Journal, v. (1885) p. 82.
‖ Bull. Soc. Zool. France, x. (1885) pp. 351–2.

body of hemispherical tumours from one and a half to ten centimetres in diameter; from these parts the scales drop off and the tumour becomes ulcerous in appearance. In the matter of the tumours there are to be found myriads of psorosperms which are analogous to and are probably of the same species as those which MM. Robin and Balbiani have found in the tench and the carp, where they form the matter of the cysts which are particularly found in the swim-bladder. The cells are lenticular and composed of two valves which inclose some protoplasm, while a long cilium projects from an orifice at one end. The author explains the infection of the fishes thus: the psorosperms which escape from the ulcers are taken in with the water which is swallowed or respired, and these by the blood reach the subcutaneous cellular tissue, where they undergo their final metamorphosis.

Bütschli's 'Protozoa.'*—Parts 32 and 34, with plate LV., of Prof. O. Bütschli's 'Protozoa' were published at the end of 1885. The account of the Dinoflagellata is continued and that of the Cystoflagellata begun. Of the former twenty-six genera and from ninety to ninety-five species are known; the first sub-order is that of the Adinida Bergh (Prorocentrina Stein), with the family Prorocentrina; the second Dinifera, with the families Peridinida, Dinophysida, and Polydinida. The author gives a phylogenetic table. Cystoflagellata is Prof. Häckel's name for the Noctilucidæ of authors; the group contains as yet only the two genera *Noctiluca* of Suriray (1816) and *Leptodiscus* of R. Hertwig (1877); in each genus there is but one species, the former being cosmopolitan, the latter known only from the Mediterranean.

BOTANY.

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

a. Anatomy.†

Movements of Protoplasm in Tissue-cells.‡—Dr. H. de Vries has investigated the question whether the rotation and circulation of protoplasm are confined to isolated cells and to filament-cells, in which they are usually observed, or whether the phenomena are not equally displayed in the constituent cells of tissues. For this purpose he examined *Tradescantia rosea* and *Tropæolum majus*, and found in both cases movements of the protoplasm in the living wood-fibres, the cambiform cells, the young bast-fibres, the pith, the bast-parenchyma

* Bronn's 'Klassen u. Ordnungen d. Thierreiches,' 8vo, Leipzig and Heidelberg, 1885.

† This subdivision contains (1) Cell-structure and Protoplasm (including the Nucleus and Cell-division; (2) Other Cell-contents (including the Cell-sap and Chlorophyll); (3) Secretions; (4) Structure of Tissues; and (5) Structure of Organs.

‡ Maandbl. voor Natuurw., 1884. See Bot. Centralbl., xxiv. (1885) p. 79.

of the internodes, the leaf-stalks and mid-rib of the leaves, the rhizome, and the roots. Observation of the currents leads to the conclusion that it is by these currents that the substance for the formation of starch is conveyed to the amyloplasts.

For the purpose of these observations the author placed a large drop of a 5 per cent. solution of sugar on the substance to be cut, moistening the knife also with the same solution. Each section was then placed on the slide, the sugar solution removed by blotting-paper and replaced by a new drop. The sections were then left for from one to two hours before examination, by which time the currents of protoplasm had again set up.

Chemistry of Chlorophyll.*—Mr. E. Schunck first deals with the action of acids on chlorophyll; the best to use is hydrochloric acid. By adopting essentially the method of Frémy he had been able to separate phyllocyanin and phylloxanthin. The properties of the former are described in detail; when heated on platinum it gives off an acid smell, swells up considerably, evolving gas which burns with a smoky flame, and leaves a voluminous charcoal which burns away slowly, leaving hardly a visible trace of ash. It is rapidly decomposed on being treated with boiling dilute nitric acid. Insolation causes it to yield products which resemble, if they are not identical with those due to the action of nitric and chromic acids. Phyllocyanin appears to play the part of a weak base, that is, it combines with strong acids, the compounds, however, being unstable and easily decomposed, even by water. Mr. Schunck enumerates a number of the compounds he was able to obtain, among which are phyllocyanin cupric acetate, stearate, and phosphate, phyllocyanin zinc palmitate and oleate, phyllocyanin ferrous citrate and malate; the characters of these various compounds are described.

Studies on Chlorophyll.†—M. V. Jodin describes some experiments bearing on M. Regnard's hypothesis, that the action of chlorophyll on carbonic acid is purely chemical, and not physiological. In order to prove this he suppresses in turn all the physiological conditions. After being dried, the green leaf loses the power of decomposing carbonic acid and exhaling oxygen in sunlight. By leaving a leaf for sixty-five hours in an atmosphere of hydrogen or of nitrogen, it likewise loses this power. He suppressed the respiration of the leaves by heating them in sealed tubes in a water-bath. Some of the tubes were then placed in the dark, and were found to have undergone no change; but others, placed in sunlight, became discoloured, by absorbing the oxygen in the tubes.

This result seems to show that, "apart from the physiological entirety, light only acts on the leaf by destroying chlorophyll and giving rise to oxidation." In order to show that this photochemical oxidation was really exerted on the chlorophyll, and not on other substances, such as tannin, a solution of xanthophyll, &c., in alcohol was placed in sunlight, when it was found to become oxidized and

* Proc. Roy. Soc., xxxix. (1885) pp. 348–61.
† Comptes Rendus, cii. (1886) pp. 264–7.

give off carbonic acid. Drying oils are known to absorb oxygen even in the dark; when mixed with chlorophyll the oil becomes nearly inoxidizable in the dark, but its oxidation in the light is increased by the presence of chlorophyll.

Contents of Sieve-tubes.* — Dr. A. Fischer states that the collection of mucilage seen beneath the sieve-plate in sections of sieve-tubes, and known as "Schlauchkopf," does not occur in the tubes in the uninjured plate, but is the result of injury. No trace of this structure is apparent if the plant is first boiled for from two to five minutes, by which means the contents of the sieve-tubes are coagulated. When treated in this way, the sieve-tubes of *Cucurbita* are seen to be completely filled by a finely turbid granular mass, while a parietal layer of protoplasm can be demonstrated by staining; it sometimes contains drops of mucilage. The author considers that in the uninjured state the sieve-tubes of *Cucurbita* contain a clear thin mucilaginous sap; when the tubes are cut, a portion of this sap is pressed out; the sieve-plate acts as a filter and keeps back the denser part, which then forms the "Schlauchkopf."

Colouring Matters of Plants.†—According to Sig. P. Baccarini the red and yellow colour of plants is not always due to the presence of chromoblasts. Where this is the case, the originally round chromoblasts frequently lose their form in consequence of crystallization, as in the fruits of *Eugenia bahiensis* and the flower-buds of *Bignonia venusta;* while in others the form is changed by the formation of a vacuole in their interior, as in the flowers of *Tecoma capensis*, *Tritomia uvaria*, and *Aloe socotrina*.

The inner perianth-leaves of *Chamædorea elegans* display before blossoming a chestnut-brown colouring due to amorphous masses of a non-protoplasmic character within the cells. In the unripe fruits of *Euchylæna tomentosa* there are, in the parenchymatous cells, more or less rounded grains of chlorophyll, usually with a vacuole in the middle; as these capsules disappear the vacuole swells, and the contents become yellow or bright red from the formation of a soluble pigment. A similar soluble yellow pigment is found in the fruits of *Rivina lævis*, and the flowers of *Calceolaria amplexicaulis* and *Buddleya madagascariensis*. The yellow colour of the flesh of the fruit of *Eugenia bahiensis* is caused by tabular chromoblasts within the cells, probably derivatives of chlorophyll.

The roots of *Echium plantagineum* are coloured in patches on the surface from amorphous masses of protoplasm permeated by a pigment. In the flower-buds of *Bignonia venusta*, alcohol causes a precipitation of sphero-crystals, which the author regards as a calcium phosphate.

Pigment-bodies in Neottia nidus-avis.‡—Herr O. Lindt opposes the view of Wiesner that chlorophyll exists in the cells of this

* Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 230–9. Cf. this Journal, v. (1885) pp. 477, 1020.

† Ann. Istit. Bot. Roma, ii. (1885) 23 pp. (1 pl.). See Oester. Bot. Zeitschr., xxxv. (1885) p. 439.

‡ Bot. Ztg., xliii. (1885) pp. 825–34.

plant, combined with a substance which masks its colour. He details microchemical experiments which lead him to the conclusion that the chlorophyll does not pre-exist in the cells, but that it may be formed from the brown pigment-bodies by the action of a reducing substance such as a volatile aldehyde, present in some cases in the cells; hence the occasional "greening" of the plant under special circumstances.

Occurrence of Calcium Oxalate in the Epidermal Cells of Acanthaceæ.*—Professor A. Weiss finds in the epidermis of the organs of several species belonging to the Acanthaceæ a peculiar deposit of calcium oxalate, not in any way connected with the cystoliths. Not only do these crystalline masses occur in the same cell with starch-generators, starch, and chlorophyll, but the crystals are of the two kinds, rhombic and klinorhombic, completely intermixed with one another.

Formation of Gum in Trees.†—Dr. W. Beyerinck, it will be remembered,‡ considered the formation of gum in trees to be due to a pathological change brought about by the influence of a fungus. Working independently, and in ignorance of Dr. Beyerinck's researches, Dr. J. Wiesner has since arrived at a similar conclusion, except that he attributes the formation of gum to the action of an unformed ferment. This ferment he considers to belong to the starch-converting or diastatic enzymes, but to differ from the ordinary members of the group in that, while it converts starch into dextrin, it produces no sugar that reduces Trommer's solution. The seat of the development of the gum-ferment appears to be the granular protoplasmic matter of the parenchyma-cells. From thence it attacks the cellulose of the cell-walls, converting it into gum or mucilage, in the latter case disappearing itself from the finished product. The ferment probably converts any starch it may meet with into dextrin, though never into a reducing sugar; indeed it seems capable of arresting the action of diastase in this direction, when added to a solution of dextrin containing diastase.

Wax of Box-leaves.§—Prof. G. A. Barbaglia has examined the chemical constitution of the wax found chiefly on the upper sides of the leaves of *Buxus sempervirens*, and finds that, like Chinese wax and bees'-wax, it contains palmitic acid.

Stimulation of Gland-cells in Tentacles of Drosera dichotoma.‖—Mr. W. Gardiner finds that, as regards the general histology of the tentacles of *Drosera*, the gland-cells of the head are provided with delicate uncuticularized cell-walls, which are remarkably pitted on their upper surfaces; the other epidermal cells have their outer walls excessively cuticularized and resistent, while their radial longitudinal walls are freely pitted. In the typical resting gland-cell the proto-

* SB. K. Akad. Wiss. Wien, xc. (1884) pp. 79–88 (1 pl.).
† Bull. Torrey Bot. Club, xii. (1885) pp. 119–20.
‡ See this Journal, iv. (1884) p. 419.
§ Atti Soc. Toscana Sci. Nat., iv. (1885) pp. 115–6.
‖ Proc. Roy. Soc., xxxix. (1885) pp. 229–34.

plasm is arranged in a network, the meshes of which are excessively close round the nucleus; after stimulation, which is best effected by the application of food, large spherical cavities appear in the meshwork, owing to the breaking down of some part of the plexus; this increases as time goes on; the secretion may be sometimes seen to escape in drops and to assume a rod-like form; it is of a mucous nature, and is due to the breaking down of the protoplasm. The author describes the changes which take place in the stalk-cell after electrical stimulus or feeding, and states that the body which he calls the plastoid or "rabdoid," markedly decreases in size after long stimulation, so that there are some grounds for believing that it consists mainly of some reserve-material or some substance which is used up during secretion. The normal effect of a regulated stimulus is a swelling of the protoplasm and a loss of turgidity; as the reaction is unequal in various cells there is a movement of the tentacle.

Articulated Laticiferous Vessels.*—By observation on specimens of *Hevea brasiliensis* from Ceylon, Dr. D. H. Scott confirms his previous conjecture that the laticiferous tissue of this genus agrees in structure with that of *Manihot*, in consisting of true vessels formed by cell-fusion, and not of inarticulated laticiferous cells, as in the Euphorbiaceæ previously investigated. The laticiferous tubes occur on the phloem side of all the vascular bundles, and are limited to this position, more being found in the parenchyma between the bundles; they form a complete anastomosing system. The absorption of the transverse walls is not in all cases complete. Dr. Scott regards the tissue as having a nutritive function.

The author criticizes the classification of Euphorbiaceæ by Pax,† founded on the nature of the laticiferous tissue. He accepts Pax's view that the form of laticiferous tissue which consists of a series of closed sacs, his "articulated tubes," gave rise to the inarticulated laticiferous cells. The forms with closed laticiferous sacs may be regarded as having given rise, on the one hand, to those with typical laticiferous cells, as *Euphorbia*, on the other hand to those with true vessels produced by cell-fusion, as *Manihot* and *Hevea*. In Papaveraceæ we have an instructive series of transitional forms, illustrating how the transition from sacs to vessels may have taken place.

Medullary Rays of Conifers. ‡ —Herr A. Kleeberg enters into great detail respecting the structure and position of the thin spots in the walls of the medullary rays and tracheids in Conifers. On the cells of the medullary rays these spots occur in the form of circular depressions, pores, or simple pits; on the tracheids they are funnel-shaped, the widest part of the funnel always facing outwards and being closed by a delicate membrane; these are the bordered pits. There is again a difference in these bordered pits, according to whether they are in juxtaposition with another bordered or with a simple pit.

* Journ. Linn. Soc. Lond. (Bot.), xxi. (1885) pp. 566–73 (4 figs.). Cf. this Journal, iv. (1884) p. 409.

† See this Journal, v. (1885) p. 824.

‡ Bot. Ztg., xliii. (1885) pp. 673–86, 689–97, 705–14, 721–9 (1 pl.).

All the sections of *Pinus*, with the exception of *Abies*, have two kinds of cells in their medullary rays, the normal, and those called "transverse tracheids," which always possessed bordered pits and frequently spiral thickenings.

The particulars of these various structures are described in detail with respect to a large number of species of Conifers.

The author finds chromic acid an exceedingly good substance for removing the resin from the resin passages and cells of the medullary rays and parenchyma of the wood.

Leaf-stalk and Cushion.*—According to Herr P. Preuss, the most widely distributed element in these organs is the collenchyma; then follows the bast; the libriform plays a subordinate part; the formation of the scattered sclerenchymatous cells is not clear. The most abundant kinds of vessels are the reticulated and the pitted.

Herr Preuss classifies leaf-stalks and cushions under three types, which are not, however, sharply distinguished from one another, viz.—

1. Leaf-stalk nearly of the same thickness throughout, not distinguishable into a cushion and a thinner part, (*a*) without bast and libriform, (*b*) with bast or libriform.

2. Leaf-stalk with a cushion at both upper and lower ends, and with the intermediate portion not flexible.

3. Leaf-stalk with a cushion at each end, and with the intermediate portion moderately flexible.

Structure of the Bundle-sheath.†—M. C. van Wisselingh describes the structure and development of the sheath which surrounds the central cylinder in the root of Phanerogams. In the species examined it is derived from the outermost layer of the plerome. The outer and inner walls of the cells composing it are marked by stronger thickening, while on the radial walls neither a middle lamella nor a primary thickening is to be made out. The principal thickening is on the inner walls.

Tubercles on the Roots of Leguminosæ.‡—Herr J. Brunchorst contests the view of Woronin and Eriksson that the rod-like bodies found in these structures are bacteria, connected genetically with the fungus-hyphæ which are also frequently found in them. He has frequently found them where the hyphæ were entirely wanting; and has also found on the hyphæ a formation of spores altogether differing from the bacterium-like bodies. These he regards as simply albuminoid particles separated from the normal protoplasm of the root, and proposes to call them *bacteroids*.

This view is confirmed by the facts that there is no evidence of the entry of any parasite into the root, and that the bacteroids have

* Preuss, P., 'Die Beziehungen zwischen d. anat. Bau u. d. phys. Function d. Blattstiele u. Gelenkpolster,' 58 pp., 8vo, Berlin, 1885. See Bot. Centralbl., xxiv. (1885) p. 297.

† Arch. Néerland. Sci. Exact. et Nat., xx. (1 pl.). See Bot. Centralbl., xxiv. (1885) p. 326. Cf. this Journal, iii. (1883) p. 383.

‡ Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 241–57.

frequently entirely disappeared in older tubercles. The author finds them also almost universally diffused among Papilionaceæ, as well as many Cæsalpinieæ and Mimoseæ, from all climates and soils, but exhibiting very different forms in different species. He regards them as probably the means through which the food-material obtained from the soil is assimilated.

Tubercles on the Roots of the Alder.*—Herr J. Brunchorst has re-investigated the cause of these structures, and pronounces decidedly against Möller's view that they are caused by the plasmodium of a *Plasmodiophora*. Since, however, the germination of the spores has not yet been determined, it is impossible at present to decide the systematic position of the fungus to which they belong.

The tubers on the roots of Elæagnaceæ correspond altogether in structure to those of *Alnus*.

Cell-markings as Specific Characters of Exogenous Trees.†—Examining sections of a very large number of American exogenous woods, Mr. P. E. Lawrence and Mr. C. S. Raddin have come to the conclusion that the markings on the cell-walls are quite unreliable as characters for the distinction of species and even of genera. The same species may differ in this respect according to the soil in which it grows, while species of the same genus showed no relationship to one another; and the markings of trees belonging to widely separated natural families presented cell-markings almost indistinguishable from one another.

Biology of Water-plants.‡—Herr H. Schenck contributes an exhaustive account of the anatomy and physiology of these plants, which (excluding seaweeds) he classifies under three heads:—those which are altogether hydrophytes; those which have the capacity, under special circumstances, to live on the land in peculiar forms; and those which are truly amphibious.

Water-plants are as a rule characterized by the leaves being deeply cut, to enable them to withstand the currents of water and to be reached by the diffused light. Exceptions are furnished by the broad-leaved *Potamogetons*. The stem is usually thin and flexible, and provided with stolons, and there is no difference in the structure of the primary and secondary axes. The roots are reduced, and serve rather as organs of attachment than of absorption, and are often destitute of root-hairs. The stem is endowed with rapid apical growth, and has no secondary increase in thickness. For the purpose of fertilization the flowers are sometimes elevated above the surface of the water and conspicuous, when they are fertilized by flying insects, or elevated and inconspicuous, when they are fertilized by the wind or by insects which run on the surface of the water. Other species have special contrivances for fertilization out of the water,

* Versamml. Deutsch. Naturf. Strassburg, 1885. See Bot. Centralbl., xxiv. (1885) p. 222.

† The Microscope, v. (1885) pp. 241–3.

‡ Schenck, H., 'Die Biologie der Wassergewächse,' Bonn, 1886 (2 pls.). See Bot. Centralbl., xxiv. (1885) p. 355.

as in *Vallisneria* and *Hydrilla*, or below the surface, like the absence of extinc, as in *Naias* and *Ceratophyllum*.

The author enters into further details respecting the mode of life and variability of water-plants, their hibernation, their vegetative multiplication, the structure of the flowers, the dissemination of the seeds, their germination, and geographical distribution.

Pollen-tubes.* — M. C. Degagny finds that the "cellulose stoppers" which obstruct the pollen-tube do not consist of cellulose. By the use of methyl-blue, which stains cellulose, the membrane is not coloured, but the protoplasm of the "deposit" is stained; this indicates that this is analogous to, but not identical with, the callus of sieve-tubes; for whilst the latter is not stained by chlor-iodide of zinc, the former is. He concludes that these deposits are protoplasm, richer in carbo-hydrates than is the callus, in which the nitrogenous substances prevent the staining by means of this reagent. Assimilation ends in the formation of a large quantity of uncoloured protoplasm, the degradation of which is so much the more rapid in proportion as the nitrogen reserve materials have not time to be formed in sufficient quantity. The degradation is not complete, as in ordinary cellulose secretions; in fact, these new reactions show that the nitrogen is not totally eliminated. These are phenomena special to the male cell or pollen-tube and to the increase of protoplasm, which is the active element of fertilization.

White-seeded Variety of the Honey-locust.†—Mr. T. Meehan, referring to seeds of an old specimen of *Gleditschia triacanthos*, which were white instead of the ordinary olive-brown colour, and which showed other differences from the ordinary variety, said that this was the only known instance of the species producing white seeds. He suggested that environment was not so great a factor in producing variations as it was usually considered to be, and is inclined to attribute the variation to the "plant's own innate power to change," since it is difficult to see how this one tree, out of several growing in the neighbourhood and under exactly the same conditions of climate and soil, could be influenced by its environment. Cross-fertilization often produced great changes in the colour of seeds of Indian corn.

Germinative Power of Seeds after exclusion of Air and Drying at High Temperatures.‡—Experiments carried on by Herr Wilhelm as to the power of germination of seeds dried and hermetically sealed, gave the following results, with winter wheat, rye, oats, and linseed. Exclusion from air enables the seed to retain its vitality longer than when air has access to it; two hours' heating at 50° C. removes water and preserves the seed well; when heated to a higher temperature the seeds germinate more slowly. Seeds which have been artificially dried, when subsequently moistened, absorb more water than they would otherwise have done.

* Comptes Rendus, cii. (1886) pp. 230–1.

† Proc. Acad. Nat. Sci. Philad., 1885, pp. 404–5.

‡ Journ. Chem. Soc. Lond., l. (1886) p. 171, from Bied. Central., 1885, pp. 611–3.

Distribution of the Fruits of Compositæ.*—Herr M. Kronfeld describes the various ways in which the mature pappus serves to disseminate the fruits of the Compositæ. The most common mode is by the finely divided hairs of the pappus itself forming a parachute. In the Cynareæ the pappus-hairs are united together by their base into a ring, and the whole becomes detached from the achene by the slightest pressure. This appears to be a contrivance for enabling the fruit to reach the ground after travelling a short distance. In some species the withered flower acts the part of a pappus. A second mode of dissemination is by means of teeth attached to the hairs of the pappus, by which they become attached to the skins of animals, and thus carried away. A third mode is by running water, the pappus forming a floating apparatus, often greatly facilitated by a bubble of air being retained by the hairs.

Epidermal System of Cactaceæ.†—Herr H. Caspari describes two kinds of spines in the plants belonging to this order; in one the epidermal cells which surround the sclerenchymatous bundle are cylindrical or prismatic in the upper, flat and imbricate in the lower part of the spine; while in *Mamillaria* the terminal cells are chiefly prosenchymatous, the basal parenchymatous. The occurrence of these two kinds of spine may be used as distinguishing characters of species, but not of genera. The Cactaceæ are specially adapted for their dry habit, by the strong cuticularizing of the cuticle, the great development of hypoderma, and the structure and distribution of the stomata.

Anatomy of Leafless Plants.‡—Herr T. Schube describes the arrangements by which plants that have no or very few leaves are able to carry on the functions of assimilation. This is effected by an unusually abundant development of parenchyma in the axial organs, and by a diminution of the means of transpiration.

Flowers of Figs.§—Dr. F. Ludwig reports some recent observations of cases where fertilization is effected by insects which deposit their ova on the flowers. Riley ‖ has shown how the yucca-moth, in depositing its ova within the flowers of the *Yucca*, accomplishes the fertilization, and how the few seeds which the larvæ devour in their cradle are unimportant in such richly filled ovaries.

Graf zu Solms-Laubach ¶ has observed a complicated arrangement in various species of figs. Besides the male flowers, two entirely

* SB. K. Akad. Wiss. Wien, xci. (1885) (1 pl.). See Oester. Bot. Zeitschr., xxxv. (1885) p. 436.

† Caspari, H., 'Beitr. zur Kenntniss des Hauptgewebes der Cacteen,' 53 pp., 8vo, Halle, 1883. See Bot. Ztg., xliii. (1885) p. 804.

‡ Schube, T., 'Beitr. zur Kenntniss der Anat. blattarmer Pflanzen, mit besonderer Berücksichtigung der Genisteen,' 28 pp. (2 pls.), 8vo, Breslau, 1885. See Bot. Ztg., xliii. (1885) p. 805.

§ Biol. Centralbl., v. (1885) pp. 561–4.

‖ Trans. Acad. Sci. St. Louis, 1875, 1878. Proc. Amer. Assoc. Adv. Sci., 1880.

¶ 'Domestikation und Vaterland des gewöhnlichen Feigenbaums,' Göttingen, 1882. Cf. this Journal, *ante*, p. 99.

different female flowers exist: (*a*) those without stigmas and with short style adapted to ovipositors of gall-wasps (*Cynips blastophaga*), and with ovaries which swell up (without fertilization) as the result of the gall-formation ("Gallenblüten"); and (*b*) those with long usually curved style and developed stigmas which do not admit of oviposition by wasps but are adapted for fertilization ("Samenblüten"). Two sets of colonies occur (1) with only female fertilizable flowers (*b*), and (2) male colonies, with male flowers in the upper portion and with proterogynous gall-flowers (*a*) below. Only in the last can the young wasps develope; in passing out they bear away pollen from the upper male flowers, they visit female colonies (1) (*b*) and fertilize these, but are unable to effect deposition of ova. The caprificus or male tree has several generations of inflorescences—the "mamme" which last through the winter (with only female gall-flowers (*a*)), and the "profichi" with male flowers in the upper zone, which ripen much later than the female gall-flowers which occupy the lower two-thirds of the fig. When the male flowers shed their pollen, the fertilizable female flowers (*b*) of the female tree are ready to receive it. The different species exhibit a series of modifications through which this interesting arrangement may have arisen. In *Ficus elastica* and other probably archetypal *Urostigma* species, male and female flowers occur irregularly in the same inflorescence, and the latter are all alike. In others (*U. religiosum* e. g.) a separation has taken place into an anterior male and posterior female zone. Again we find the same arrangement, but dimorphic females (*a*) and (*b*) irregularly intermingled. The long-styled flowers became more and more protected from the danger of gall-formation, and were separated from the other.

Professor Ludwig points out the interest of these observations in connection with the ancient custom of caprification—hanging the wasp-containing figs of the goat-fig—*Caprificus* (i. e. the males and gall-forming female flowers (*a*)) on the blooming female trees (the Essfeige); and also in relation to the general theory of the relation of flowers and insects.

Fruit-scales of Cupressineæ and Placentæ of Abietineæ.*—Herr A. Kramer points out that in the Coniferæ the fruit-scales ("Fruchtschuppen") are simple in some tribes, while in others they are inserted in the axis of small leaves or bracts ("Deckschuppen"). With regard to the morphology of the parts, he supports the view of Sachs, Eichler, and Göbel, that the "bracts" are really open carpels, and the fruit-scales placentæ bearing the ovules. The observations were made on *Thuja occidentalis*, *T. gigantea*, *Biota occidentalis*, *Chamæcyparis Lawsoniana*, *Cupressus sempervirens*, and *Juniperus communis* among Cupressineæ, and on *Pinus sylvestris*, *P. montana*, *P. Strobus*, *P. Cembra*, *Larix Ledebourii*, *Abies pectinata*, *Picea rubra*, and *Tsuga canadensis* among Abietineæ.

The cone of Cupressineæ consists of several decussate carpels placed on an axis, in the axils of which the ovules originate. The history of development shows that these separate carpels are inde-

* Flora, lxviii. (1885) pp. 519-28, 544-68 (1 pl.).

pendent foliar structures, not resulting from the union of two different organs; in the young condition therefore the cone of Coniferæ must be regarded as a single flower and not as an inflorescence. With regard to the origin of the swellings on these leaves, investigation shows that either only one cushion is formed on the carpel, which is then always on the upper side, or that the swelling takes place on all sides. In the Cupressineæ a partial transformation of the otherwise parenchymatous structure of the carpels always takes place into scattered sclerenchymatous cells.

In the Abietineæ the structures formed in the axils of the carpels must be regarded as placentæ; and here also each cone must be regarded as a single flower, and not as an inflorescence. These placentæ always appear at first as axillary swellings, and afterwards as transverse cushions in the axil of the carpels which generally remain small. In this condition they are nearly alike in the different species, and only subsequently develope in different ways. The rudimentary cones attain a very different degree of structure in the different species in the autumn preceding their true development. In the species of *Larix*, and in *Pinus sylvestris* and *montana*, there is to be met with at that time only a longish oval mass of tissue, the subsequent axis; while in *Tsuga canadensis* not only have the carpels begun to be formed, but even the placentæ in their axil.

Structure of the Leaves and Stomata in Coniferæ.*—Dr. A. Mahlert has examined in great detail the anatomy of the leaves and the structure and mode of development of the stomata in a large number of Coniferæ, and in a few Cycadeæ and Gnetaceæ. The following are the general results arrived at:—

In most Coniferæ the stomata are recognized on the white or grey coating of wax, which also extends into their outer opening. This coating is altogether wanting in *Taxus*, *Taxodium*, *Gingko* (*Salisburia*), *Torreya*, and *Sciadopitys*, and is but very feebly developed in the broad-leaved *Araucarias*, *Dammara*, and some species of *Podocarpus*.

In *Gingko*, *Araucaria Cunninghamii*, *A. excelsa*, *A. Cookii*, *Cryptomeria*, *Arthrotaxis*, and nearly all Cupressineæ, the stomata are distributed without order over the surface of the leaf. In *Dammara*, *Taxodium*, *Araucaria imbricata*, *A. brasiliensis*, *A. Bidwillii*, *Cunninghamia*, and *Sequoia*, the longer axes of the stomata are parallel to one another, in the two first usually at right-angles to the direction of the vascular bundles, in the rest parallel to it. In *Pinus*, *Picea*, *Cedrus*, *Larix*, *Abies*, *Tsuga*, *Pseudotsuga*, *Saxe-Gothea*, *Taxus*, *Cephalotaxus*, *Torreya*, *Sciadopitys*, and *Podocarpus*, they are in longitudinal rows, parallel to the vascular bundles. Three different forms of guard-cell are described and figured.

The epidermal cells are nearly always lignified and thickened on the outer side; beneath them is a hypodermal bast-layer, the cells of which are lignified, and lengthened in the longitudinal direction of the leaf. A few cases of exception to both rules are given.

* Bot. Centralbl., xxiv. (1885) pp. 54–9, 85–8, 118–22, 149–53, 180–5, 214–8, 243–9, 310–2 (2 pls.).

The assimilating parenchyma lies on the side exposed to the light, and, where only one side is so exposed, has the ordinary palisade-form, of which there are several varieties. In *Pinus*, *Picea*, *Cedrus*, *Larix*, *Pseudolarix*, *Abies*, *Tsuga*, *Pseudotsuga*, *Cunninghamia*, *Sciadopitys*, and *Gingko*, the vascular bundle is surrounded by a lignified protecting sheath, usually consisting of cells varying in size and number, in which the bordered pits are irregularly disposed over the lignified cell-wall. The xylem usually occupies the part of the bundle nearest the upper surface of the leaf, and consequently facing the stem; in *Sciadopitys* the reverse; the position of the "transfusion-tissue" in relation to the bundle varies greatly; in Abietineæ its walls are always provided with bordered pits; in Taxineæ they are reticulately thickened. Sclerenchymatous cells are sometimes imbedded among the parenchymatous cells.

The position of the resin-passages corresponds to that described by Thomas and Meyer. A sheath of bast-cells occurs only in *Pinus* and some species of *Picea;* these cells are slightly thickened in *Cedrus* and *Sciadopitys;* the outer layer of cells surrounding the resin-passages is lignified in *Tsuga*, *Arthrotaxis latifolia*, *Sequoia sempervirens*, *Torreya*, and *Gingko*. The resin-passages are not lignified in *Abies*, *Larix*, *Pseudolarix*, *Pseudotsuga*, *Araucaria*, *Cryptomeria*, *Dammara*, *Sequoia gigantea*, *Taxodium*, *Dacrydium*, *Saxe-Gothea*, and *Podocarpus*.

Peculiar Epidermal Organ.*—Herr G. Ebel describes a peculiarity of the epidermal cells of various species of *Eriocaulon*, which is probably of mechanical significance. These cells have long protuberances on the inner side which project into the tissue of the plant like bristles. They resemble in form the cells of a palisade-parenchyma, but always remain in connection with the epidermal cells, and are, like them, thick-walled and destitute of chlorophyll. Each epidermal cell has either one or two of these appendages. In other instances they were shorter.

Aril and Seed of the Nutmeg.†—Herr A. Tschirch finds the epidermis of the aril of *Myristica fragrans* to consist of several layers of cells, beneath which are delicate vascular cells, large oil-cells, and fundamental tissue. The cells of the latter contain a protoplasmic matrix, imbedded in which are grains, from 2 to 10 μ in size, of a peculiar substance, shown, by their microchemical reactions, to belong to a peculiar group of albuminoids.

The cells of the endosperm are filled with starch, oil, and grains of aleurone, with some protoplasmic residue. The aleurone-grains contain either a number of small crystalloids or a single solitaire.

Phylloclades of Phyllanthus.‡—Herr H. Dingler describes in detail the flat leaf-like shoots that go by this name in the section *Xylophylla* of *Phyllanthus*, especially with reference to the course of

* Versamml. Deutsch. Naturf. Strassburg, 1885. See Bot. Centralbl., xxiv. (1885) p. 288.

† Ibid., p. 313.

‡ Dingler, H., 'Die Flachsprosse der Phanerogamen. Heft 1, Phyllanthus, sect. Xylophylla.' 153 pp. (3 pls.), 8vo, München, 1885.

the fibrovascular bundles. Growth takes place apically from a tetrahedral apical cell. The larger number of species of *Phyllanthus*, characterized by phylloclades, grow in moist rather than in dry climates.

β. Physiology. *

Excretion of masses of Sexual Protoplasm before and during Impregnation.†—Herr A. Dodel-Port illustrates this phenomenon from a large number of types in both the animal and vegetable kingdoms.

In the Peronosporeæ the male fertilizing substance consists only of idioplasm, the nutrient protoplasm remaining behind; in the female organ the periplasm must be regarded as the analogue of the "excretion-substance" of *Ulothrix* and *Sphæroplea*. In the Saprolegnieæ, the author considers that a sexual process takes place, and the excretion of sexual protoplasm is in most cases reduced to the expulsion of water. In the Zygomycetes the separation of the resting-spore from its parent-cells must be regarded as a phenomenon of excretion. In the lowest sexual stage of vegetable life, the Gamosporeæ, where conjugation takes place between two similar swarm-spores, as *Ulothrix*, *Acetabularia*, *Enteromorpha*, *Ulva*, *Cladophora* (?), &c., the excretion-substance appears to be represented only by the so-called "vesicle" of the sexual parent-cells.

The Algæ display a higher stage. In *Spirogyra Heeriana*, during coalescence of the conjugating cells, an excretion of protoplasm always takes place. In *Craterospermum* and *Staurospermum* only the chlorophyll-plates coalesce, while the protoplasmic utricle of the conjugating cells remains behind as useless. In *Sirogonium* a much more copious excretion takes place, the male cell throwing off two and the female cell one sterile cell. In *Sphæroplea* the male cells throw off almost the entire nutritive protoplasm, and consist of idioplasm only, the ovum-cell becoming the chief bearer of the nutritive protoplasm. In the Œdogonieæ, Vaucheriaceæ, and Fucaceæ, the excretion from the protoplasm of the ovum-cell is much more striking; and in Characeæ only a portion of the protoplasm of the male cells is used in the production of antherozoids, the rest being excreted as useless.

In the Archegoniatæ we have a still further step. The excretion in the female protoplasm is preceded by a division of the nucleus and the formation of the ventral canal-cell, which may be regarded as a true excretion-substance. In Gymnosperms the whole of the pollen-tube, except the nucleus which enters the ovum-cell, constitutes the male excretion-substance. In the embryo-sac of Angiosperms the daughter-nucleus which moves towards the pole after the first division of the nucleus appears to be the carrier of the female idioplasm. It

* This subdivision contains (1) Reproduction (including the formation of the Embryo and accompanying processes); (2) Germination; (3) Nutrition; (4) Growth; (5) Respiration; (6) Movement; and (7) Chemical processes (including Fermentation).

† Dodel-Port, A., 'Biologische Fragmente,' Part II. (24 figs.). Cassel and Berlin, 1885. See Bot. Centralbl., xxiv. (1885) p. 132.

divides into two, and each of these again into two derivative nuclei; three of these constitute the "egg-apparatus"; the fourth, which again moves to the centre of the embryo-sac, is the last product of excretion. Of the contents of the pollen-tube, the larger part is again excretion-substance.

In the higher types it would appear as if the excretion of protoplasm from the female cell before impregnation had for its object simply to form a nidus for the reception of the male fertilizing agent.

Hybrid-pollination.*—Prof. E. Strasburger describes the conditions under which it is possible for the pollen-grains of one species to germinate on the stigma of another species, and the pollen-tubes even to reach the ovules. Special contrivances to prevent the access of foreign pollen are unnecessary, since pollen of the same species always has an advantage over foreign pollen. Hybrids are comparatively very rare in nature, even in those species which display the greatest tendency to hybridization.

Lathyrus montanus will put out pollen-tubes which will reach to the ovary of *Convallaria latifolia;* and those of *Agapanthus umbellatus* will penetrate deep into the style of *Achimenes grandiflora*. Those of *Fritillaria persica* will not only enter the ovary of species of *Orchis*, but will even excite the development of the ovules and will cause them to begin to swell. The pollen-grains of *Achimenes grandiflora* will not, on the other hand, penetrate the stigma of *Agapanthus*.

The possibility of the pollen-grains of one species or genus developing tubes on the stigma of another species or genus does not depend on the possibility of hybridization between them. *Orchis Morio* produces no pollen-tubes on *O. fusca*, while, on the contrary, the pollen-tubes of the latter enter the ovary of the former species, cause the normal development of ovules, and occasionally even impregnate them. As a rule, the pollen-tubes penetrate into the style or even the ovary to a depth proportional to the relationship of the species, though this is not without exception, as in the case of *Lathyrus montanus* and *Convallaria latifolia*, and therefore cannot be regarded absolutely as a measure of sexual affinity.

That varieties of the same species exhibit greater capacity for exciting the development of pollen-tubes than species of the same genus, depends simply on a greater resemblance in the composition of the nutrient material furnished to the pollen-grains and tubes by the stigma and style. Hybridization is an evidence of sexual affinity, while its non-occurrence is no evidence of the absence of affinity.

Unisexual Flowers and movements of the Stamens in Anemone.†—Dr. S. Calloni states that it is quite common, towards the end of March or beginning of April, to find flowers of *Anemone hepatica* which have become unisexual by the complete suppression of the stamens, and distinguished at once from the hermaphrodite flowers by their small size. He also observed a slow motion of the stamens in

* Versamml. Deutsch. Naturf. Strassburg, 1885. See Bot. Centralbl., xxiv. (1885) p. 285.

† Arch. Sci. Phys. et Nat., xiii. (1885) pp. 409–14.

this species, of the kind known as automatic, and evidently intended to render self-fertilization possible. Similar movements, but less pronounced, were observed in *A. nemorosa* and *ranunculoides*.

Self-fertilization in Orchideæ.*—Mr. H. O. Forbes describes the contrivances to assist fertilization in a number of tropical orchids from Java. *Phaius Blumei* furnishes a very remarkable instance of an orchid which has every facility for attracting insects, a large showy flower with some perfume and a distinct nectary, which appears, however, never to be visited by insects, but to be always self-fertilized. As a general conclusion, Mr. Forbes states that many orchids with showy flowers never set their seeds, while many genera are always self-fertilized, and in many cases cannot be fertilized in any other way. The great family of Vandeæ, however, seem rarely, if ever, to be self-fertilized; they are either cross-fertilized or do not produce fertile seeds.

Morphology and Physiology of Germination.†—Herr G. Klebs classifies flowering plants under the following heads in relation to the phenomena connected with their germination:—

I. Germination with two or more cotyledons.
   A. Cotyledons above-ground (five types).
   B. Cotyledons under-ground, and serving only as reservoirs of food-material.
II. Dicotyledons, with one or both cotyledons rudimentary (parasites, saprophytes, &c.).
III. Monocotyledons (seven types).

The author then describes in detail the following points connected with germination:—The fixing of the seed in the soil and the absorption of water; the first emergence of the seedling; the fixing of the seedling in the soil, and the absorption of the endosperm; the emergence of the cotyledons from the seed and the penetration of the soil; the unfolding of the cotyledons and of the first leaves above the soil.

Formation and Transport of Carbohydrates in the Leaves.‡—Dr. A. F. W. Schimper has made a long series of experiments on this subject, the plant observed being chiefly *Impatiens parviflora*. To determine the presence of starch in the cells, the leaves, after extraction with alcohol, were placed in a solution of iodine in aqueous hydrate of chloral (eight parts of chloral to five of water), and left for twelve to twenty-four hours. The leaves, if not too thick, were by this means rendered so transparent that they could be easily examined by the strongest immersion-system, and the chloral causes the starch-grains to swell so strongly that the smallest could be detected by the iodine reaction. The presence of glucose was determined by the sugar-reaction.

The experiments showed clearly that the product of the solution

* Journ. Linn. Soc. Lond. (Bot.), xxi. (1885) pp. 538–50 (1 pl.).

† Unters. aus dem Bot. Instit. Tübingen, i. (1885) pp. 536–635. See Bot. Centralbl., xxiv. (1885) p. 260.

‡ Bot. Ztg., xliii. (1885) pp. 737–43, 753–63, 769–87.

of starch in the leaves was glucose, and that this glucose is transported into the leaf-stalk and stem. This transformation into soluble sugar is undoubtedly due to a diastatic ferment. Further experiments showed that the veins are the sole conduit through which the transport of glucose takes place, and that it occurs almost exclusively in the "conducting sheath" or tissue which encloses the finest ramifications of the vascular bundles as a single layer of cells, the stronger bundles as a tissue composed of several layers. The chlorophyll-grains in this sheath possess only to a small degree the power of forming starch. The transport is the direct consequence of darkness, and the current of assimilated substances takes place practically in the veins, but chiefly in their conducting sheath. The sugar begins to disappear after the complete transformation of the starch; first from the mesophyll and finer veins, then from the stronger veins, gradually from the apex to the base. The cells of the conducting sheath are adapted for their function by a much stronger attractive force for dissolved carbohydrates than those of the mesophyll.

In *Impatiens* the formation of starch is comparatively feeble. Totally different results are obtained from a number of plants where the changes go on with such energy that the glucose is temporarily again transformed into starch in all the cells through which it passes. An extreme case of this is furnished by *Hydrocharis morsus-ranæ*. Here the sheaths of the thicker bundles are found to retain the starch the longest.

With regard to the transport of food-materials by the laticiferous vessels, as assumed by Schwendener * and others, experiments of the author on *Euphorbia Peplus* and *E. lathyris* are quite opposed to the hypothesis.

In a Hepatica, *Plagiochila asplenioides*, the transformation of starch into sugar was also determined. Details are given with regard to the formation of starch and sugar in a number of other plants.

Functions of Chlorophyll.†—Herr C. Timiriazeff sums up the evidence in favour of the view which he has advocated that the decomposition of carbonic acid in the light is effected by the heat-rays of the spectrum, and that their maximum and that of the decomposition of carbonic acid corresponds with the absorption-band of chlorophyll in the red. He criticizes the opposing conclusions of Draper, Pfeffer, N. J. C. Müller, and others.

Temperature of Growing Fruits.‡—Interesting experiments have been tried on the temperature of growing fruits by Dr. W. M. Ord. He used a slender-pointed thermometer, which could be easily thrust into the fruit. The trials were made on cucumbers in a hot-house, and the variations due to fluctuations were indicated by the temperature of a bottle of water suspended at the side of the fruit. A difference of one or two degrees was found between the temperature

* See this Journal, v. (1885) p. 1022.

† Bull. Congrès Internat. Bot. St. Petersburg, 1884, pp. 103–34. See Comptes Rendus, c. (1885) p. 851, and Bot. Centralbl., xxiv. (1885) p. 264.

‡ Brit. Med. Journal, 1885, ii. p. 784. Cf. Bot. Gazette, x. (1885) p. 430.

of green fruit and the air or water in the bottle, the latter two usually varying one way or the other by about a degree; a difference of a degree was also recorded between the two extremities of the fruit, which represent different stages of growth. This is suggestive of an interesting line of research.

Respiration of Leaves in the Dark.*—Experiments were undertaken by MM. P. P. Dehérain and L. Maquenne to ascertain whether any of the carbonic acid produced by green leaves was retained by them. A known quantity of the leaves of *Euonymus japonica* was placed in a known volume of pure air; this air was then analysed. The leaves were then placed in vacuo, when the remainder of the air retained by the leaves was extracted and analysed. The relation between the "apparent ratio" (first result) to the "real ratio" (both results together) was found to depend on the ratio of the volume of the leaves to the volume of space in which they were confined. Leaves placed in an atmosphere of carbonic acid, in the dark, absorb a considerable quantity of the gas.

Intramolecular Respiration.†—Herr W. Pfeffer has tested the conclusions on this subject of Mr. W. P. Wilson by the method of passing alternately a current of air and of hydrogen over plants, and absorbing by baryta-water the carbonic acid produced. Designating the carbonic acid produced by normal respiration, by N, and that produced by intramolecular by I, then the proportion $\frac{N}{I}$ differs for different plants, though almost always less than unity; *Vicia Faba* being the only plant in which it approached unity. With seedlings of *Sinapis alba* it was 0·177; with *Abies excelsa*, 0·077; with leafy shoots of *Ligustrum vulgare*, 0·816; with beer-yeast, 0·31; with *Cantharellus cibarius*, 0·666. Intramolecular respiration is not a phenomenon of decadence, but is connected with the vitality of the cells. The author regards respiration as a true process of direct oxidation.

Respiration of Plants.‡—Pursuing their researches on this subject, MM. G. Bonnier and L. Mangin confirm their previous conclusions that at any given moment for the same individual the relation $\frac{CO_2}{O}$ is independent of temperature, pressure, and light, equally for all kinds of plants and for all parts of the plant. They now find, in *Pinus maritimus*, the same results at all temperatures between zero and 36° C., and in the ivy between zero and 35° C. These conclusions are also now confirmed by the results obtained by MM. Dehérain and Maquenne.§

* Comptes Rendus, ci. (1885) pp. 887–9. Cf. this Journal, v. (1885) p. 678.

† Unters. aus d. Bot. Inst. Tübingen, i. (1885) 50 pp. (1 fig.). See Bot. Centralbl., xxiv. (1885) p. 161.

‡ Comptes Rendus, ci. (1885) pp. 1173–5. Cf. this Journal, v. (1885) p. 835.

§ See this Journal, v. (1885) p. 678.

Aerotropism.*—Dr. H. Molisch's researches on this subject are now published more at length and in great detail.

Godlewski's Theory of the Motion of Water in Plants.†—Herr A. Zimmermann claims to show that Godlewski's theory is a physical impossibility. The assumption that when water is driven out of the cells of the medullary rays it passes entirely or chiefly into the upper tracheids, and conversely when it is absorbed by these cells, involves a more rapid increase of the air-pressure in the tracheids downwards than can occur in nature.

Circumnutation of Etiolated Seedlings.‡—By experiments on young plants of *Polygonum Fagopyrum*, *Tropæolum majus*, and *Brassica Napus* growing in a warm chamber lighted only with red light, Herr F. Noll has determined that the circumnutation characteristic of twining stems may be induced also in ordinary shoots made to grow abnormally in vital conditions otherwise favourable. He finds in this an explanation of the occurrence of climbing plants in isolated genera of widely separated natural orders.

Influence of Gravitation on the Movement of Floral Organs. § — M. J. Dufour finds a remarkable diversity in the way in which the floral organs of plants are affected by gravitation, some appearing to be entirely uninfluenced by it. The cause of this diversity appears to be connected with some unknown factors in the way in which geotropism works.

Insufficiency of the Imbibition Theory.‖—Herr M. Scheit adduces further arguments against the theory that the motion of the sap in wood is due to currents in the cell-walls themselves. These arguments are derived from the extent to which cell-walls increase in size when permeated by water, from the fact that these membranes are, even in the living plant, in a dead state, and from other considerations.

Mechanism of Twining Plants.¶—Herr J. Wortmann proposes the following as an adequate explanation of the phenomena of twining stems. The movement is brought about by a combination of negative geotropism and circumnutation. In every smallest transverse section of the growing part of a twining stem, these two forces combine in such a way that at the apex of the stem circumnutation is much stronger than negative geotropism, the latter increasing in force towards the base, and therefore in older internodes. The consequence of this is a modification of the ordinary movement of growth, each smallest transverse section of the twining stem having

* SB. K. Akad. Wiss. Wien, xc. (1884) pp. 110–96 (1 pl.). Cf. this Journal, v. (1885) p. 96.

† Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 290–2. Cf. this Journal, v. (1885) p. 490.

‡ Bot. Ztg., xliii. (1885) pp. 664–70.

§ Arch. Sci. Phys. et Nat., xiv. (1885) pp. 413–24. Cf. this Journal, v. (1885) p. 272.

‖ Jenaisch. Zeitschr. f. Naturwiss., xix. (1885) pp. 166–73. Cf. this Journal, v. (1885) p. 679.

¶ Versamml. Deutsch. Naturf. Strassburg, 1885. See Bot. Centralbl., xxiv. (1885) p. 252.

the tendency to grow not in a straight line, as is the case with ordinary orthotropous internodes which do not twine, but in a spiral, which is very flat at the apex from the combination of the two forces, but becomes gradually steeper and steeper towards the base.

If a stem growing in such a spiral meets with no support, but is at the same time protected from falling, it will, after its growth in length is completed, assume a straight and vertical position, like any other orthotropous stem, since the spiral line becomes constantly steeper towards the base so long as growth continues and geotropism is also acting. This property enables the strongest twining plants to cling round the slenderest supports. The true object of the support is to act as a hindrance to the straightening of the stem which is growing with a spiral movement. The stoppage of growth by thick supports causes the internodes of stems which coil round them to be usually shorter than those of stems coiling round slender supports. The erect position of the higher internodes prevents the terminal bud ever being at a great distance from the support. The torsions so often observed in climbing plants are of secondary importance in the process of coiling.

Mechanism of Twining.*—Herr H. Ambronn discusses all the previous theories on this subject, and confirms Baranetzki's statement that the circumnutation of twining plants ceases when they are made to rotate slowly round a horizontal axis. He considers the movement of twining to be made up of three factors, viz. (1) circumnutation; (2) negative geotropism; (3) the resistance offered by the support to the movements of the apex of the shoot. The part played by these three factors is discussed in detail.

Sensitiveness to Contact.†—Herr W. Pfeffer insists on the distinction between sensitiveness to contact and sensitiveness to impact ("Stossreize"). The first is the result of continuous contact with a solid body, as in the case of tendrils; the second of momentary powerful action, as in the sensitive plant. Static pressure does not bring about the second kind of irritation when it is unequal, and consequently causes unequal pressure on neighbouring points. This was proved by the pressure of water, mercury, and gelatin. In the case of tendrils the weight of the body is no factor in the sensitiveness. Pieces of cotton-wool of the weight 0·00025 mgr. produced no effect if carefully placed on the tendril, but did when they caused gentle impact by slight currents of air.

Contrary to the statement of Darwin, the author found the glandular hairs (tentacles) of *Drosera* to have a sensitiveness very similar to that of tendrils, statical pressure producing no effect. Small pearls or splinters of glass only produced irritation of the glands when they caused a rubbing as the result of concussion; fluids producing no effect, as with tendrils.

* Ber. Math.-Phys. Klasse K. Sächs. Gesell. Wiss. Leipzig, 1885. See Bot. Centralbl., xxiv. (1885) p. 81.

† Unters. aus d. Bot. Instit. Tübingen, i. (1885), Heft 4. See Bot. Centralbl., xxiv. (1885) p. 75.

The author considers the conduction of the sensitiveness to be not altogether due to the continuity of the protoplasm from cell to cell, since in the case of *Mimosa* such continuity could not be demonstrated to extend to the epidermis; the sensitiveness is, on the contrary, conveyed through the cell-walls to the protoplasm. In many cases there were found in the tendrils pits in the outer wall of the epidermal cells, which appeared to play a part in the conduction of the irritation. In *Mimosa* the author regards the movement of water as the chief agent in the transmission of the irritation; the protoplasmic threads may have more to do with the sensitiveness of tendrils.

Polarization-phenomena of Tissues.*—Dr. N. J. C. Müller describes the optical properties of various parts of plants which he refers to a small number of types, and traces to the molecular forces which were active in their formation.

Exhalation of Ozone by Flowering Plants.†—Dr. J. M. Anders has repeated his experiments on this subject, the test employed being papers moistened with tincture of guaiacum (8 parts resin to 90 parts alcohol). The general conclusions are that scentless plants exhale only a very small amount of ozone, or none at all; while scented plants, whether flowers or leaves, are powerful generators of ozone. This is especially the case with the pine and the hemlock (*Abies canadensis*). As a control, to insure that the blue colour of the guaiacum-paper was not due to the presence of alkaline substance, reddened litmus-paper was also used.

Disinfection of Plants.‡—Sig. F. Sestini points out the inconveniences of the method of disinfecting vines attacked by *Phylloxera* by means of hydrocyanic acid. He proposes instead the use of sulphocarbonate of potassa, which he prepares in the following way. One part by weight of the sulphocarbonate is dissolved in 400 parts of water, and this must then be applied to the roots or other parts affected so that they are under its influence for about an hour.

Desiccation of Plants in Aqueous Solutions.§—M. A. Levallois finds that if an orange-branch is placed in a concentrated solution of calcium chloride it goes through all the phenomena of withering from loss of water, leaves, stem, and flower all losing weight, the total weight diminishing from 25 to 10·5 grm. Similar results were obtained with leaves of the scented geranium and mint; while flowers by themselves of the rose, jasmine, orange, or tuberose lost but very little in weight, their surface being protected against the action of the calcium chloride. The desiccation of leaves was nearly as great as that caused by a stove, and was in proportion to the desiccation of the solution. After a time, however, an opposite process sets in, and the leaves regain their original weight.

* Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 226–9.
† Amer. Natural., xix. (1885) pp. 858–65. Cf. this Journal, iv. (1884) p. 777.
‡ Atti Soc. Toscana Sci. Nat., iv. (1885) pp. 172–6.
§ Comptes Rendus, ci. (1885) pp. 1175–6.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Antheridia and Antherozoids of the Heterosporous Lycopodiaceæ (Selaginellaceæ).*—Herr W. Belajeff has made a detailed examination of the internal structure and germination of the microspores of *Isoëtes* and *Selaginella*, with a view to reconciling the conflicting statements on some important points of Millardet and Pfeffer. While differing on some points from both these authorities, he agrees much more nearly with the former than with the latter.

Of *Isoëtes* the two species examined were *I. setacea* and *Malinverniana*, in both of which the microspores closely resemble those of *I. lacustris*. The spores have three membranes, epispore, exospore, and endospore: of which the innermost shows the cellulose reaction with zinc chlor-iodide, but neither of the outer ones. The outermost coat, the epispore, is yellowish, and has a fissure through which the exospore projects. In *I. setacea* the epispore is very thick and full of vacuoles. The brown exospore or middle coat is the first formed of the three. In the interior are a number of albuminous granules and a nucleus.

The first process in germination is the separation of a small lenticular cell, the rudimentary prothallium, the rest constituting the antheridium. This then divides into three cells by two oblique walls, and the central of these again divides into two. Each of these four primary cells of the antheridium contains a nucleus; their walls do not show cellulose reaction. By further division the antheridium consists of two internal cells completely surrounded by four outer ones; the two inner ones are hyaline, the four outer ones filled with granular protoplasm. Each of the two inner cells again divides into two; these four all contain nuclei, and are the mother-cells of the antherozoids. The surrounding cells coalesce, by the disappearance of their walls, into a turbid granular mass. The lenticular prothallium remains all this time unchanged. The membrane of the inner cells finally deliquesces and the antherozoids uncoil, two disc-shaped spongy bodies dropping from them at the same time.

The antherozoids of *I. Malinverniana* are remarkably large. They consist of a spirally coiled ribbon-shaped body and a large number of cilia all attached to the anterior end; all of them also coiled, and at first pointing backwards. Attached to the body along its length is a clear ribbon-shaped appendage, which is broadest behind. The antherozoids are in motion only for from three to five minutes, and then coil up to the form they had in the mother-cell. All the nuclein in the nucleus of the mother-cells is used up in the construction of that of the body of the antherozoids. The cilia are formed out of the protoplasm of the mother-cell.

In the microspores of *Selaginella* the author found two types of structure, one represented by *S. Kraussiana* and *Poulteri*, the other by *S. cuspidata*, *lætevirens*, *fulcrata*, *stolonifera*, *Martensii*, *viticulosa*, *inæqualifolia*, and *caulescens*.

* Bot. Ztg., xliii. (1885) pp. 793–802, 809–19 (1 pl.).

The microspores of the first group have three separable membranes, of which the two outer ones are coloured brown, the innermost blue by zinc chlor-iodide. The granular spiny epispore has three fissures uniting at the apex, through which project ridges of the clear homogeneous exospore. The exospore is again the first-formed of the three. The spore contains oil-granules and a nucleus. After the separation of the lenticular prothallium-cell, the antheridium-cell divides first of all into two, and each of these two again into four cells by three oblique walls; these walls again do not show cellulose reaction; each of the cells contains a nucleus. By further division the antheridium consists of four inner cells entirely surrounded by eight outer cells. Each of the four inner cells then divides into a number, the mother-cells of the antherozoids, which float in a granular mucilaginous mass resulting from the deliquescence of the walls of the outer cells.

In the second group of *Selaginella* the microspores have only two separable membranes, the inner one of which only gives cellulose reaction; but the outer one is divided into two layers, the outermost of which is spiny. The processes of internal division are in the main the same as in the first group, but there are only two inner primary, surrounded by eight outer cells; from the two inner ones are developed the mother-cells of the antherozoids. The antherozoids, on escaping, are still enveloped in a small globular membrane; they have only two cilia.

These observations bring the mode of formation of the antheridium in the Selaginellaceæ much more into harmony with that in the other Archegoniatæ than appeared from the descriptions of Millardet and Pfeffer. In all cases the primordial cells of the antheridium arise from a single cell by successive divisions; some of these primordial cells break up, by a wall parallel to the outer surface, into the inner mother-cells of the antherozoids and the outer enveloping cells.

The author considers the establishment of a special class, the Ligulatæ, for the heterosporous Lycopodiaceæ as very unsatisfactory, there being no sufficiently good general characters for it. Nor does he consider the differentiation of microspores and macrospores as a good basis for classification.

Influence of the Direction of the Light on the Division of the Spores of Equisetum.*—According to Prof. E. Stahl, the direction in which the division of the nucleus takes place in the spores of *Equisetum* is dependent on the direction of the rays of light, the two daughter-nuclei lying in that direction. The nucleus at the greater distance from the source of light is that of the root-cell, the one nearer to the source of light that of the prothallium-cell. The former is therefore on the side of the spore which is turned away from the light.

Calamites of the Coal-measures.†—Herr C. E. Weiss enters at great length, and in great detail, into the structure and systematic

* Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 334–40.

† Abhandl. Geol. Spezialkarte v. Preussen, v. (1884), 8 figs. and an atlas of 28 pls. See Bot. Centralbl., xxiii. (1885) p. 310.

position of the fossil Calamarieæ. He regards them as a very large group, varying widely in some points of structure, of which our modern Equisetaceæ represent a strongly differentiated type. The Equisetaceæ are therefore calamites, but it is wrong to speak of the latter as in all cases Equisetaceæ. The leaves only rarely display sheathing coalescence (*Equisetites*); and the spores appear to have been destitute of elaters. The spores are frequently dimorphic. *Volkmannia* and *Sphenophyllum*, as well as the Lycopodiaceæ, the author regards as more nearly related to the true Calamarieæ than had previously been supposed. In some cases the stems show a very similar structure to that of *Equisetum*, in the central cavity, the separate vascular bundles with lacunæ, the peculiar course of the bundles, and the silicification; but in other cases, the structure was widely different. A considerable variety was also displayed in the organs of fructification; and on the characters of the fructification he proposes to base the diagnoses of the genera.

Fructification of Sigillaria.*—M. B. Renault describes in detail the structure of *Sigillaria Menardi*, and derives therefrom confirmation of his previous conclusion that the *Sigillariæ* are a transitional group, and may be divided into two families:—the *Leiodermarieæ*, or phanerogamic *Sigillariæ*, with smooth bark, nearly allied to the Cycadeæ, and the *Rhytidolepidæ* or cryptogamic *Sigillariæ*, with channelled bark, allied to the Isoëteæ.

Algæ.

Protoplasmic Continuity in Seaweeds.†—Continuing his researches on this subject, Mr. T. Hick finds that in *Laminaria digitata* (belonging to the Phæosporeæ) the protoplasts of the cortex are rhizopod-like masses, with pseudopodia spreading in such a manner that the cells of each layer are brought into connection with one another and with those of adjacent layers. Both here and in the cortex continuity is effected by the intervention of sieve-plates; in the epidermal tissue it was not detected with the same certainty. In *Himanthalia lorea* (Fucaceæ) the same phenomena were observed, though by no means so universally.

Cystosira barbata.‡—Dr. A. Dodel-Port has submitted this seaweed to a careful examination, as a type of the Fucaceæ.

The branching is monopodial. The ultimate branches are the organs of assimilation, and bear also the reproductive organs or receptacles at their youngest solid ends.

In the stem four distinct parts are to be distinguished:—(1) A central cylinder of fibre-cells; (2) a layer of thick-walled cells with irregular cavities; (3) the cortical layer, the cells of which become gradually shorter centrifugally, the outermost being isodiametrical and containing chromatophores; (4) the epidermis, not sharply

* Comptes Rendus, ci. (1885) pp. 1176–8.

† Journ. of Bot., xxiii. (1885) pp. 354–8. Cf. this Journal, v. (1885) p. 682.

‡ Dodel-Port, A., 'Biologische Fragmente,' Part I. (10 col. pls.), Cassel and Berlin, 1885. See Bot. Centralbl., xxiv. (1885) p. 129.

differentiated from the cortex, and filled with chromatophores. The epidermis is the chief assimilating organ. The growing point lies in a funnel-shaped depression at the apex of the branch. The barren conceptacles are formed on the young branches in acropetal succession; a bundle of paraphyses projects from their ostiole; and these are continually renewed as the old ones are rubbed off. No transitional structures were observed between the barren and fertile conceptacles. The air-bladders are formed by strong tangential growth of the cortex and epidermis; the central tissue remaining unaffected. A large number of barren, but only a few fertile conceptacles are found on the air-bladders.

The sexual organs are formed from November to May in the solid warty cartilaginous conceptacles; these are from a few millimetres to 2 or 3 centimetres in length, and are usually brightly coloured. The fertile, like the barren conceptacles, are formed in acropetal succession, and have a circular ostiole. The parts of the wall nearest to the ostiole develope a large number of branched antheridial hairs with a few paraphyses; large quantities of oogonia springing from the base, surrounded also by paraphyses. Occasionally some of the conceptacles are unisexual.

After the escape of the antheridia from the conceptacle, they lie before the ostiole in an orange-coloured heap: the oogonia, on the contrary, never collecting round the ostiole. The ripe antheridia are somewhat curved, and the antherozoids are formed in them with great rapidity by bipartition. In *Cystosira* the wall of the antheridium consists of only one layer of cells, the entire antheridium escaping through the ostiole; while in other Fucaceæ the wall consists of two layers which separate from one another, and the inner layer only, with the antherozoids, escapes through an opening in the outer. The antheridia are specifically heavier than sea-water, and are frequently caught when sinking by the tuft of paraphyses projecting from the ostiole of the barren conceptacles; the antherozoids then escaping by the conversion into mucilage of their investing membrane. They are curved and pear-shaped, and contain a colourless corpuscle (nucleolus?) and an orange-coloured eye-spot; they have two cilia of unequal length. The swarming takes place chiefly in the forenoon.

The oogonia are usually sessile and have a distinct nucleus; they are of an olive-brown colour with light-coloured apex. The membrane consists of two layers, both becoming gelatinous when ripe; the nucleus divides in two; the lower portion becomes the true ovum-nucleus, and the upper portion is expelled as the "excretion-substance." In the act of impregnation a number of the antherozoids force themselves into the gelatinous envelope of the oosphere; the cubic contents of the latter exceeding that of a single antherozoid 40,730 times. The actual contact of the antherozoids with the protoplasm of the oosphere was not observed; but apparently the entrance of a single antherozoid is sufficient to cause the excretion of a cellulose membrane; the gelatinous envelope disappearing at the same time. Impregnation usually takes place while the oospheres

are sinking in the water, or when caught by the paraphyses of the barren conceptacles.

The oospores displayed evidences of germination after nineteen hours, putting out a colourless rhizoid. Excluding this, the young plant is not larger than the oospore.

Embryo Plantlets of Fucus.*—Dr. W. R. M'Nab calls attention to young embryo plants of *Fucus vesiculosus*, adhering in considerable numbers to the conceptacular region of the thallus. They probably escape from the thallus after a short adherence.

Durvillæa Harveyi.†—Herr J. Grabendörfer describes in detail the structure of this alga from South Brazil, belonging to the Fucaceæ, from dried specimens and material preserved in alcohol.

The most important point brought out in the structure of the vegetative organs is the absence of an apical growing point such as appears to exist in all other Fucaceæ, with the exception perhaps of *Splachnidium*.

The conceptacles agree in all important points with those of *Fucus*, but are considerably smaller; *Durvillæa* is dicœcious; but no difference is perceptible in the mode of growth of plants of the two sexes. One point of difference from *Fucus* was established, that the contents of the oogonia divide, not into eight, but into four oospheres: viz. first of all into three by two transverse septa, and then the middle one of these again into two by a longitudinal wall.

Lessonia ovata.‡—This seaweed from South Brazil, belonging to the Laminariaceæ, has been subjected to a critical examination by Herr J. Grabendörfer, both in dried specimens and in material preserved in alcohol.

In the structure of the vegetative organs *Lessonia* shows no very marked departure from other genera of the order. It agrees with *Macrocystis* rather than with *Laminaria* in showing a rather marked differentiation between the medullary and the cortical tissues in the stem. The "sorus" consists of two kinds of cells peculiar to it:—(1) the sporangia, ovate cells filled with numerous polyhedral bodies, and at first thin membrane; and (2) the paraphyses, club-shaped cells with moderately thick membrane and brown contents. Both paraphyses and sporangia are formed from epidermal cells.

"Prothallus" of Padina.§—Dr. G. M. Giles describes a structure which he regards as the "prothallus" or sexual generation of *Padina pavonia*, found abundantly on the fronds of the seaweed itself on the coast of British Burmah. They are minute flat bodies, on which were observed peculiar structures which the author considers to be of the nature of antheridia and archegonia. Young fronds of the non-sexual form were found sprouting from the edge of these prothalloid bodies.

* Ann. and Mag. Nat. Hist., xvii. (1886) pp. 163–4.
† Bot. Ztg., xliii. (1885) pp. 609–18, 625–36 (1 pl.).
‡ Ibid., pp. 641–8, 657–64 (1 pl.).
§ Journ. Asiatic Soc. Bengal, liv. (1885) pp. 71–5 (2 pls.).

Endochrome of Diatoms.*—According to Dr. M. Lanzi, the form and arrangement of the endochrome in a large number of species of Diatomaceæ varies according to the age of the individual, being sometimes homogeneous, sometimes divided into a larger or smaller number of distinct species. He regards this as a distinct confirmation of the statement of Castracane† and others, that, in addition to division, conjugation, and reproduction by auxospores, diatoms have another, though rarer mode of multiplication, by non-sexual endogenous spore-formation.

Diatoms in Town Water.‡—Prof. W. I. Macadam mentions the presence of certain diatoms left on the sandy filter through which water supplied to Edinburgh had passed. *Fragilaria capucina* Desm. was most abundant, together with various species of *Cymbella*, *Encyonema*, *Navicula*, *Achnanthes*, *Nitzschia*, and others. He points out that the presence of these is evidence rather of the purity, than of any pollution of the water.

Schmidt's 'Atlas der Diatomeenkunde.'—After a long interval, parts 21 and 22 of this work are now published. They contain eight plates, all of forms of *Triceratium*, including many new varieties. A second edition of the whole work is also being issued.

New Desmidieæ. §—M. Raciborski describes 175 species of Desmidieæ from the neighbourhood of Cracow. Of these twenty-four species are new, viz.—eleven species of *Cosmarium*, seven of *Staurastrum*, one of *Euastrum*, two of *Micrasterias*, one of *Cylindrocystis*, and two of *Penium*.

New Algological Journal—'Notarisia.'—We welcome the appearance of the first number of a new quarterly journal entitled 'Notarisia: Commentarium Phycologicum,' published at Venice, under the editorship of Drs. G. B. De Toni and D. Levi. This number contains a list, with diagnoses, of all new algæ published in 1885, an index of algological literature for the year, and lists of published collections of algæ, with some other matter. The first part of the editors' "Sketches of genera of Florideæ, adapted to Ardissone's 'Phycologia Mediterranea,'" consists of two plates in photo-lithography, with accompanying letterpress, and illustrates the genera *Callithamnion*, *Griffithsia*, *Halurus*, *Crononia*, *Ceramium*, *Centroceras*, *Microcladia*, and *Chantransia*.

Fungi.

Behaviour of the Nucleus in the Coalescence of the Cells of Fungi. ‖—Herr C. Fisch has investigated this process in a number of fungi, with a view to determine the existence or otherwise of a true

* Atti Accad. Pontif. Nuov. Lincei, xxxvii. (1885) 6 pp.

† See this Journal, v. (1885) p. 1041.

‡ Proc. R. Phys. Soc. Edinburgh, 1885, p. 483–5.

§ Ber. Phys. Com. Akad. Wiss. Krakau, xix. (1885) pp. 3–24 (5 pls.). (Polish with Latin diagnoses). See Oester. Bot. Zeitschr., xxxv. (1885) p. 438.

‖ Versamml. Deutsch. Naturf. Strassburg, 1885. See Bot. Centralbl., xxiv. (1885) p. 221.

act of sexual conjugation. The staining material used was various preparations of hæmatoxylin.

In *Pythium* (with which *Cystopus* appears to agree) the nuclei occur in considerable numbers in the mycelium, each having a very large nucleolus. In young oogonia, before the formation of the oospheres, the number is usually from ten to twenty. When the oosphere is being formed, they collect together and coalesce into a single large ovum-nucleus. In the antheridial cell only a single nucleus was found, but this was probably the product of the coalescence of several. This nucleus passes, with the gonoplasm, into the oosphere, and coalesces with the ovum-nucleus.

Among Ustilagineæ, *Tilletia*, *Urocystis*, *Ustilago*, and *Protomyces* were examined. The spores of these appear to contain only a single nucleus, while the mycelial cells usually contain several, as also those of the promycelium, and usually those of the sporidia. In the "copulation" of the sporidia and mycelial cells, no coalescence of nuclei was ever observed. In the mycelium which is formed subsequently to "copulation," a number of nuclei generally enter with the protoplasm, and are separated from one another by protoplasm, so that here there can also be no coalescence. In the Hymenomycetes also nothing of the kind was observed.

The general conclusion of the author is that in *Pythium* and its allies there is a true process of sexual union; but not in the Ustilagineæ and Hymenomycetes.

Classification of the Discomycetes.*—M. E. Boudier insists on the importance of the mode of dehiscence of the ascus in the classification of this family. In the fleshy Discomycetes there are only two modes of dehiscence of the ascus—by a kind of apical operculum, and by a foramen or perforation of the cell-wall at the apex. These two groups, the *Operculata* and *Inoperculata*, are well defined, and the tribes and genera may be further distinguished by characters drawn from the receptacle, the form of the ascus, the paraphyses, and the spores. The terrestrial Discomycetes, of a soft or waxy consistence, belong to the Operculata; whilst the epixylous or epiphytal species, of more elastic consistence, which approach the Pyrenomycetes, come under the Inoperculata. The whole group may be divided into six tribes, as follows:—

I. Operculata.

1. *Mitreæ*:—Morchelleæ and Helvelleæ.
2. *Cupuleæ*:—Rhizineæ and Peziceæ.
3. *Lenticuleæ*:—Ciliarieæ, Humarieæ, and Ascoboleæ.

II. Inoperculata.

4. *Clavuleæ*:—Geoglosseæ and Leotieæ.
5. *Carnoseæ*:—Ombrophileæ and Callorieæ.
6. *Gathuleæ*:—Helotieæ, Dasyscypheæ, and Urceoleæ.

* Bull. Soc. Mycol., 1885. See Bull. Soc. Bot. France, xxxii. (1885). Rev. Bibl., p. 129.

Aspergillus Oryzæ.*—Herr M. Büsgen has investigated the properties of this mould, the agent in the fermentation of the Japanese drink "saké." The mycelium consists of branching and septated filaments 7μ in thickness; the conidiophores attain a length of 1 mm., and the heads of conidia resemble those of *A. repens.* The sterigmata are unbranched, and the greenish-yellow conidia 5–7μ in diameter, and finely verrucose. Perithecia have not been observed. The author considers it certain that this fungus is a producer of diastase.

Poisonous Properties of the Morel.†—Herr E. Jacobasch has investigated the alleged poisonous properties of *Helvella esculenta.* He concludes that in all circumstances it is extremely dangerous to eat the freshly-gathered fungus raw. Hot water dissolves out a substance which renders it extremely poisonous. If kept for a fortnight it is still dangerous; and it is only when kept for six or twelve months that it can be eaten without suspicion.

Peziza baccarum.‡—Dr. M. Woronin describes the hitherto undetected gonidial form of this fungus, the sclerotia of which cause the bleaching of the fruits of *Vaccinium Myrtillus* var. *leucocarpum.* The conidia can be made to germinate in water, and produce round spermatia-like sporidia. Their germination on the stigma of the *Vaccinium* produces filaments which penetrate into the ovary, and there give rise to sclerotia which almost entirely replace the tissue of the berry. Similar parasites attack also the berries of other species of *Vaccinium.*

Agaricus cirrhatus, a new phosphorescent Fungus.§—Dr. F. Ludwig found a number of specimens of *Agaricus* (*Collybia*) *cirrhatus* Pers., the long slender bent stipites of which sprang from small pale-yellow or reddish-yellow sclerotia. In the dark, distinct phosphorescence was exhibited by the sclerotia at the spots from which the fructifications sprang, and by the pieces of moss and decaying grass-stems, &c., in connection with them.

Pestalozzia.‖—Sig. P. Voglino publishes a monograph of this genus of Fungi, in which the following new species are described, viz.—*P. Montellica*, on oak-leaves near Treviso; *P. affinis*, on grape-clusters and nut-branches in France; and *P. abietina*, on fir-cones in Northern Italy, Carinthia, and North America. The author retains the three subgenera of Saccardo, viz. Eu-pestalozzia, Monochætia, and Pestalozzina.

Bommerella, a new genus of Pyrenomycetes.¶—M. E. Marchal gives the following description of this new genus:—"Fungus conidio-

* Ber. Deutsch. Bot. Gesell. Generalversammlung, 1885, pp. lxvi.–lxxi. Cf. this Journal, v. (1885) p. 1045.

† Verhandl. Bot. Ver. Prov. Brandenburg, xxv. (1884) pp. ii.–viii.

‡ Ber. Deutsch. Bot. Gesell. Generalversammlung, 1885, pp. lix.–lxii.

§ Hedwigia, xxiv. (1885) pp. 250-1.

‖ Atti Soc. Veneto-Trentina Sci. Nat., ix. (1883), Fasc. 2 (3 pls.). See Bot. Centralbl., xxiv. (1885) p. 34.

¶ CR. Soc. R. Bot. Belgique, 1885, pp. 169–70.

phorus *Oosporam* exhibens. Perithecia superficialia, sparsa, ostiolata, contextu parenchymatico fuligineo setis vestita. Asci octospori, pedicellati, aparaphysati. Sporæ eximie triangulares, depressæ. Partibus externis sat similis est *Chætomio* a quo sporarum forma mox dignoscitur." The only species, *B. trigonospora*, was found on hare's dung.

Tubercularia persicina Ditm.*—Prof. C. Gobi finds this fungus associated with and parasitic on the æcidia and spermogonia of *Puccinia Poarum* parasitic on *Tussilago Farfara*, and also in the tissue of the leaves themselves, usually on the under side. The pustule consists of a delicate mycelium composed of fine septated much-branched hyphæ, forming a weft which is especially dense immediately beneath the epidermis. The spores are produced in great numbers beneath the epidermis, which they push up and rupture; but they do not constitute a powdery mass, being imbedded in a hyaline mucilaginous jelly. The ripe spores are round, oval, or pear-shaped, of a delicate lilac colour, with a thick smooth membrane, and about 6 μ in diameter. In hot dry weather the formation of spores is suppressed, and the fertile hyphæ become divided by septa and assume a lilac colour. This process advances from the periphery of the pustule inwards, gradually forming a pseudo-parenchymatous structure or sclerotium. In damp weather these sclerotia are reproductive, putting out germ-tubes, from the ends of which conidia are abstricted. The so-called "sporidia" are simply vegetative cells of the promycelium, and have no sexual functions.

The author found this fungus also on *Sorbus Aucuparia*, *Paris quadrifolia*, and *Cirsium oleraceum*. Its true systematic position he considers to be among the Ustilagineæ, and proposes for it the generic name *Cordalia;* this genus and *Entyloma* forming together a group with spores enveloped in mucilage, which represents a transition from the Ustilagineæ to the Tremellini.

Basidiobolus, a new genus of Entomophthoreæ.†—Dr. E. Eidam describes a very peculiar fungus found on the excrement of frogs, to which he gives the name *Basidiobolus ranarum*. The conidia are produced singly on conidiophores elevated in the air; beneath each conidium is a swollen basidium, which, when ripe, is violently detached along with the conidium, the conidium being again severed from its basidium in the act of being thrown off. The conidia may be germinated in a nutrient solution, and in two or three days again produce on the mycelium conidiophores and an extraordinary number of resting-spores.

The resting-spores or zygospores are produced on the mycelial filaments. Two adjacent cells on the same filament put out each a beak-like protuberance close to the septum between them, and become gametes. One of the gametes always swells up to a spherical form close to the septum, while the other remains small; true conjugation

* Mém. Acad. Imp. Sci. St. Petersbourg, xxxii. (1885) No. 14, 25 pp. (1 col. pl.).

† SB. Schles. Gesell. f. Vaterl. Cultur, Nov. 5, 1885. See Bot. Centralbl., xxiv. (1885) p. 284.

takes place between them by the coalescence of their contents after resorption of the septum; the apices of the protuberances, however, remain, and are shut off as small cells. The spherically swollen cell then becomes separated as a zygospore, excretes a thick stratified cell-wall, which becomes brown and covered with conspicuous warts, and which always possesses the characteristic beak. The direct production of zygospores from conidia was also observed, without the intervention of a mycelium.

New Genera of Fungi.*—Among a number of new species of fungus from the province of Venice, Sig. G. Bizzozero describes the following new genera:—

Testudina (Perisporiaceæ). Perithecia sparsa v. sæpius dense gregaria, superficialia, carbonacea, astoma, globosa v. pyriformia, dein in areolas subpentagonas regulariter rupta, basi subnuda. Asci globosi-clavati, stipite articulato, longo, subinde ramoso inserti. Sporidia ellipsoidea, 1-septata, fuliginea, asperula. On decaying yew-leaves.

Cytoplea (Sphæropsideæ). Stroma subsuperficiale, pulvinatum, confluendo effuso-crustaceum, intus monostiche multi-locellatum; loculis plus v. minus distincte cuboideis. Sporulæ ovoideo-oblongæ, continuæ, olivaceo-fuligineæ, initio subcatenulatæ, stipitatæ et filiformi-paraphysatæ.

Dacrymycella (Hyphomycetes?). Acervuli discoidei, rubro-rosei, superficiales, subinde confluentes, initio subgelatinosi, sicci duriusculi, nitidi. Basidia distincte et longe ramosa, filiformia, ubique, basi excepta, verruculoso-conidifera. Conidia subrotunda, hyalina.

New Genera of Fungi.†—In the second series of Sigg. P. A. Saccardo and A. N. Berlese's 'Miscellanea Mycologica,' a large number of new species are described, together with the following new genera:—Among Australian fungi, chiefly collected by Scortechini in South Queensland:—*Scortechinia*, belonging to Sphæriaceæ, with the single species *S. acanthostroma*, on the bark of trees; *Gibellia*, intermediate between *Botryosphæria* and *Cryptosporella*, on decorticated twigs; *Gamospora*, belonging to Sphæropsideæ, a peculiar genus, in which the stylospores are formed, as in Basidiomycetes, in twos or threes on the apices of basidia; a single species, *G. eriosporoides*, on unknown coriaceous leaves. Among North American fungi, from various collectors:—*Martindalia*, a genus of Hyphomycetes, with one species *M. spironema*, on an elm-wood vessel in a cellar; *Periconiella*, also belonging to the Hyphomycetes, parasitic on living leaves, already described by Winter as a species of *Periconia; Scoriomyces*, a very remarkable genus of quite uncertain position; the only species, *S. Cragini*, on the bark of *Rhus venenata*. Among Italian fungi from the province of Padua:—*Uncigera*, belonging to Hyphomycetes, the single species, *U. Cordæ* (*Fusisporium uncigerum* Corda) on elm-leaves.

* Atti R. Istit. Veneto, iii. (1885) (2 pls.). See Bot. Centralbl., xxiv. (1885) p. 289.

† Atti R. Istit. Veneto, iii. (1885) (4 pls.). See Bot. Centralbl., xxiv. (1885) p. 199.

New Fungi.*—Herr H. Zukal describes the following new species of fungus, viz.—*Erythrocarpon microstomum*, *Microascus longirostris*, *Sporormia immersa*, *Melanospora ornata*, and *M. Solani*, also the pycnidia of *Sphæronema vitreum*. Two new Myxomycetes are also described, viz. *Trichia nana*, near to *T. fallax*, and *Amaurochæte speciosa*, distinguished by the structure of its capillitium; and a new bacterium, *B. tortuosum*, forming zooglœas, and well marked by the ribbon-like arrangement of the separate individuals.

Heterœcious Uredineæ.†—Pursuing his investigations of the life-history of these fungi, Herr E. Rostrup has made out that several species of *Cæoma* are æcidial forms of *Melampsora*, *M. Capreæarum* DC., for example, growing on *Salix cinerea* and *S. Capræa*, is the second generation of *Cæoma Euonymi;* another species growing on *S. mollissima*, *viminalis*, and other species, is identified with *C. Ribesii* Lk. found on *Ribes Grossularia* and *alpinum;* a *Melampsora* occurring on *Populus tremula* and *alba* has its æcidial form in *Cæoma Mercurialis* Pers.; while *C. pinitorquum* is connected genetically with a *Melampsora* growing on *Populus*.

Puccinia dioica Magn. was found on *Carex dioica*, and in close proximity specimens of *Cirsium palustre* attacked by a rare æcidium which is probably connected with it. A new æcidium, *Æ. Cinerariæ*, was found on *Cineraria palustris*, and close by *Eriophorum angustifolium* attacked by *Puccinia Eriophori*.

The author makes the observation, in conclusion, that it is not uncommon, in experimental sowings, for the spores to germinate in the leaves of plants which are not normally attacked by them, and there to produce spermogonia and uredospores in small quantities; and this may occur also in nature. Thus among a number of specimens of *Senecio vulgaris* largely attacked by *Coleosporium Senecionis*, was one of *Crepis tectorum*, a single leaf of which bore a single sorus of the parasite; *Gymnosporangium clavariæforme* produces, on pear-leaves, only spermogonia, not rœsteliæ; and *Cromartium ribicola*, very common on *Ribes nigrum*, occurs only rarely and exceptionally on other species of the genus.

New Uredineæ.‡—Herr W. Voss describes a new species of Uredineæ, *Puccinia* (*Pucciniopsis*) *carniolica*, found on *Peucedanum Schottii*, in two of its forms, the hymenium-form (*Æcidium Peucedani*) and the teleutospore form. Also the three forms of *Uromyces* (*Euuromyces*) *Cytisi* Schröt., viz.:—the hymenium-form (*Æcidium Cytisi*), the stylospore-form, and the teleutospore-form (*Uredo Cytisi* DC., *U. Laburni* DC., *Uromyces Laburni* Fck., *U. Cytisi* Schröt.). He also gives the distinguishing diagnoses of the following species of *Puccinia*, viz.—*P. Falcariæ*, *P. carniolica*, *P. Bunii*, and *P. Smyrnii*.

* Verhandl. K. K. Zool.-Bot. Gesell. Wien, xxxv. (1885) pp. 332–45 (1 pl.). See Oester. Bot. Zeitschr., xxxvi. (1886) p. 64.

† Overs. K. Dansk. Vidensk. Selsk. Forhandl., 1884 (1 pl.). See Bot. Centralbl., xxiv. (1885) p. 97. Cf. this Journal, iv. (1884) p. 421.

‡ Oester. Bot. Zeitschr., xxxv. (1885) pp. 420–3.

Gymnosporangia of the United States.*—Prof. W. G. Farlow has pursued his experiments of sowing various species of *Gymnosporangium* on different trees belonging to the Rosaceæ. Spermogonia showed themselves on *Cratægus oxyacantha*, *Douglasii*, and *tomentosa*, after sowing with the spores of *Gymnosporangium fuscum* var. *globosum*, *macropus*, and *clavipes*, and on *C. tomentosa* and *Amelanchier canadensis* with the spores of *G. biseptatum*. *G. Ellisii* gave no result.

The author believes the æcidium of *G. biseptatum* to be probably *Rœstelia botryapites*, that of *G. globosum* to be *R. aurantiaca*, and that of *G. macropus* to be a *Rœstelia* growing especially on the plum and on *Amelanchier*.

The author has found in the White Mountains a *Peridermium* growing on *Abies nigra*, resembling *P. abietinum*, associated in Europe with *Chrysomyxa Rhododendri* and *Ledi*. *C. Ledi* was found in the same region, in June, on *Ledum latifolium*. In July the leaves of the same *Ledum* no longer exhibited the *Chrysomyxa*, but two uredos, *Uredo ledicola* on the upper surface, and on the lower surface another apparently distinct species.

Elaphomyces and Fir-roots.†—Herr M. Reess regards the hyphal covering so frequently found on the roots of firs as *Elaphomyces granulatus;* and though it is probable that in the other trees in which this phenomenon is known, the species of fungus may be different, he has always found this present in the neighbourhood of *Monotropa*. He describes further the development of the fructification, which at first has no immediate contact with the root, but is at length always enveloped in the hyphal root-cover.

Apple-scab and Leaf-blight.‡—Mr. W. Trelease has carefully investigated this disease, caused by *Fusicladium dendriticum*. He describes in detail the blotches on the leaves and on the fruit, which are due to the same cause. The effect of the parasite is to remove all the products of assimilation from the leaves, and hence render them functionless. In the fruit it does not penetrate below the epidermal cells, but obtains nourishment from the hypodermal cells, which it kills. It does not injure the seeds. In older fruits the part infected by the parasite is usually thrown off and replaced by cork. The spores appear to be retained and to germinate in depressions of the epidermis caused by the puncture of insects or by lenticels.

New Fungus parasitic on the Olive.§—Under the name *Inzengæa asterosperma*, Sig. A. Borzì describes a new species and genus of fungus which forms a dense mould on olives. The mycelium is septated and much branched, and gives a beautiful blue colour with iodine. The conidiophores arise erect, a number being united on the same stalk,

* Proc. Amer. Acad. Sci. and Arts, 1885. Cf. this Journal, i. (1881) p. 774.

† Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 293–5 and Generalversammlung, 1885, pp. lxiii.–lxiv. Cf. this Journal, v. (1885) pp. 844, 1025.

‡ First Ann. Rep. Agricult. Experiment. Station at Wisconsin for 1883 (1885) pp. 45–56 (8 pls.).

§ L'Agricoltore Messinese, viii. (1885) No. 1. See Bot. Centralbl., xxiv. (1885) p. 14.

and closely resemble those of a *Stilbum*. The conidia are spherical or ovoid, colourless or light pink, forming terminal chains; they germinate very readily, the new mycelium producing again conidia after twelve hours.

Sexual organs are also produced, pollinodia and carpogonia. The former have the form of elongated swollen vesicles, or short pedicels consisting of three or four cells. The carpogonium is a relatively thick branch of the mycelium, rich in protoplasm, attaching itself to the pollinodium, and winding round it in a two- or three-fold spiral. The author could not detect any act of impregnation, and believes that reproduction is apogamic. The pollinodium appears to have no further function; the carpogonium divides into several cells, and developes by branching into a small ball, the rudiment of the receptacle. The enveloping hyphæ become differentiated into an outer and inner layer of the perithecium; the central part becomes the fertile tissue, in which are ultimately developed the asci, each containing eight ascospores, which escape when ripe through an ostiole.

The arrangement of the asci in the perithecium brings *Inzengæa* near the Tuberaceæ, and especially to *Elaphomyces*, differing from this genus in the presence of an ostiole. The author regards it as possibly presenting a transition to the Perisporiaceæ.

Olive-disease.*—M. E. Prillieux points out that the disease of the olive-trees known as "noir" or "morfée" is frequently of a double character, consisting of a blackish coating, and a honey-dew-like exudation. The former is caused by a *Fumago* which multiplies very readily by gemmæ, every cell being reproductive. The honey-dew-like exudation is the result of the puncture of the leaves by an insect, *Chermes oleæ*, which thus inflicts a double injury on the tree, the sweet viscid exudation both fixing the spores of the fungus, and furnishing a nidus in which they increase with great rapidity.

New Parasitic Fungus.†—Under the name *Trichosphæria nigra* Prof. R. Hartig describes a newly detected parasite on fir-branches. The mycelium is dark-brown and perennial. Extremely delicate haustoria perforate the thick outer wall of the epidermal cells of the host, the mycelium itself entering the tissue through the stomata. The perithecia appear in large numbers on the surface; they are large, spherical, and covered with hairs.

Trametes radiciperda and Polyporus annosus.‡—Prof. R. Hartig points out the great difference between these two fungi, which have frequently been confounded.

Fungus in Human Saliva.§—In studying the parasitic organisms of the saliva, M. V. Galippe observed, during the process of filtration,

* Bull. du Ministère d'Agriculture, iv. pp. 239 *et seq.* See Bull. Soc. Bot. France, xxxii. (1885), Rev. Bibl., p. 121.

† SB. Bot. Ver. München, Feb. 11, 1885. See Bot. Centralbl., xxiii. (1885) p. 363.

‡ SB. Bot. Ver. München, Feb. 11, 1885. See Bot. Contralbl., xxiii. (1885) p. 362.

§ Journ. Anat. et Physiol. (Robin), xxi. (1885) pp. 538–53 (1 pl.).

a mycelium growth with spores. He was able to cultivate the fungus and to trace its development. Care was of course taken during the sowing, &c., to prevent the entrance of foreign spores. He distinguishes the following stages: (1) Seven hours after sowing, some of the spores had formed at one end a small increasing sphere, at first homogeneous, but soon exhibiting refracting granules; (2) after an equal lapse of time, a third expansion from the primitive spore was observed, and occasionally two symmetrically situated; (3) in three or four days these expansions have elongated, and formed numerous intertwining lateral branches; (4) the interior of the mycelium tubes becomes granular, apparently containing refracting bodies, and the partitions make their appearance; (5) the ends of the lateral branches, or sometimes of the terminal expansions, become swollen; in the centre of the swelling a small refracting and protoplasmic mass becomes visible; (6) the first spore is thus formed, or if the branch has bifurcated a primitive spore is produced at the end of each fork. If the conditions are favourable the further fructification is quickly developed, behind the first spore a second is formed, and so on; a chaplet of twenty to twenty-five may be formed, but the number is very variable. The oldest, that is, the most terminal, are sometimes separated off.

The spores themselves were elliptical, measured 6·36 μ by 5·26 μ, exhibited a double contour and translucent contents, becoming granular as germination began. They varied considerably in contour and content, according to the season and the surroundings. M. Galippe is uncertain whether the fungus was originally in the saliva, or whether the spores insinuate themselves from the hospital or laboratory atmosphere into the filtering apparatus, but inclines to the latter hypothesis.

According to Prof. P. Van Tieghem the fungus is neither an *Aspergillus* nor a *Penicillium*, while Prof. M. Cornu referred it to the genus *Monilia*. M. Galippe has therefore defined it as *M. sputicola* nov. sp.

New Diseases of Cultivated Plants.*—Herr E. Rostrup records the following new observations:—

In a field of clover consisting of *Trifolium repens*, *hybridum*, and *pratense*, and *Medicago lupulina*, many of the plants of *Medicago* were found to be dying. On both root and stem were found black tuberous sclerotia, which on germinating developed a fungus with a layer of acicular paraphyses, and club-shaped asci with numerous minute spores. It was named by the author *Vibrissea sclerotiorum*.

In a field of barley many of the plants were sickly, the leaves discoloured and flaccid, and the whole plant overrun by *Penicillium*, *Cladosporium*, and *Macrosporium*. The cells of the stem were found to be almost entirely filled by a mycelium, producing smooth yellow spores closely resembling those of *Pythium deBaryanum*, not previously observed on barley.

* 'Oversigt ov. d. i 1884 indlobne Forespörgsler angaaende Sygdomme hos Kulturplanter,' Copenhagen, 1885. See Bot. Centralbl., xxiv. (1885) p. 47.

Rhizoctonia violacea was found in vigorous development on *Trifolium repens*, *pratense*, and *hybridum*, usually attacking the upper part of the root, causing it to put out a number of new roots. Ripe sporangia were found only on completely rotten roots.

New Peronospora of the Vine.*—Sig. G. Arcangeli has observed on a number of vine-stocks from seeds brought from Cochin-China a *Peronospora* differing from *P. viticola* dBy. in the smaller size of the spores; their length being 11–13 μ and their breadth 9–11 μ, instead of a length of 16–23 μ and breadth 12–15 μ, as in the latter species. Since, however, the vines on which it was found were always in close proximity to American vines attacked by the common *Peronospora*, he is disposed to regard it as a degraded variety of the latter, and proposes the name *Peronospora viticola* dBy. var. *Ampelocissi*.

Oidium albicans.†—Herr H. Plaut contests Grawitz's view that this fungus ("der Soorpilz") is identical with *Mycoderma vini*. He gives the results in detail of cultivations of the microbe from men, children, and fowls. In fermentable fluids it produces, when luxuriant, moderately strong fermentation, while *Saccharomyces Mycoderma* produces only very slight fermentation, and soon dies. The *Oidium* shows no intercellular formation of spores, while, according to Reess and Cienkowski, *S. Mycoderma* does. In its yeast-form the *Oidium* is more nearly spherical, *S. Mycoderma* ellipsoidal or fusiform. Pure culture of *Oidium* reproduces the same form; that of *S. Mycoderma* remains without result. The author considers the *Oidium* as more nearly allied to *Monilia candida* Bon. or to Hansen's new species of that genus.

Mycology of Rome.‡—Sigg. P. Baccarini and C. Avetta describe 116 Micromycetes from the neighbourhood of Rome, 98 of which are new to the district. The following three species are described for the first time, viz.:—*Chætomidium Pircuniæ*, on rotting wood of *Pircunia dioica*; *Metasphæria Ferulæ*, on dead branches of *Ferula communis*; and *Cucurbitaria hirtella*, on rotten branches of *Sambucus*.

Fossil Chytridiacea.§—MM. B. Renault and C. E. Bertrand find, in the superficial cells of the seeds of *Sphærospermum oblongum*, a fossil gymnosperm from the upper "terrain houiller," the mycelium and sporangia of a fungus which they name *Grilletia Sphærospermi*, and refer to the Chytridiaceæ. The sporangia are naked, ovate, and swollen on one side where the opening occurs, without any operculum. It differs from other Chytridiaceæ in the absence of an operculum and neck to the sporangia, in the presence of a mycelium, and in its habit. It appears to develope in the seeds when they begin to decay.

* Atti Soc. Toscana Sci. Nat., iv. (1885) pp. 181–3.

† Plaut, H., 'Beitr. zur systemat. Stellung des Soorpilzes,' 16 pp., 8vo, Leipzig, 1885. Cf. this Journal, iii. (1883) p. 540.

‡ Ann. Istit. Bot. di Roma, i. (1885) Fasc. 2 (1 pl.). See Bot. Centralbl., xxiv. (1885) p. 33.

§ Comptes Rendus, c. (1885) p. 1306.

Protophyta.

Nucleus in Yeast-cells.*—Herr F. Krasser has endeavoured carefully to test the accuracy of the statements of Schmitz, Strasburger, and De Bary of the presence of a nucleus in the cells of *Saccharomyces cerevisiæ*, but with entirely negative results, using as staining materials hæmatoxylin and hæmatein-ammonia, as well as other reagents, such as carmine, saffranin, &c. With the ammoniacal staining materials he was sometimes able to colour granular structures, but these could not with certainty be recognized as nuclei, especially as they occurred also in cells from which the nuclein had been removed. The author states that the nucleus always contains nuclein, but the converse is not always true, that the presence of nuclein indicates a nucleus, the facts rather pointing to the conclusion that in the cells of yeast the nuclein is distributed through the protoplasm.

Nomenclature of Schizomycetes.†—Herr H. Buchner considers that the various species of Schizomycetes are constant, but that they are subjected to a great variety of "growth-forms," according to their vital conditions. In order to avoid the confusion at present prevailing in their nomenclature, he proposes to retain the Latin names *Micrococcus*, *Bacillus*, &c., to designate the species, and some such scheme as the following for the "growth-forms."

A. Forms isolated in their growth.

Spherical form. The longitudinal and transverse diameters equal.
Oval form. Longitudinal not more than double transverse diameter.
Short-rod form. Longitudinal 2–4 times transverse diameter.
Long-rod form. „ 4–8 „ „
Filiform form. Longitudinal more than eight times transverse diameter.
Semi-helix or *Comma* form. A very short helix of not more than a single circuit.
Long-helix or *Spiral* form. Two or more circuits of the helix.
Spindle form. Rod with fusiform ends.
Oval-rod form. Ends less pointed than spindle-form; longitudinal 2–4 times transverse diameter.
Club form. Rod with end thickened on one side.

B. Forms united in their growth.

Double-sphere form. Union of two spheres. When the separation is barely indicated:—*Hour-glass* form.
Row-of-spheres form. Union of spheres up to eight. When the separation is barely indicated:—*Torula* form.
Filament-of-spheres form. Union of more than eight spheres. When curved:—*Rosette* form. When the separation is barely indicated:—*Torulose filaments.*

* Oester. Bot. Zeitschr., xxxv. (1885) pp. 373–7.
† SB. Gesell. Morphologie u. Physiologie München, June 23, 1885. See Bot. Centralbl., xxiv. (1885) p. 258.

Cluster form. A cluster of a number of spheres.
Double-rod form. Composed of two short rods. When composed of more than two:—*Filament-of-rods* form.
Tetrahedral or *Cubical* form. Spheres or short rods united in fours in one or two layers.

Microbe of Rabies.*—Prof. H. Fol gives an account of a microbe, the presence of which appears to be associated with hydrophobia. The preparations were made by hardening the spinal cord or brain by immersion, directly after death, in a solution of 2·5 grms. bichromate of potash, and 1 gramme of sulphate of copper in 100 parts of water; the piece of tissue is divided so as to be able to take up Weigert's solution of hæmatoxylin, then placed in absolute alcohol, imbedded in paraffin, and cut into sections not more than 1/200 mm. in thickness. In these preparations, when carefully decolorized, we see groups of small globules, not unlike micrococci. If a cultivation be made of part of the brain there is a deposit which, on inoculation into healthy animals, produces all the features of rabies. If, however, the cultivation be more than six days old, there are no marked toxic effects. M. Pasteur had already recognized the presence of certain granulations in the spinal cord of rabid animals, but they were not sufficiently fully described to enable M. Fol to say whether or no they are the same as the microbes which he has been able to detect; nothing can be distinctly made out by merely reducing the nervous tissue to a pulp, and examining it microscopically as recommended by M. Gibier.

Microbes of Calf-lymph.†—Fermenting forms of *Saccharomyces* have been found only exceptionally in vaccine taken directly from the arm of children, in capillary tubes with glycerin-lymph, and in the lymph of children dried in the air; but are found abundantly in calf-lymph cultivated on Koch's gelatin-plates, and on malt-extract gelatin-plates. Herr L. Pfeiffer describes these forms in detail. They consist of elongated or spherical budding cells 1·5 μ by 4 μ, varying in form according to the nutrient fluid. The author regards them as probably derivatives of higher fungi such as Ustilagineæ, which have reached the cattle through the fodder. Pfeiffer thus describes the hypothetical *Saccharomyces vaccinæ*:—Small, roundish, or ellipsoidal cells, single or united into chains, of 1·5–4·5 μ diameter, usually with a vacuole in the centre, and a shining lateral nucleus. The gemmation is evident on a fresh nutrient substratum, with no formation of mycelium nor of internal spores. In beer-wort they cause no or very little alcoholic fermentation.

Action of Sunlight on Micro-organisms, &c.‡—Dr. A. Downes has previously shown that sunlight is fatal to microsaprophytes by a process of hyper-oxidation thereby induced. In this process the more

* Comptes Rendus, ci. (1885) pp. 1276–9. Arch. Sci. Phys. et Nat., xiv. (1885) pp. 549–53.

† Pfeiffer, L., 'Ueber Sprosspilze der Kälber-lymphe,' Weimar, 1885. See Bot. Centralbl., xxiv. (1885) p. 176.

‡ Proc. Roy. Soc., xl. (1886).

refrangible rays were the most active. In the course of the induction which led to this conclusion two other facts of importance were elicited. The molecule of oxalic acid was speedily resolved into water and carbonic acid by the combined effect of light and free oxygen, and a typical representative of the diastases, the invertive ferment of cane-sugar, had its qualities completely destroyed by sunlight, which was, however, without effect in a vacuum or a neutral atmosphere. During the past eight years evidence confirmatory of these conclusions has accumulated from various sources, and the principal facts are reviewed by the author.

After referring to the observations of Warington and others on the nitrifying ferment, of Tyndall in regard to the insolation of putrefiable infusions under an Alpine sun, and to others, Dr. Downes summarizes the recent results of Duclaux,* who finds, from an examination of several species, that *Micrococci* are apparently far more sensitive to sunlight than the more resistant *spore-forming Bacilli*. Duclaux, who has likewise observed the destructive effect of sunlight on a diastase, agrees that this injurious action on germs is an affair of oxidation. In his previous papers the author had noted the different powers of resistance of various organisms to sunlight, notably of *Saccharomycetes* or *Mucedines*, as compared with Bacteria. He now describes a specially resistant *Bacterium*, roughly resembling, but not identical with, the *Ascobacterium* of Van Tieghem, of which he finds no previous record.

In refuting the conclusion of Jamieson, an Australian observer, that both he and Prof. Tyndall had mistaken effects of heat for effects of radiant energy distinct from heat, Dr. Downes describes recent experiments of his own, which indicate that a similar action, though of course in a less degree, is exercised by diffused light. He concludes with a reference to the well-known observations of Pringsheim on the destruction of vegetable protoplasm by the more refrangible rays, and claims them as evidence of the truth of his former generalization, that the hyper-oxidation of protoplasm by light is a general law, from the action of which living organisms require to be shielded by a variety of protective developments of cell-wall, aggregation of tissue or colouring matter, and in other ways.

* See this Journal, v. (1885) p. 1047.

MICROSCOPY.

a. Instruments, Accessories, &c.*

Fol's Travelling and Dissecting Microscope.—Prof. H. Fol's Travelling Microscope is shown in fig. 45.

As will be seen, the upper portion is similar to the large Microscope of the Geneva Society (cf. Vol. IV. 1884, p. 281), while the folding base is made on the ingenious plan of the Travelling Microscope of the same manufacturers (cf. tom. cit., p. 437).

The new points (in addition to the special stability and size of the stage, unusual in "Travelling" Microscopes) are: (1) the stage and

FIG. 45.

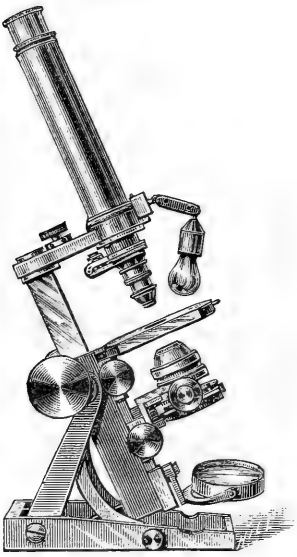
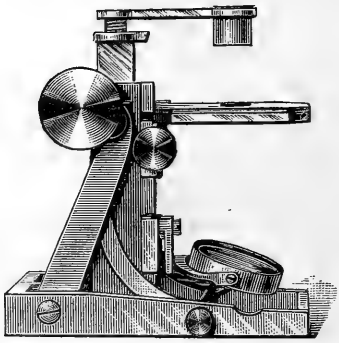


FIG. 46.



substage, both of which are movable on a single rack, and (2) the incandescent electric lamp of four candle power attached to the front of the cross arm, and worked by a bichromate battery of four elements. The lamp can also be attached beneath the stage when desired.

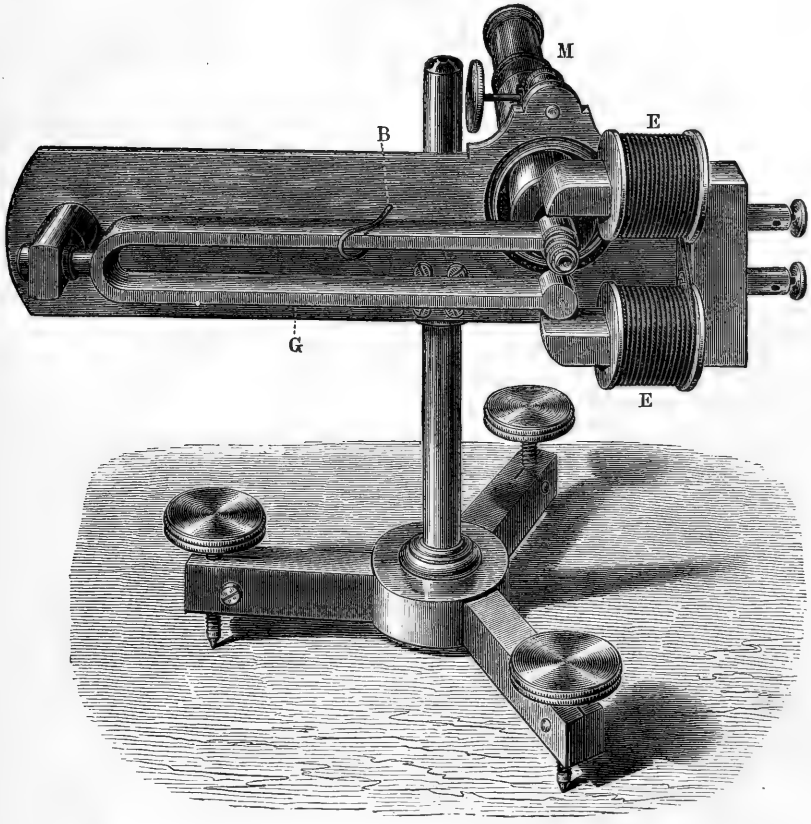
Another point is (3) that the instrument can be converted

* This subdivision is arranged in the following order:—(1) Stands; (2) Eyepieces and Objectives; (3) Illuminating Apparatus; (4) Other Accessories; (5) Photo-micrography; (6) Manipulation; (7) Microscopical Optics, Books, and Miscellaneous matters.

into a Dissecting Microscope, as shown in fig. 46. It is for this use of the instrument that the stage is made to move up and down by rack and pinion, so as to form a fine adjustment.*

Helmholtz's Vibration Microscope.†—Professor H. L. F. Helmholtz's instrument (fig. 47) is thus described by him.

Fig. 47.



"No complete mechanical theory can yet be given for the motion of strings excited by the violin bow, because the mode in which the bow affects the motion of the string is unknown. But by applying a

* The Microscope is briefly described in Arch. Sci. Phys. et Nat., xiv. (1885) p. 575, but the above figs. are taken from photographs kindly sent us by Prof. Fol.

† Helmholtz, H. L. F., 'On the Sensations of Tone as a Physiological Basis for the Theory of Music,' 2nd Eng. ed. by A. J. Ellis, London, 1885, pp. 80–2 (2 figs.). 'Die Lehre von den Tonempfindungen,' 4te Ausg., Braunschweig, 1877, pp. 137–41 (2 figs.).

peculiar method of observation, proposed in its essential features by the French physicist Lissajous, I have found it possible to observe the vibrational form of individual points in a violin string, and from this observed form, which is comparatively very simple, to calculate the whole motion of the string, and the intensity of the upper partial ones.

Look through a hand magnifying glass consisting of a strong convex lens, at any small bright object, as a grain of starch reflecting a flame, and appearing as a fine point of light. Move the lens about while the point of light remains at rest, and the point itself will appear to move. In the apparatus I have employed, which is shown in fig. 47, this lens is fastened to the end of one prong of the tuning-fork G. It is in fact a combination of two achromatic lenses, like those used for the object-glasses of Microscopes. These two lenses may be used alone as a doublet, or be combined with others. When more magnifying power is required, we can introduce behind the metal plate which carries the fork, the tube and eye-piece of a Microscope M of which the doublet then forms the object-glass. This instrument may be called a Vibration Microscope.

The end of the other prong of the fork is thickened to counterbalance the weight of the doublet. The iron loop B, which is clamped on to one prong, serves to alter the pitch of the fork slightly; we flatten the pitch by moving the loop towards the end of the prong. E is an electro-magnet by which the fork is kept in constant uniform vibration on passing intermittent electrical currents through its wire coils.

When the instrument is so arranged that a fixed luminous point may be clearly seen through it, and the fork is set in vibration, the doublet moves periodically up and down in pendular vibrations. The observer, however, appears to see the luminous point itself vibrate, and, since the separate vibrations succeed each other so rapidly that the impression on the eye cannot die away during the time of a whole vibration, the path of the luminous point appears as a fixed straight line, increasing in length with the excursions of the fork.

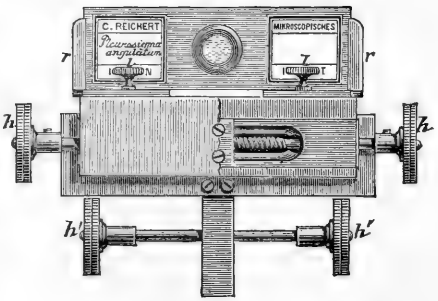
The grain of starch which reflects the light to be seen, is then fastened to the resonant body whose vibrations we intend to observe, in such a way that the grain moves backwards and forwards horizontally, while the doublet moves up and down vertically. When both motions take place at once, the observer sees the real horizontal motion of the luminous point combined with its apparent vertical motion, and the combination results in an apparent curvilinear motion. The field of vision in the Microscope then shows an apparently steady and unchangeable bright curve, when either the periodic times of the vibrations of the grain of starch and of the tuning-fork are exactly equal, or one is exactly two or three or four times as great as the other, because in this case the luminous point passes over exactly the same path every one or every two, three, or four vibrations. If these ratios of the vibrational numbers are not exactly perfect, the curves alter slowly, and the effect to the eye is as if they were drawn on the surface of a transparent cylinder which slowly revolved on its axis. This slow displacement of the apparent curves is not disadvantageous, as it allows the observer to see them in different positions. But if

the ratio of the pitch numbers of the observed body and of the fork differs too much from one expressible by small whole numbers, the motion of the curve is too rapid for the eye to follow it, and all becomes confusion.

If the Vibration Microscope has to be used for observing the motion of a violin string, the luminous point must be attached to that string. This is done by first marking the required spot on the string with ink, and, when it is dry, rubbing it over with wax, and powdering this with starch so that two or three grains remain sticking. The violin is then fixed with its strings in a vertical direction opposite the Microscope, so that the luminous reflection from one of the grains of starch can be clearly seen. The bow is drawn across the strings in a direction parallel to the prongs of the fork. Every point in the string then moves horizontally, and on setting the fork in motion at the same time the observer sees the peculiar vibrational curves already mentioned."

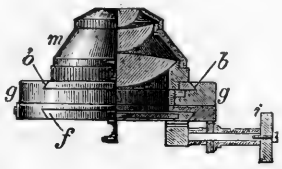
Reichert's Stand with New Stage and Iris Diaphragm.—Herr C. Reichert has adapted to this stand (fig. 50) an arrangement for moving the object in two directions, which, like that of Mr. J. Mayall jun., does not necessitate any addition to the thickness of the stage so as to interfere with the illumination.

Fig. 48.



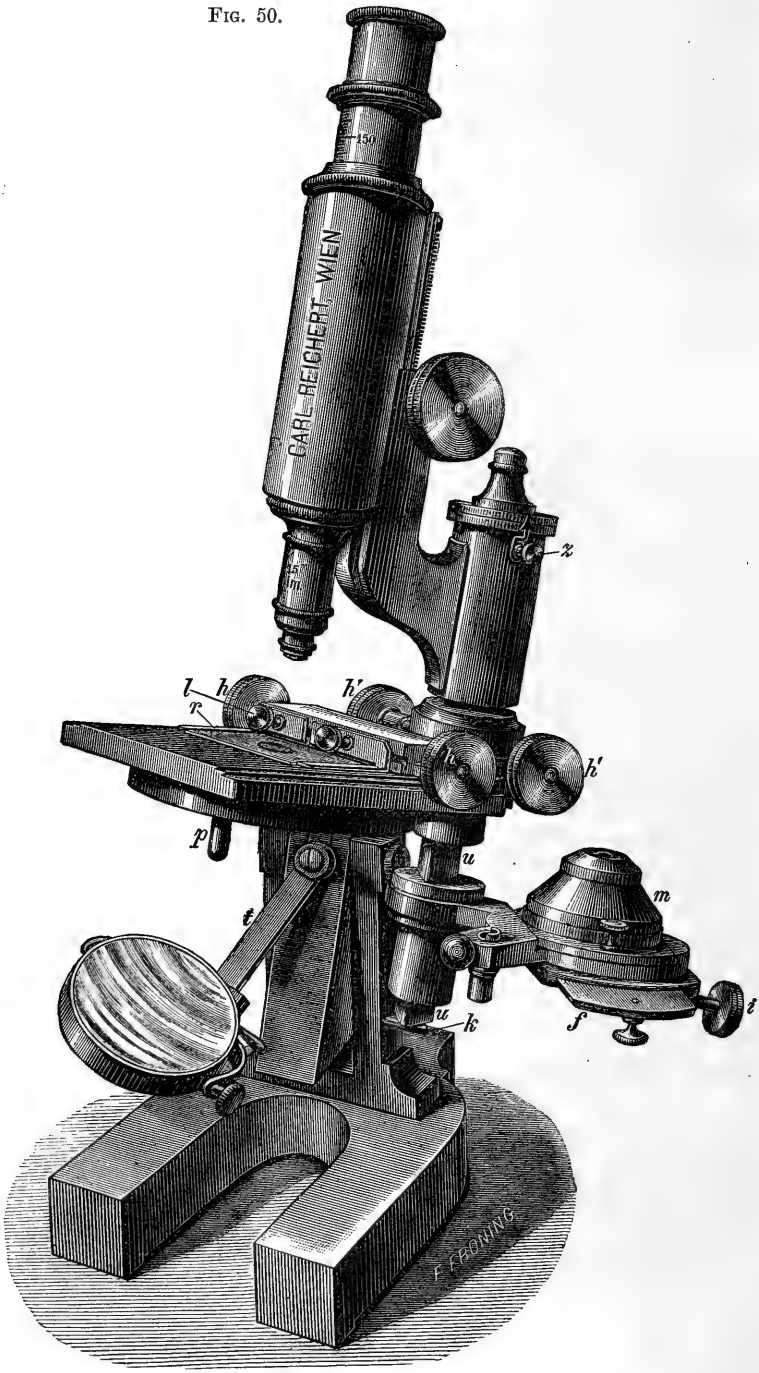
The arrangment is shown in fig. 50 *in situ*, and also separately at fig. 48. The glass slip is held between two clips *r r*. These clips are attached to a nickel-plated frame which slides on the upper surface of the stage, and is secured in place by grooves at the side. A projecting tail-piece with a rack on the under side passes through the limb of the Microscope, and the frame is moved from back to front by a pinion in the limb, which is actuated by the milled heads *h' h'*. The motion of the slide from side to side is effected by the milled heads *h h*, which by means of a screw move the piece to which the clips are attached. The clips consist of two metal plates, with a piece of indiarubber between, slightly projecting laterally, so that the metal is not in contact with the slide. By loosening the screws *l l* the clips can be brought closer together, so as to grasp the slide tightly, which is thus moved on the surface of the stage without any intermediate support.

Fig. 49.



The Abbe condenser is shown in figs. 49 and 50. It is movable by

Fig. 50.



Reichert's Stand with New Stage and Iris Diaphragm.

rack and pinion on the bar *u*. The diaphragm slide *f* can be rotated on the ring *g*, and also moved excentrically by the milled head *i*. The lenses *m* are attached to a slide *b*. A rotating stop at *k* prevents the condenser from being racked off the bar *u* unless desired. A pin *p* serves as a guide for the condenser on the other side of the stage.

A novelty in a Continental Microscope is the iris-diaphragm N (figs. 51 and 52), the first we have seen. It is made on G. Wale's

Fig. 51.

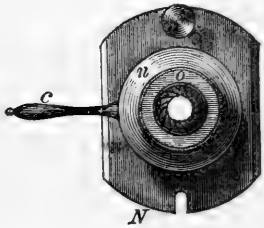
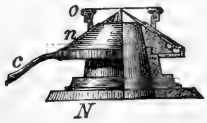


Fig. 52.



plan; the rotation of the cone *n* by *c* causes the pieces of which the iris is composed to close or open; *o* is a cap.

Thoma's Microscope for observing the Circulation of the Blood.*—This Microscope was designed by Prof. R. Thoma, to observe the circulation of the blood (and especially inflammatory disturbances of the circulation), not in frogs, but in warm-blooded animals, using for the purpose the mesentery of dogs, cats, guinea-pigs, &c. For this purpose a very large stage is of course necessary, with some kind of heating apparatus, and it is also desirable to be able to keep a stream of liquid constantly flowing over the part of the animal under observation, as previously recommended by the author (see *infra*, Thoma's frog-plate).

The instrument as now made by Herr Jung of Heidelberg, is shown in fig. 53. It consists of a stout iron stand, with a wooden top $19\frac{1}{2} \times 10$ in., which forms the base plate of the stage. The Microscope keys into the lower part of the frame by a stud pin beneath the standard, so that it can be removed as required. The mirror is attached to the front foot of the tripod of the Microscope. On the wooden base-plate is a second plate of wood of the same size as the lower one. It is unattached, and can be moved about by the hand as desired. To ease the friction, the bottom of the plate has four brass-headed nails on which it moves. To maintain an approximate equilibrium, a cord and weight are fixed to each of the front corners, the cords passing over pulleys projecting from the lower plate. The latter has a horseshoe aperture just beneath the body-tube, and the upper plate has a circular aperture, over which is fixed

* Arch. f. Pathol. Anat. u. Physiol. (Virchow), lxxiv. (1878) pp. 360–93 (1 pl.).

a "hot stage." This consists of a box $4\frac{1}{2} \times 2\frac{3}{8} \times 1$ in., through which is an aperture for illumination closed at the top and bottom by glass plates. Hot water is brought to the box by the tube on the left and passes away through the waste-pipe on the right. A third

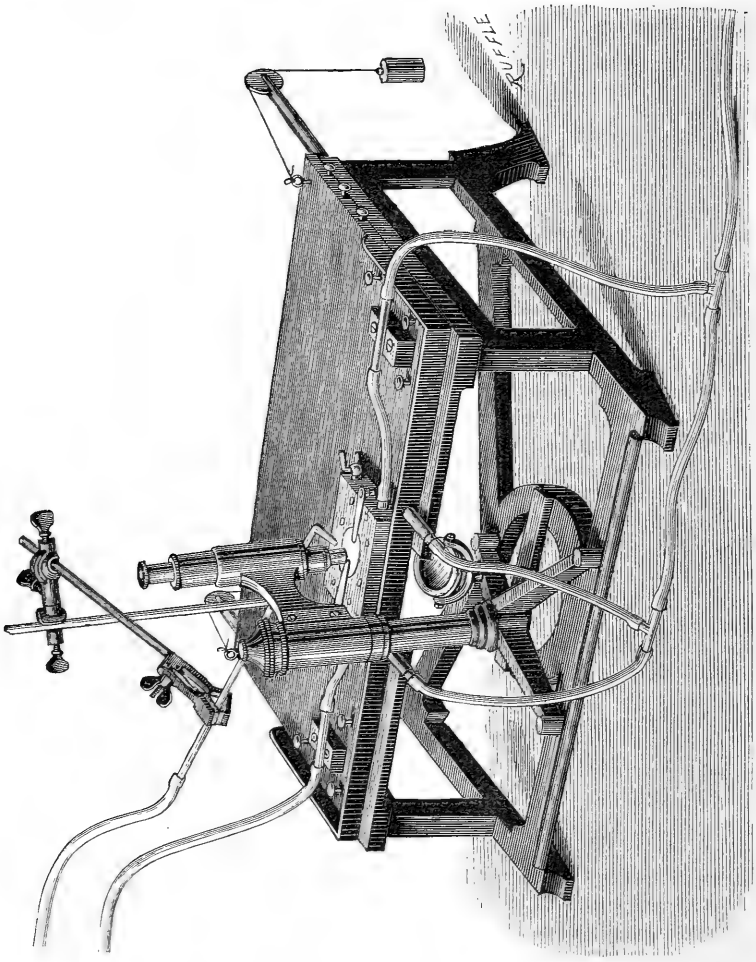


Fig. 53.

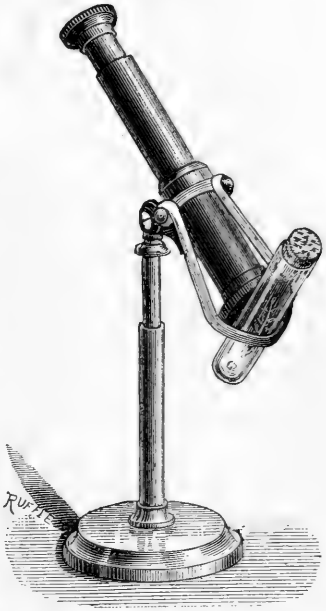
Thoma's Microscope for observing the Circulation of the Blood.

opening with a tap allows air-bubbles to be eliminated. The arrangement for irrigating the object consists of a rod and clamp for supporting a tube, through which the liquid can be directed upon the object. The stage being inclined at an angle of about 20° the liquid

flows to the side next to the Microscope, and is prevented by a raised ledge from running off, except through the two tubes on either side of the Microscope which are connected with the waste-pipe. Twelve nails in the sides and on the top of the upper plate are for the cords used in tying the animal.

The author also describes and figures the arrangement of water-bath, heating and irrigating apparatus, cork plates, &c., of which he made use, and gives directions for examining the mesentery, as well as a full description of the results of his researches.

FIG. 54.



Watson's Collectors' Pocket Microscope.—This instrument (fig. 54), made by Messrs. Watson and Sons, is a small compound Microscope with 4 in. body-tube and a 2 in. objective, mounted on an upright pillar, which screws into a round brass base-plate. There are universal motions, so that the tube may be pointed in any direction for the best illumination of the object. The body-tube slides in an outer tube or jacket for adjustment of focus, and at the object end of this is a hollow cut for a test-tube to lie across the optic axis, being held there while being examined by an elastic band. Ordinary slides (3 × 1 in.) may also be held in the same manner. The instrument, and three glass specimen tubes, pack into a flat case $5\frac{1}{2} \times 5\frac{1}{4} \times 1\frac{1}{2}$ in.

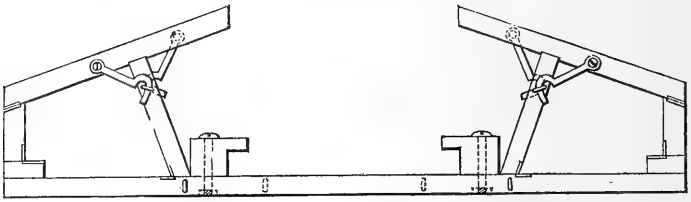
Cheap Dissecting Microscope.*—Prof. C. R. Barnes writes as follows:—"No laboratory or workers need be unsupplied with dissecting Microscopes. If even the cheapest form manufactured by the opticians is beyond the means of the school or individual, an effective stand may be made as follows:—Into any block of wood of suitable size fix upright a short piece of stiff wire or rod having a smooth surface. Bore a hole in a fine-grained cork, a little to one side of the centre, so that the cork will slide smoothly on the rod. Bend one end of the smaller wire into suitable shape to hold whatever lens is at hand, and make a hole of proper size in the cork at right angles to the first. This arrangement gives ample and smooth movements of the lens in any direction for adjustment. The plan may be elaborated to any desired extent. If the rod be fixed in a plain piece of board, dissecting may be done on a piece of glass laid flat on

* Bot. Gazette, x. (1885) pp. 427–8.

the board. Pieces of black or white paper underneath will give the backgrounds against which any object may be seen. For dissecting in liquid a deep butter-plate answers well. If it is desired to have transmitted light, the object may be dissected on the bottom of an inverted tumbler which has a *smooth* concavity. Sloping blocks may be placed at the sides for hand-rests. Still better illumination may be had by fixing two such blocks, one on each side of the upright rod, and placing between them a strip of mirror-glass inclined to an angle of 30°–40°. In fact, with a little ingenuity and mechanical skill, one may construct a stand for dissecting which will equal in efficiency any of the simple Microscopes offered for sale."

Hand-rests.*—Dr. R. H. Ward describes the hand-rests which he has been accustomed to use, and which are made of mahogany strips about 1 cm. thick, and 10 to 12 cm. wide, constructed as shown in front view in fig. 55.

Fig. 55.



The rests are attached by hinges, and are held down firmly with brass hooks, hinged strips supporting the rests at the desired height and in an inclined position. Wooden buttons, held by large screws fastened with brass nuts below, hold the base of the Microscope firmly

Fig. 56.

in position. The hinges are all so arranged that the strips can be folded together solidly, for portability, as shown in fig. 56, and held in that position by the same hooks as when open. By a slight change in size it is applicable to any dissecting Microscope. It should be made of such size that the upper ends of the rests will be nearly

* Behrens' 'Microscope in Botany' (Amer. ed. by Hervey and Ward), 8vo, Boston, 1885, pp. 108–10 (2 figs.).

continuous with, or slightly below, the stage of the Microscope. Exact approximation is not necessary. When properly adjusted, the rest is perfectly firm and steady. When portability is not required, the hinges and hooks may be dispensed with, and the wooden strips fastened together with glue and brads.

Astigmatic Eye-piece.*—Mr. E. Gundlach discusses the nature of astigmatism and its interference with the perfect use of the eye, as well as the relation of the astigmatic eye to the use of optical instruments and the injurious effects of astigmatism on microscopic observations.

As a remedy he proposes the use of an eye-piece of an asymmetric form, so as to just neutralize the asymmetry of the crystalline lens of the eye. This can best be done by making the outer surface cylindrical instead of spherical or plane. It may be made either concave or convex as the requirements of the case may demand. The eye-piece must be constructed with special regard to the purpose, so as to place the asymmetric surface in such close proximity to the eye that no perceptible secondary distortion is produced by the oblique direction of the eye towards the edge of the field, and at the same time the prismatic colours dispersed in the direction of the astigmatic distortion must be neutralized.

Mr. Gundlach intends to construct such eye-pieces, and expects to start with a 1 in. To enable the applicant, for this special purpose at least, to be his own examiner for astigmatism, he intends to furnish with the eye-piece three eye-glasses, alike in mounting but different in the degree of asymmetry, for selection; the difference being such as to practically approach both limits of common astigmatism. The one of the three lenses nearest in asymmetry to that of the eye will correct the astigmatism to an undisturbing minimum. The observer will then have to test all the lenses, beginning with the weakest, on a suitable object, slowly revolving the eye-piece until its best position is found. Mark this position, and do the same thing with the other lenses. After this, compare the action of the lenses, each in its best position, to find the one best fitted for the eye. Of course the eye-piece, or rather its asymmetric eye-lens, must then always be used in the same position to the astigmatic axis.

Dr. J. K. Stockwell considers † that while Mr. Gundlach's plan is quite feasible and very excellent in optical results, there are several serious objections that may be mentioned.

The first, and perhaps most tenable one, is the fact that while the eye-piece would perfectly suit the person for whom it was made,—one eye at least—not another one in several thousand could use it, unless it was so constructed as to admit of having the eye-lens, the asymmetric part, readily removed and replaced by a symmetrical one, and the optical results would not be commensurate with the trouble and expense involved.

Complicated combinations of spherical and cylindrical lenses,

* The Microscope, vi. (1886) pp. 1-4. † Ibid., pp. 29-32.

requiring plus and minus lenses of both kinds, ranging in focal distance from six inches in extreme to seventy or one hundred in mild cases, and skill and experience are necessary to correct astigmatism. How then can the ordinary microscopist bring order out of confusion by experimenting with three eye-glasses?

It would improve matters if the astigmatic observer were to have the formula for a lens neutralizing his asymmetry (for instance, thus:—36 cyl. axis 180°) sent to an optician, and have made a small lens, with a setting of thin brass, so constructed as to slip on the top of the eye-piece, over the eye-lens and as close to it as possible. The slight details of convenient construction readily suggest themselves to the optician.

If the microscopist uses the eye-piece of one maker, the accessory, for such it is, fits each and all of them as they are brought into use, and when not needed it may be easily removed, leaving the perfect eye-piece ready for use under the normal eye.

Many, in fact most, astigmatic persons have a different degree of defect in each eye, and therefore a better plan would be to have suitable cylindrical lenses put into *spectacle frames*, and worn only while using the Microscope. These can be placed near the eyes, the axis of each is firmly held in its proper relation to the effective medium and each eye has before it the exact correction of that eye's asymmetry. To be sure, this requires the aid of a skilled specialist, but once done, there is no further trouble or anxiety—no examination with test-lines in order to be sure that the glasses are in the best position for work.

Secondary distortion because of being a little distance from the eye-lens of the instrument is not troublesome, nor worth considering as against convenience, comfort, and the ability to instantly change eyes when working—an important desideratum.

The author also thinks that many of the disputes between microscopists as to the markings of test and other objects, notably those having lines meeting or crossing at various angles, are possibly due to the fact that they are not seen through optically similar eyes, one being practically free from astigmatism and the other having it developed to a much greater degree, thus making it utterly impossible for the observers to see alike.

Malassez's Camera Lucida.*—M. L. Malassez discusses cameræ lucidæ in general, and describes a modification which he has designed to avoid the inconveniences attendant upon the existing forms, and particularly the necessity of placing the Microscope vertical and drawing on an inclined plane in order to insure the correspondence of drawing and object. It is much preferable to be able to have the Microscope in an inclined position and the paper horizontal.

If a Doyère and Milne-Edwards or Nachet camera is placed on a Microscope inclined 15°–18°, so that the image is thrown behind the Microscope, it will be found that it is partly projected on the base.

* Laborat. d'Histol. du Collège de France. Travaux de 1884 (1885) pp. 166–79 (1 fig.).

This can be remedied by inclining the Microscope to an angle of 40°–45° and altering the position of the camera prisms as shown in

FIG. 57.

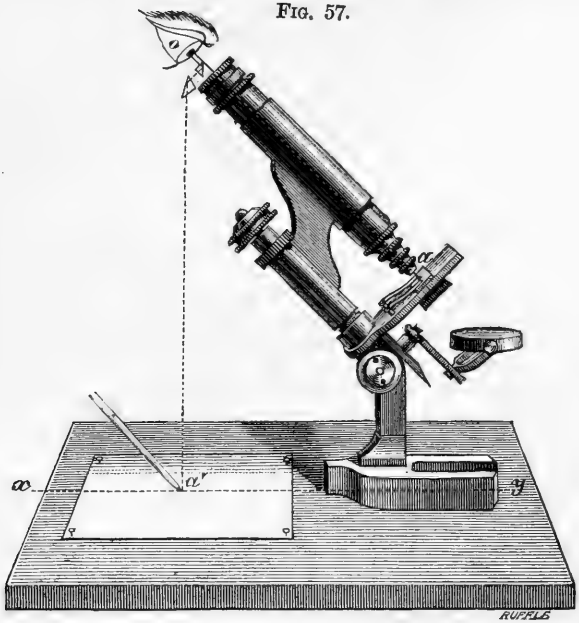


fig. 57. A drawing thus made will be undistorted if its axis (a' o) is exactly perpendicular to the surface of the table. For this, however, it is necessary that the axis should fall on the line x y, and that it should make with the axis of the Microscope an angle (a o a') equal to the angle of inclination of the Micro scope.

FIG. 58.

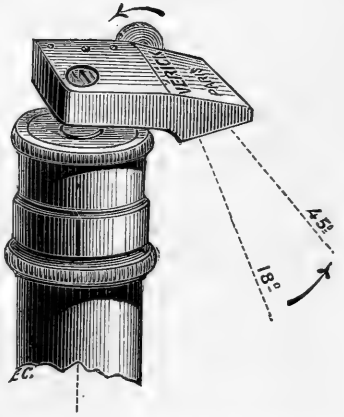


Fig. 58 shows M. Malassez's modification of a Doyère and Milne-Edwards camera to meet these conditions. One of the prisms can be rotated by a milled head and adjusted for the 45° position, or where the objects must be kept horizontal and the Microscope therefore vertical it can be set for an angle of 18°. The modification can be applied to other cameræ, but where the reflecting surfaces are not movable the original construction must be altered.

The author considers that Dr. Schröder's camera is objectionable,

on account of the rays from the Microscope having to undergo a double total reflection, whilst the necessity of drawing with the head in the same position as when using a vertical Microscope sacrifices one of the great advantages of an inclined Microscope. This would be remedied by reversing the prisms, so that the unreflected rays are those which come from the Microscope and not from the paper, the reflected rays being received from the paper.

Relative merits of Filar and Ordinary Glass Eye-piece Micrometers.*—Dr. M. D. Ewell has undertaken a series of comparisons to test Mr. H. L. Tolman's conclusion † that the cobweb micrometer does not offer sufficient advantage in point of accuracy to compensate for its additional cumbersomeness and expensiveness.

Dr. Ewell comes to the conclusion that for the comparison of lengths nearly equal and for the measurement of minute distances with low powers, the glass eye-piece micrometer is vastly inferior to the filar micrometer; and that in cases where the greatest attainable accuracy is required, as for example in the measurement of blood-corpuscles in criminal cases, nothing but the filar micrometer should be used.

The New Objectives.—For some months past it has been known that we were on the eve of an important advance in objectives, depending mainly on the elimination of the secondary spectrum, leaving only a small tertiary spectrum. We alluded to the subject at the Anniversary Meeting, by way of supplement to the remarks of the President on the great value which he had found an increase of aperture to be in his researches on very minute organisms with high powers, and we expressed the belief that the new objectives would be found to be of at least equal advantage.

Two objectives have now been received in this country, and their examination has fully borne out the expectation formed of them, and has shown that however trifling the improvement might at first sight be thought to be on theoretical grounds,‡ it is very distinctly appreciable, so that the high power work of the future will almost necessarily be done with these glasses.

The objectives in question are both 1/8 in. The special point in their construction is that they are made of new kinds of optical glass, which Prof. Abbe and Dr. Schott have been working for the last five years to perfect. The objectives are composed of ten single lenses, combined to five separate lenses, with a single front lens. Their working distance is 0·25 mm., and in order to secure this the aperture is limited to 1·40 N.A. With the length of tube

* The Microscope, vi. (1886) pp. 32–40. † See this Journal, v. (1885) p. 704.

‡ Prof. Abbe writes us on this point, "We have now made what I called in 1878 'the Microscope of the future,' i. e. objectives which admit of a more perfect concentration of all the rays from the object. If now (as I am nearly sure they will) microscopists should feel somewhat disappointed at being told that 'the Microscope of the future' is nothing more and nothing better in principle than these objectives, I must answer 'It is not *my* fault that at this time microscopical optics is such an ungrateful domain of human work, that many years' hard labour have no other result than a slight advance.'"

engraved on the setting (taken from the nose-piece to the eye-lens), the objectives have their best correction for a cover-glass of 0·16–0·18 mm. Much thinner covers require a lengthening of the tube by 10–25 mm. further. They are very sensitive in regard to length of tube, and the change in this length is the simplest, and in fact the best, means for slight corrections for different covers—the reason being that a change of that kind does not alter the proper balance of the various corrections (spherical, chromatic and sphero-chromatic), whilst an alteration in the distance of the lenses of the objective from one another, as is done by a screw-collar, does disturb that balance to the injury of the performance of the objective. It may be possible to find a formula which will be less sensitive in regard to this question of correction, but until it is found, Dr. Zeiss, by whom the objectives are made, will not supply any with correction-collars, so as to convert a good objective into a medium one for the sake of a non-essential convenience only.

A novel point in connection with the objective is that its performance is improved by the use of special eye-pieces, of which two are supplied, of 25 mm. and 15 mm. focal length. Their function is to compensate for certain aberrations *outside* the axis, which cannot be compensated for in the objective. With these eye-pieces, particularly with that of 25 mm. focal length, the field of view is surprisingly uniform.

Of the ten lenses of which the objective is composed, two only are of siliceous glass, the other eight being made of borates and phosphates. The crown and flint glass now used by opticians does not contain (as essential components) more than six chemical elements, O, Ca, K, Na, Pb and Si, whilst the new objective contains not less than fourteen elements.

The optical principle on which the objectives have been constructed is indicated in a paper by Prof. Abbe in this Journal,* "On new methods for improving spherical correction," &c. In fact, all the work of Prof. Abbe and Dr. Schott during the five years has been solely directed to finding the proper means for the realization of the desideratum there mentioned, viz. doing away with the secondary chromatic aberration, and with the chromatic difference of spherical aberration. The proper means was found in special kinds of glass, which allowed of *proportional* dispersions in different parts of the spectrum, and which at the same time exhibit different relations between the refractive indices and dispersive powers. By these means a more perfect concentration of all the rays emanating from the object is obtained. With the old kinds of crown and flint glass *two* different colours only could be collected to one focus, a secondary spectrum remaining uncorrected, whilst the new objectives collect *three* rays of different colours to one focus, leaving a small tertiary spectrum only. Moreover, spherical correction has hitherto been confined to rays of *one* colour, being made for the central part of the spectrum, the objective remaining *under*-corrected spherically for the

* See this Journal, ii. (1879) p. 42.

red rays and *over*-corrected for the blue rays. In the new objectives, however, the correction of the spherical aberration is obtained for *two* different rays of the spectrum, that is practically for all colours at the same time, and the objective shows the same degree of chromatic correction for the central as for the marginal part of the aperture. All this requires greater complication in the construction, hence the use of five lenses instead of the four hitherto employed. In addition, uniformity of amplification by the various zones of the clear aperture has been obtained in a higher degree than could hitherto be done.

The objectives will be specially useful in photo-micrography where the correction of the secondary spectrum will be found of considerable practical advantage. Not only is there no difference in the optical and chemical foci, but the image formed by the chemical rays is in itself much more perfect. This advantage is very clearly verified by experimental trials which have been made. For photo-micrography a third eye-piece magnifying $2\frac{1}{2}$ times is supplied, the lenses of which can be slightly separated for exact adjustment of the image.

Two series of objectives will be constructed, one adapted for the short Continental body-tube and the other for the long English body-tube, and there will be a corresponding "compensating" series of eye-pieces. The homogeneous-immersion lenses will have apertures of 1·40 N.A. and 1·30 N.A., and focal lengths of 3·0 mm. and 2·0 mm., the latter with much increased working distance. The water-immersion lenses will have an aperture of 1·25 N.A. and a focal length of 2·5 mm., and the dry lenses 0·95 N.A., 0·60 N.A., and 0·30 N.A., with focal lengths of 4 mm., 8 mm., and 16 mm.

We append what will we think be of interest to many of the Fellows, a brief account of what we understand to be the history of the construction of the new glass, though, as we have not been able to submit it to Prof. Abbe, he must not be understood to endorse it in any way.

The origin of the matter was Prof. Abbe's Report on the Microscopes of the South Kensington Exhibition published in 1878.* This contained at the end some general considerations as to the unfulfilled requirements of practical optics in regard to the properties of optical glass, and complaints of the unfavourable conditions then existing. Dr. O. Schott (of Witten, in Westphalia), a chemist, but long versed in practical glass-making, and who had made some remarkable researches on the physical properties of glass, read the report, and in the beginning of 1881, having communicated with Prof. Abbe, they commenced a preliminary study of the optical properties of the various chemical elements as far as they admit of "vitrifiable" combinations. This was conducted at first on a very small scale, Dr. Schott working alone at Witten, and the optical part of the research being carried out at Jena. After a year it was decided to continue the experiments on a larger scale, with the object not only to determine the optical effects of various elements, but to try the production of practically useful combinations. In January 1882, Dr. Schott settled at Jena, and he and Prof. Abbe established a complete melting-laboratory with large

* See this Journal, iv. (1884) p. 291.

gas-furnaces, a gas engine for driving blowers, &c., and with the aid of two assistants for the chemical and the optical part of the work, and of several workmen, the experimental research was continued there for two years.

The general direction of the work was based on the principles indicated in the Report of 1878, and in the paper in this Journal before mentioned. According to these principles, there were *two* distinct objects:—(1) To obtain a greater variety of the optical properties of the glass in regard to the relation of the refractive to the dispersive power. The existing kinds of optical glass constituted nearly *a line*, i.e. the dispersion increasing always with the refraction, with very slight deviations only. The object was to combine glasses which, if arranged according to n and Δn, would *not* be confined to a linear series, but would embrace an *area* of a certain breadth, one value of n admitting various values of Δn, and *vice versâ*, as far as possible.

(2) The second problem was:—To procure kinds of glass of different relative dispersions, in which the dispersions should be *proportional*, as near as possible, in different parts of the spectrum (the problem of "secondary chromatism").

In regard to the general research, Prof. Abbe and Dr. Schott had a predecessor in the late Rev. W. Harcourt, who worked at the subject in conjunction with Prof. G. G. Stokes. They could not, however, use his results, as all that was published about them is very fragmentary and very indefinite, and they were obliged to begin quite anew. Nevertheless, one important fact was brought to a practical result, viz. the very peculiar property of boracic acid in regard to the second problem, the new observations being only a confirmation of Prof. Stokes's account of the glass-samples produced by the Rev. W. Harcourt (though in other essential points the results do *not* confirm the statements of Prof. Stokes).

Dr. Schott had succeeded, after the first months of his melting at Witten, in obtaining fusions of very small quantities—down to 100 grammes—with a remarkable degree of homogeneity, admitting of an exact measurement of the refraction and dispersion by means of spectrometric observation. This was the very basis of advance, because it allowed of a continuous and strict co-operation of the chemical and optical research. Every change of chemical composition could be immediately controlled, in regard to the optical effect, by measurement.

The fusions were obtained by means of gas-furnaces, and with crucibles of very different kinds—a great number with platinum crucibles and tools—in quantities of from 50 grammes to 12 kilos, according to the particular object, nearly all chemical elements being submitted to trial; there is even glass containing 10 or 20 per cent. of *mercury*.

A large number of analyses had been executed by the assistants up to the end of 1883, and more than 600 prisms were ground and measured by the spectrometer. Since then this figure has reached 1000. As it would have been detrimental to the progress of the work

to depend on the weather, the spectrometer measurements were always made by means of the five *bright* lines, K_α, H_α, Na, H_β, H_γ, after the methods described in Prof. Abbe's paper, 'Neue Apparate,' &c.

There were innumerable difficulties to be overcome in order to obtain compositions which should not only show the optical properties desired, but at the same time fulfil so many other requirements for optical glass; and many repeated trials were necessary for one and the same subject before a satisfactory result could be obtained. It is due to the ingenuity and energy of Dr. Schott that these obstacles were overcome.

Towards the end of 1883, Prof. Abbe and Dr. Schott had exhausted the programme, as far as appeared possible in a laboratory-research, and were about to close the affair, and publish the results, as showing the possibility of a series of new kinds of optical glass, and thereby giving an impulse, as was hoped, to its manufacture. At this period, however, several distinguished astronomers and physicists who had taken notice of these researches, encouraged them to go one step further, and to undertake the practical utilization of the results in the way of manufacture. Through the aid of these gentlemen a subsidy was obtained from the Prussian Government (though Jena is not in Prussia) to continue the experiments, so as to establish a manufacture of optical glass, which did not exist in Germany. Messrs. Zeiss, who had already furthered the work, since the beginning, in the most liberal manner by putting all the personal and technical resources of their establishment at Prof. Abbe and Dr. Schott's disposal, united with them, and in the beginning of 1884 glass-works were set up, with a large furnace and machinery. The Prussian Government's subsidy was 3000*l.*, and given under conditions as liberal as any Government has ever granted when putting public money into the hands of private persons.

The new furnace was lighted in September 1884, and since that time Dr. Schott has been actively engaged, almost day and night, in overcoming the difficulties of the operations. The experiences of other manufacturers being inaccessible to a new competitor, everything had to be learned anew. A year later, the first part of the matter was brought to an end—the production of the ordinary siliceous glass, and this, since last autumn, is used by nearly all German opticians. In a few months, it is hoped, that the borates and the phosphates will also admit of regular production, and then the Jena manufactory will be opened for the supply of optical glass on a strictly scientific basis.

This extension of the work has had the effect of delaying the introduction of better glass into microscopical optics by more than two years. In the summer of 1883, sufficient materials had been obtained for the construction of microscope-lenses, and, in fact, the first objectives were made by Messrs. Zeiss at that period, but after it had been decided to establish a manufactory with the aid of public money, Messrs. Zeiss were obliged to abstain from using the new glass, and to wait until the latter should be accessible to other opticians also.

At present the objectives are not on sale, but it is expected that very shortly both objectives and glass can be purchased in the usual way.

Mr. E. M. Nelson, who has had our objective under examination, writes as follows:—

"The great benefit which will accrue to microscopists from the use of lenses of this construction will be due, not so much to the absence of colour as to the greater freedom from spherical aberration. In other words, these lenses will stand illuminating by axial cones of larger angle. This is evident from its performance on *Navicula rhomboides* (Cherryfield). This diatom, which under oblique light is a test for a 1/4 of 90°, becomes a pretty severe test for the widest-angled homogeneous-immersion objective under a large axial cone; in the former case only crossed striæ, or checks could be made out, but in the latter the minute grating should be clearly seen.

This minute grating I have never seen so sharply defined as with this new objective when illuminated by Powell's achromatic condenser with full aperture. It shows the following very delicate objects most distinctly: fracture through the delicate perforated membrane inside the large areolations in *Isthmia nervosa*, and the fracture through the still more minute perforations inside the hexagonal structure of *Triceratium favus*. This last object may be termed the highest test to which the 'microscopy' of the present day can be subjected. Those interested in oblique light will be glad to hear that the striæ on *A. pellucida* come out sharper than I have ever seen them before. The valve is resolved from tip to tip, showing that the lens is flat in its field. To sum up, this lens is decidedly the most brilliant objective I have ever seen. . . . After mentioning the above tests, it is almost unnecessary to say that bacteria, stained and mounted in balsam, are most clearly defined." *

Mr. Nelson subsequently wrote us that he had discovered a very minute perforation on the interior lining membrane of *Eupodiscus Argus*. This diatom consists of two separate membranes. The outer one has a brown tint with transmitted light, but appears white and sparkling, not unlike loaf sugar, with reflected light. This outer membrane has large and for the most part oval areolations all over it, the interspaces being granulated. The inner membrane, which is very transparent, has rows of comparatively large white dots radiating from the centre of the diatom. The whole of this inner membrane between these white dots is covered with very minute perforations. These perforations are often arranged in circular rows round the white dots, and are, in reality, "tertiary" markings.

There is, so far as he is aware, no record of a "tertiary" marking on a diatom having been observed before.

Liquid Lenses.*—Herr P. Lebiedzinski has described some liquid lenses prepared by a method devised by Herr K. Lochovski and himself.

* Engl. Mech., xliii. (1886) pp. 62-3.

† Medical Society of Warsaw, 1881, p. 379. Reported in Jahresber. über die Fortschritte der Anatomie und Physiologie, x. (1882) p. 6.

They are made of a glycerin mixture; and it is said that the drop of liquid adopts a form near that of a paraboloid or ellipsoid, and thus to a certain extent eliminates spherical aberration; the curvature, and with it the magnifying power, can be altered by piston- and screw-motions. Such a lens forms a cheap Microscope made on Plateau's principle, with a magnifying power of 100–200. After use the liquid can be withdrawn by means of the piston into a hollow receptacle. The lenses may be combined to the number of two or three to form a system.

Koristka's Abbe Illuminator.*—Yet another mounting for the Abbe Illuminator has been devised by Signor Koristka, of Milan, for Students' Microscopes, and is shown in figs. 59 and 60. The lenses

Fig. 59.

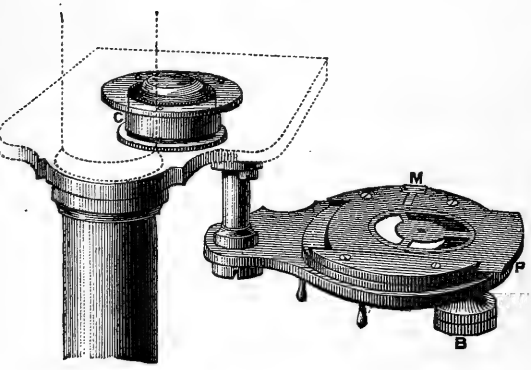
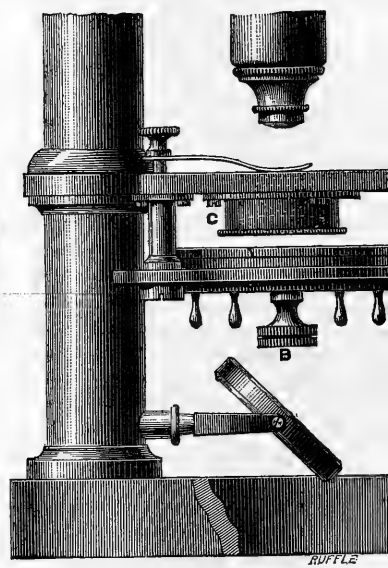


Fig. 60.



are separated from the diaphragm-holder, and slide in a tube *c* fixed to the under side of the stage, the upper lens being level with the top of the stage or below it, as may be desired. The diaphragm-holder swings on a pivot, and the diaphragms can be placed excentrically by moving the slide P by means of the milled head B. A catch at M shows when the diaphragms are central. The central plate of the holder can also be revolved by the pins underneath it.

For Microscopes which have a less space than 38 mm. between the centre of the pillar and the stage, and 80 mm. between the base and the stage, a still simpler plan is adopted, the diaphragms being carried in a ring which is movable on the under side of the stage.

Central v. Oblique Light.†—One of the familiar arts of controversialists is to conjure up an imaginary adversary who propounds the most absurd propositions which are immediately demolished by

* G. Martinotti in Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 500–2 (2 figs.).
† Engl. Mech., xlii. (1886) pp. 451-2 (3 figs.); pp. 527–8 (5 figs.).

his better informed antagonist. This device has been applied by Mr. E. M. Nelson to the question of central and oblique light.

The author first describes Mr. Stephenson's paper (*ante*, p. 37) as having for its object to discountenance the use of central illumination, and as drawing the conclusion that the central portion of the illuminating beam is "useless, harmful, and as such ought to be stopped out"! It is hardly necessary to tell any one who has read that paper that Mr. Nelson's description is as little correct as it would be to describe it as a paper having for its object the extraction of central illumination from cucumbers. The demonstration of the absurdity of the supposed view is, of course, under such circumstances, unusually complete.

Mr. Nelson next combats the view "that nothing can be known about the structure of the Diatomaceæ, because all the diffraction spectra are not admitted," which is proposed to be refuted by showing "that something can be known of the structure of *P. formosum*, because some of the diffraction spectra are admitted." In course of time we have come to know a little of the views of theoretical microscopists, but we have not yet met or heard of any one who holds or ever held the view quoted by Mr. Nelson, which we fear has only a subjective existence. We are at a loss to understand why such a misstatement should have been made in what is apparently intended for a scientific paper, and purporting to be written *au sérieux*. It seems to us, with all deference, to serve no useful purpose from any point of view.

The next point dealt with by the author is put in such a way that to be properly appreciated it must be quoted *in extenso*.

"It is curious to note how those who refuse to know anything about the structure of the Diatomaceæ, because all the diffraction spectra are not taken up, affirm that a German student, who had never seen a diatom, worked out the purely mathematical result of the interference of the six spectra of *P. angulatum*. The purely mathematical result is a very simple business. The diffraction spectra are chromatic images of the source of light arranged in a pattern similar to the pattern which causes the interference, the mathematical connection between the spectra and the pattern being in the size of the interspace and the angular divergence of the spectra from the dioptric beam. All that the German student *could* do was to say that the source of light was a disc, that the pattern causing the interference was similar to the pattern of the diffraction spectra—namely, quincunx—and that if the angular divergence of the spectra from the dioptric beam were given, the size of the interspaces could be found out. Instead of which, he drew a fantastic picture for which there was no warrant from the data given. As this picture had been drawn from purely mathematical investigation, of course the markings must be there, although no one had ever seen them. The angulatum was re-examined, but with a stop at the back of the objective, and the small secondary markings predicted by the German student were seen. The whole affair was given out as a microscopic edition of the discovery of the planet Neptune."

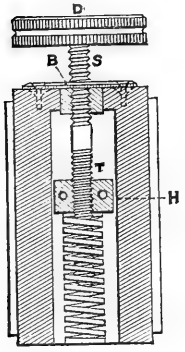
The above quotation shows that the author, at the time he wrote, had not merely not seen the paper of the German student but had not the most elementary appreciation of the manner in which hexagonal markings are derived from six spectra. The statement that the "purely mathematical result is a very simple business," &c., is as wide of the actual fact as the version of Mr. Stephenson's paper.

These are not by any means all of the mistakes into which the author has, no doubt unwittingly, fallen. It is, we venture to think, unfortunate to say the least that such crude notions should be hurried into print without any care having been previously taken to master the elements of the subject supposed to be treated of.

Illumination by aid of Air-bubbles.*—For very delicate structures, such as fur-fibres, Mr. H. L. Brevoort often purposely permits air-bubbles in the mounting material, or introduces them into it. The chances are that some of the fibres will pass through some of the air-bubbles, and when they do this in the proper position, the fibres will be found to be illuminated by the reflection of light from the upper part of the concave surface of the bubble, and the surface of the fibres may be studied with a 1/16 in. immersion lens as readily as with a 1 in. This method of illuminating he finds of great service with the highest powers, and has used it with balsam and glycerin. With the latter it works exceedingly well. The air-bubbles may best be introduced by means of a stylographic pen-filler.

Campbell's Fine Adjustment.†—Mr. E. M. Nelson describes a fine adjustment devised by the Rev. James Campbell, which he considers particularly suitable for Microscopes of the Continental type, where direct-acting screws are employed. The device consists essentially of a differential screw-adjustment, and is shown in fig. 61 as made by Messrs. J. Swift and Son.

FIG. 61.



D is the milled head of the direct-acting screw. The upper part S of the screw has 20 threads to the inch, and the lower part T 25 to the inch. B is the fixed socket forming part of the limb of the Microscope, and H is the travelling socket connected with the support of the body-tube. The revolution of D causes the screw-thread S to move up or down in B at the rate of 20 turns to the inch, whilst the screw-thread T causes the travelling socket H to move in the reverse direction at the rate of 25 turns to the inch. The combined effect, therefore, of turning D 20 revolutions, is to raise or lower T and with it the body-tube 1/5 of an inch, or 1/100 in. for each revolution. The spiral spring below H keeps the bearings in close contact.

* Journ. New York Micr. Soc., i. (1885) p. 203.
† Engl. Mech., xlii. (1886) p. 443 (1 fig.).

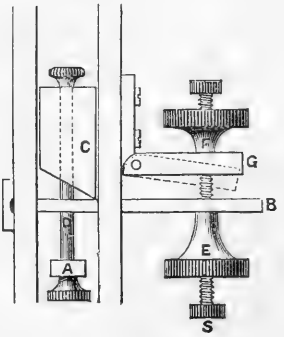
Mr. Nelson considers 25 and 20 threads upon the screw will provide a convenient fine focusing movement for students' Microscopes, though, of course, any desired speed can be obtained by proper combination of the threads. For instance, 32 and 30 would give 1/480 in. for each revolution, and 31 and 30 would give 1/960 in. He thinks the system specially commendable, from the fact that fine movements are thus obtained by the use of strong screws having coarse threads. In his opinion the difficulty with the usual fine adjustments applied to Continental Microscopes has been "that if there is a direct-acting screw with its thread fine enough to give a sufficiently slow movement, then the screw will be found too weak to stand the wear and tear. On the other hand, if it is strong enough to stand the wear and tear, the screw will have to be too quick."

It should be noted that Herr E. Gundlach applied a differential fine adjustment of this kind to the Microscope some years ago, and that at the Inventions Exhibition of last year Messrs. Ross and Co. exhibited a differential movement specially devised by Dr. H. Schröder for application to Microscopes having the "Jackson" limb.

Anderson's Double-action Fine Adjustment.—Messrs. Anderson & Sons have devised a fine adjustment by which two different rates of speed in focusing are provided, the one acting on the lever at the rate of 40 turns to the inch, and the other at 100 to the inch.

The mechanism is shown in fig. 62, where A is a stud carrying the usual tube nose-piece as applied to the "Jackson" form of fine adjustment, with a swinging pin D passing loosely through, and suspended on the top of, the metal block C, which slides freely in parallel fittings and terminates below in a knife-edge. B is a long lever acting on C. S is a screw having 40 threads to the inch at the lower part and 100 above; it is fixed in a hinged shoe-piece G, which covers a rigid bar projecting from the side of the body-tube support.

Fig. 62.



In action the rotation of the milled head E upwards raises the lever B, and consequently C, D, and A (the latter carrying the tube nose-piece), at the rate of 40 turns to the inch, and when a slower motion is required, the rotation downwards of the milled head F draws up the screw and shoe-piece G together with E, B, C, D, and A, at the rate of 100 turns to the inch, the rigid piece within G serving as the stop for this motion. A spiral spring within the body-tube acts against the upward movement of the lever B, and therefore opposes the screw movements of the milled heads E and F.

Fritsch's Stage for Stereoscopic Photo-micrographs.—Dr. G. Fritsch's apparatus, to which we referred at p. 144, is an elaboration

of that by Dr. Benecke (p. 143). It not only allows the angles of inclination of the slide to be varied to a definite extent and accurately measured, but it also enables the observer to bring the axis of inclination into exact agreement with the optic axis, a point which Dr. Fritsch considers to be of the greatest importance, as otherwise the two pictures will not be "stereo-identical." Fig. 63 is a side view, and fig. 64 a view of the apparatus from below. The base-plate consists of an outer frame *a a*, with an inner plate attached to the stage by two pins *b b*. The frame is movable laterally on the plate by the action of the screws *f f* working against the sides of the stage.

The inclining plate is at *c c*, and it can be set at different inclinations (on the axis *x*) by the screw *e* acting against the springs

Fig. 63.

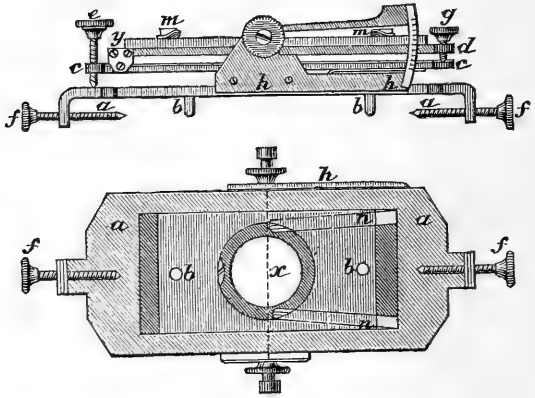


Fig. 64.

n n. The slide is not placed on this plate, but on a second plate *d*, which lies over the former, and which can be inclined (by the screw *g*), on an axis at *y*. The object of the second plate is to compensate for the thickness of the slide. At *h h* is a graduated arc for recording the inclination, and at *m m* spring clips.

The centering of the apparatus is effected by using a spider line stretched in the optic axis and a slide ruled with parallel lines. On tilting the plate *c* first to one side and then the other, any defects in the centering can be readily noticed, for if properly centred no alteration of the focus will be required for the centre ruled line, which will remain in focus at all inclinations of the plate.*

Kellicott's Moist Chamber.†—Professor D. S. Kellicott suggests a modification of Dallinger and Drysdale's moist chamber, which he thinks is an improvement. Instead of cementing the thin glass

* Festschr. zur Feier d. hundertjährigen Bestehens d. Gesell. Naturf. Freunde zu Berlin, 1873, pp. 75–95 (6 figs. and 6 stereophotographs). Cf. Stein's 'Das Licht,' 1884, pp. 201-3 (2 figs.).

† Amer. Mon. Micr. Journ., vii. (1886) pp. 267.

cover, which is the object-carrier, on the glass stage over the aperture, it is cemented on a rather deep ring, made by cutting off a glass tube of a diameter equal to that of the aperture. The ring may then be cemented to the stage, or simply made to rest in place upon it. It will be seen that the bibulous paper stage may now be made to fit close up to the ring, as the object-carrier is lifted above it into the cell or moist chamber formed by the outer glass tube and its thin rubber cover. The ring carrying the object plate and the stage perforation must be large enough to admit the substage condenser.

The author has also applied the principle of the above to the construction of a moist chamber which he has in constant use, and finds handy. An ordinary glass slip is taken; a ring with a cover-glass cemented on the top rests at its centre; then a number of layers of blotting-paper of proper size, with the centres cut out, are placed upon the slide sufficient to reach above the object; the lower paper should fit close up to the ring, and have a tongue on one side. After the object is in place, and covered or not, as the case may be, a slide is put over all, and the combination is put over a dish of water, with the tongue of bibulous paper reaching into it. The drop will not evaporate, and being surrounded by a quantity of air, the infusorian or rotifer under observation will keep in good health for a long time. A special slide and cover, 3 × 1½ in., are rather more convenient, giving a larger cell than ordinary slips.

A still better plan is to use two brass plates, 3 × 1½ in., instead of glass. The lower one is perforated at its centre, and the ring and object-carrier cemented over it; the tongued bibulous paper is then put on as before (only one layer is required to supply moisture, but an additional one with a larger hole at the centre facilitates the removal of the cover). The other plate should have a larger central perforation, over which a ring and cover-glass are cemented. When in use this one is placed over the former, covering the object with the cell, and the whole placed over a dish of water, with the tongue reaching the water. It will be seen that examination with a low power may be made at any time through the cover—the cover to be removed for the use of high powers.

Klönne and Müller's Bacteria-finder.—In the description of this apparatus (*ante*, p. 127) more stress should have been laid on the fact that the upper part of the frame is level with the top of the stage, so that the slide moves on the surface of the stage itself, thus allowing the Abbe condenser to be brought close to the under side of the slide, an advantage which is not obtainable with the earlier forms by Schmidt and Hänsch.*

Dr. W. Behrens suggests† the addition of a vernier for reading the scale on the circular slot, which it is now difficult to do on account of the end of the movable frame by which it has to be read throwing a shadow on the scale, and points out the inconvenient extent to which the apparatus projects behind the Microscope. The makers

* See this Journal, iii. (1880) p. 878.

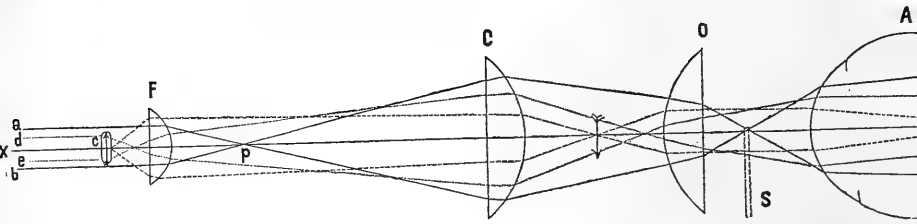
† Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 502-7 (2 figs.).

propose to add rackwork for the swinging motion, to obviate the uncertainty of moving it by hand.

Exner's Micro-refractometer.*—If a card is introduced between the eye and the eye-piece of the Microscope and moved towards the axis of the instrument, a point will be reached at which the field is partially darkened, while the objects stand out in relief with sharply defined lights and shadows as in oblique illumination. A transparent object will be gradually obliterated from one side or the other as the card is inserted. If the transparent object is thicker in its centre than at the edges, then if it is also more strongly refracting than the medium by which it is surrounded, the side which is apparently opposite to the card will be the first to become dark; if, on the other hand, the object is less strongly refracting than the surrounding medium, it will be darkened first on the side from which the screen is introduced.

The matter will be better understood from fig. 65, where F is the

FIG. 65.



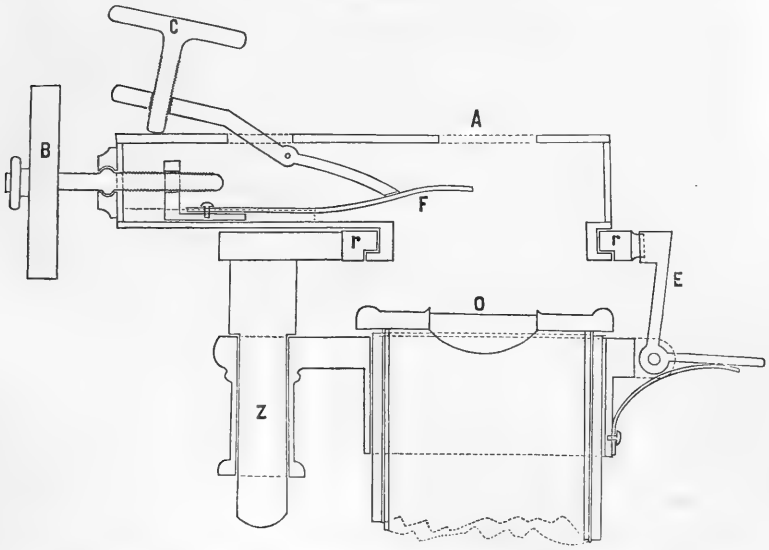
objective, C O the eye-piece, A the eye, *c* the object. The lines *a b* mark the normal course of parallel rays through a non-refracting object, while the lines *d e* represent rays passing through an object which is thicker in the centre than at the edges, and more highly refracting than the surrounding medium. In this case it will be seen that owing to its refraction towards the axis of the instrument the ray *e* is the first to be obliterated by the screen S when introduced from right to left. With a less highly refracting object, the opposite side will be first obliterated. The dotted lines which diverge from the central point of the object *c* indicate the effect of oblique illumination, produced when an opaque object is illuminated from above. S should be at the point above the eye-piece to which the rays converge.

Prof. S. Exner has devised an apparatus (figs. 66 and 67), founded on this principle, which consists of a box fitting by a spring tube above the eye-piece O, with an opening at A, and containing a screen F, with screw motions B and C, by which it can be shifted laterally and raised or depressed. The box can be rotated round the axis of the Microscope on the ring *r r*, and to allow of its being readily removed from the eye-piece, it turns on a pin *z*, and has a spring catch at E. It

* Arch. f. Mikr. Anat., xxv. (1885) pp. 97–112 (2 figs. and 1 pl.).

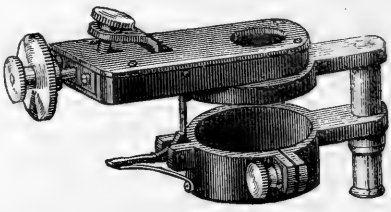
may be used for three purposes: (1) as a means of oblique illumination; (2) if the form of the object be known it will show whether the refractive power is greater or less than that of the surrounding medium; (3) if the refractive power be known it will show in which

Fig. 66.



directions the thickness of the object increases or diminishes. Prof. Exner has also used it to measure the refractive index by immersing the object in different liquids whose refractive index is known, and so finding two of very nearly the same refractive power between which it must lie. He considers that the method is so sensitive as to measure the index accurately to a few units in the fourth decimal place.

Fig. 67.



As an application of the method it is shown how the optical constants of the eye of *Hydrophilus piceus* were determined. An examination of the cornea proved that for each facet the index of refraction increases towards its centre so that the facets may be regarded as consisting of a number of cylinders inclosed within one another, the innermost having the strongest refractive power. This is just such a structure as will concentrate the greatest possible number of rays which fall upon each facet towards its axis, so that they may be utilized in the act of vision.

A plate is given showing the appearance with the apparatus of human red and white blood-corpuscles, red blood-corpuscles of a frog with two vacuoles, and a section through the cornea of *Hydrophilus*.

Apparatus for Examining the Reflex in the Compound Eye of Insects.*—Mr. B. T. Lowne has found the best method of examining the reflex to be the substitution of a reflecting ophthalmoscope for the eye-piece of the Microscope.

By this means a bright luminous spot may be observed as a real image in the tube of the instrument. A 1/4 in. objective must be used, and the mirror of the ophthalmoscope must be strongly illuminated. The Microscope is then focused so that a real image of the corneal facets is seen between the objective and the eye of the observer. By bringing the object-glass gradually nearer to the insect's eye, the reflex will come into view. The reflex appears as a disc having a fiery glow, in moths, and as a bright ruby spot in the cabbage butterfly. Sometimes six spots, surrounding a central spot, are seen in the eye of the insect; perhaps these are diffraction-images. A similar appearance is seen when the eye of this insect is observed by the naked eye, except that the spots are black. The central spot is always opposite the eye of the observer, whatever the position of the eye of the insect. The reflex seen with the micro-ophthalmoscope is green in *Tipula*, and bright yellow in the diurnal flies. Coloured diffraction-fringes are usually present around the central bright spot in both these insects; but the central image is sometimes surrounded by a perfectly black ring.

Thoma's Frog-plate.†—In addition to the Microscope described *supra*, p. 309, Professor R. Thoma previously devised and strongly recommended the following apparatus for examining the circulation of the blood in the tongue of the living frog. It is more especially intended for obviating the effects of evaporation by keeping the tongue flooded by the constant passing over it of a rapid stream of salt solution, which at the same time keeps it free from impurities which might interfere with the observations. It also allows the salt-and-water contents of the tissues to be increased or reduced, and the action of other solutions, such as indigo-sulphate of soda, to be observed.

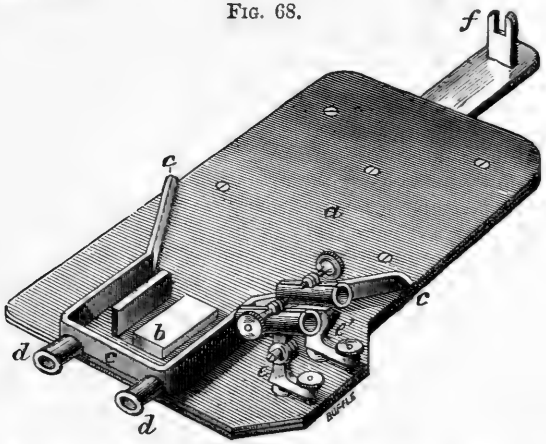
The apparatus consists of a double plate *a* of brass and vulcanite (the latter beneath) with an aperture at *b* closed by a sloping block of glass for the tongue to lie on. At *e e'* are two movable supports for the irrigation tubes. When the Microscope is inclined the fluid is retained by the ledge *c c c* which surrounds the glass block, passing away through the two tubes *d d* at the lower end. At the upper end is a support *f* for the tube used for infusing fluids into the blood, so as to prevent it being displaced if the stage-plate should be moved. Small cork plates are inserted behind the glass block to which the tongue is fixed.

* Trans. Linn. Soc. Lond.—Zool., ii. (1884) pp. 389–420 (4 pls.). Cf. Amer. Natural., xx. (1886) pp. 90–1.

† Virchow's Arch. f. Path. Anat. u. Physiol., lxv. (1875) pp. 36–47 (1 pl.).

A similar contrivance is also used for the web, mesentery, and lung of the frog.

FIG. 68.



Easy Method of Making Micro-photographs.*—The only special appliance absolutely necessary, according to Mr. F. C. Thompson, is a small dark slide to carry an ordinary 3 by 1 in. glass slip. This need be no elaborate piece of mechanism. The simplest form for use with a 1 in. objective may be constructed as follows:—Take a slip of mahogany $3\frac{3}{4} \times 1\frac{1}{2}$ in. (it may be wider if the stage of the Microscope allows of it) and 3/16 in. thick, and in its thickness make a shutter sliding longitudinally. To do this, chisel out carefully and smoothly a space $2\frac{1}{2}$ in. long, 1 in. wide, and 1/8 in. deep, so as to leave 1 in. at one end of the slip untouched, and 1/4 in. on each side. In this shallow recess cut another, the depth of the thickness of thin sheet zinc, or stout post-card. This is for the shutter to slide in; let it extend to $2\frac{1}{2}$ in. from the end of the slip, and be 3/4 in. wide. Then a piece of wood $2\frac{1}{2}$ by 1 by 1/8 in., carefully glued in the larger recess, will form a neat and light-tight groove. Before glueing in this, however, the hole should be cut in the centre of the slip, through which the picture falls on the plate. This need only be about 1/4 in. square, or the same diameter if round. Corresponding with this must be another hole in the bit of wood forming the groove. The shutter may be a piece of thin sheet zinc, or cardboard, of the thickness of an ordinary stout post-card.

On this slip thus furnished with a shutter, glue strips of wood about 1/16 in. thick, so as to leave space between them for a 3 by 1 in. slip. In the corners of this space glue small pieces of thin wood for the corners of the glass to rest upon, and keep the film from being abraded. Another slip of wood of the same dimensions as that described above, and likewise furnished with a shutter, hinged to this plate-carrying arrangement, completes the dark slide—except a

* Year-Book of Photography for 1886, pp. 49-52.

couple of fasteners, which may be made of thin sheet brass, to keep the two parts together. There is no necessity for any troublesome grooving and beading to keep out the light; the pad of blotting-paper put at the back of the plate, to soak up excess of silver nitrate, efficiently does this, and serves also for spring to keep the glass slip in place. A bellows arrangement, to go between the slide and objective, is not so good as a simple piece of black velvet, wrapped round the lens-mount, and extending to the dark slide. This is much less trouble, and more effective.

We are now prepared for the operation of focusing. It is clearly impossible to do this in the ordinary way. The picture being so small would need a second Microscope to see it, even supposing a surface sufficiently fine could be obtained on which to receive it. The principle of conjugate foci must be made use of, the property of a lens by which the object and its image are always interchangeable. In the dark slide, place face downwards, the thinnest and most distinct microscopic section available, or a micro-photograph. On each side of the centre put a pad of cotton wool or paper, to keep it in place (it is of course a convenience to provide a dark slide with a couple of springs), and close the side. Draw both shutters (which should be marked, so as to show when the hole is uncovered), and place on the stage of the Microscope, section upwards. Let the instrument have a 1 in. objective. Remove the eye-piece, and lay on the top of the tube a piece of ground glass, ground side downwards. An enlarged image will of course be produced on this; this must be focused very carefully, and in doing so it is an advantage to use a magnifier. Then, by the well-known property of lenses alluded to above, if an object be placed where the ground glass is, its image will be formed in the place occupied by the section. It is, therefore, quite unnecessary to see the small image. Turn the Microscope so that, on looking along the body-tube from below upwards, white clouds are seen, and replace the ground glass by an ordinary negative. If the operations are carried on on a bench close to a window, the window itself may keep the negative in place, otherwise a retort-stand, or some such thing, must be brought into requisition. Of course it would not entail much trouble to make a special frame, fitting on the end of the Microscope, to carry the negative, but in omitting this the aim has been to enable the worker to see some results as soon as possible.

Having thus put the instrument and negative into position, take away the dark slide, close both shutters, and insert a sensitive plate in place of the prepared slide, putting at the back a pad of blotting-paper the same size, to absorb superfluous solution, and also to act as a spring. Let the dark slide be now placed on the stage in exactly the same position as before; and around the objective, and extending from it to the dark slide, to cut off all extraneous light, wrap a piece of velvet, folded once or twice. This is extremely simple, and is done in much less time than it takes to write it. Place a card over the negative, draw the upper shutter, and all is ready for exposure, which is effected by means of the card. Experience must, as usual,

be the guide in this. A picture is not spoilt by being exposed even twenty times too long. Development is best done while looking through the plate, and as soon as the speck containing the picture distinctly appears, wash off the developer, and fix. A good magnifier will then show how much success has been obtained; if worth examining more critically, a second Microscope is a luxury, but, unless the magnifier shows a good image, it is certainly not worth while to disarrange the Microscope to examine it, if only one is in the operator's possession—especially as another plate can be exposed in two or three minutes. In fact, by having a dipper to hold half-a-dozen plates, they can be exposed, developed, and fixed in about as many minutes.

When success is fairly attained, a special negative may be taken for reduction, and a mask used to cut off all not desirable to appear in the tiny positive. It is needless to say, that this negative must be very sharp, and as clean as possible.

Instantaneous Photo-micrography.* — Mr. D. S. Holman has recently made some experiments in photo-micrography. Having succeeded in taking photo-micrographs of rapid vibrations, he determined to attempt to photograph *Amœba proteus* and other low forms of life while in motion. His method was as follows:—

Having inclosed the material in one of the Holman life-slides, and allowed it to remain until the *Amœbæ* had become accustomed to their new home and active, he cast an image of an *Amœba* on the ground glass of a camera, by means of a Holman lantern Microscope, which is illuminated with the oxy-hydrogen light. A Zentmayer 1/5 objective was used. A dry plate picture was then taken with about one-hundredth of a second exposure. Two exposures were made of one *Amœba* at intervals of three minutes, and one exposure of two *Amœbæ* in the field at one time. The photographs were a complete success, and were shown at a recent meeting of the Franklin Institute magnified 10,000 diameters, making a picture of about eight feet on the screen, so accurate that the granular appearance of the protoplasm could be distinctly seen.

"On the possibility of improvement in the Microscope."†—Dr. R. Altmann discusses the directions in which further improvements in the Microscope are likely to be made.

The absolute efficiency of an objective being $E = \frac{\lambda}{2 \sin \alpha}$, where α = semi-angle of aperture and λ = wave-length of the light employed, then in the most favourable case possible ($\alpha = 90°$) $E = \frac{\lambda}{2}$. The value actually attainable is limited, by difficulties of correction, to an angle of aperture of 120° corresponding to $E = \frac{\lambda}{2 \times 0{\cdot}866}$. The improvement theoretically possible by increase of aperture is

* Sci.-Gossip, 1886, pp. 43–4.

† Arch. f. Anat. u. Physiol. (Anat. Abtheil.), 1886, pp. 64–8 (2 figs.).

therefore about one-seventh of the maximum value, but as it is in this last seventh that the difficulties of correction increase most rapidly, it is hardly to be expected that the aperture can be much enlarged: it remains, therefore, to diminish λ by using an immersion liquid of high refractive index, and to find a form of objective which will enable the corrections to be made with the least difficulty.

If a glass hemisphere be placed with its plane surface on a printed page it will be found that the letters are magnified exactly in the ratio of the indices of glass and air. The rays which pass through the centre of the sphere suffer no aberration, so that in this case it is possible to magnify an object without spherical or chromatic aberration.

On the same principle, it will be found that using homogeneous immersion and a liquid of high index *the absolute efficiency corresponding to that index can by the alteration of a single surface be augmented without involving any essential change in the correction.*

Let B E C D, fig. 69, be the section of a hemspherical front lens, A the point of the object which lies in the axis; let a spherical surface B F C of radius A B be hollowed out, and the space between

Fig. 69.

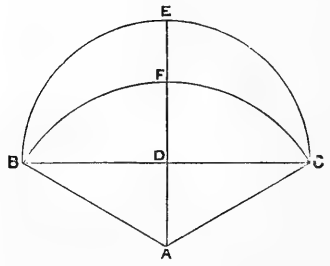
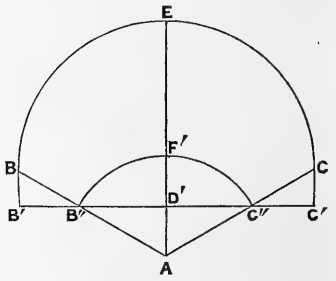


Fig. 70.



A and B F C filled with a liquid of high refractive index, then the efficiency of the objective is increased in the ratio of the indices of the crown-glass and the liquid; and if the surface B F C is accurately formed and the objective previously corrected for homogeneous immersion, the rays from A suffer no aberration; secondary aberrations only appear at some distance from A, and may be corrected by a slight alteration of the back lenses.

To strengthen the lens it is better to give it the form of fig. 70, the radius of the spherical cavity B″ F′ C″ being immaterial so long as its centre is at A. Here B′ E C′ is more than a hemisphere.

Using oil-immersion lenses of the above form, Dr. Altmann finds that without further correction the desired result is in fact attained, at least so far that with the same diameter the objective has its focal length diminished, and consequently the efficiency increased, in proportion to the index of refraction. At the same time he points out that three difficulties will be encountered in carrying out the conditions required. These are, firstly, the construction of the

cavity and the correction of the back lenses; secondly, the discovery of suitable liquids; and thirdly, the application of these liquids to histological purposes.

Imperfections in the cavity can scarcely be avoided, and will with the secondary aberrations prove a source of some trouble to opticians.

As regards the liquids to be used, methylene-iodide appears to be the best at present available; it becomes brown in the light, owing to evolution of iodine, but the colour may be removed by shaking it with aqueous potash-solution; it can be applied directly to dry diatoms, but histological preparations must be previously treated with absolute alcohol and monobromide of napthaline. More suitable liquids may yet be discovered.

With regard to the third point, the cover-glass must be dispensed with, and the immersion liquid used in contact with the object; this, however, introduces no innovation for histological preparations, and has this advantage that the principle of homogeneous immersion suffers no disturbance when the cover-glass is abolished. To get rid of difficulties arising from differences of refractive power in the tissues and the immersion-liquid it will be necessary to increase the cone of illuminating light as far as possible; with a cone of 180° this difference would theoretically be eliminated. Abbe's illuminator is not sufficient, and the best plan is to use thin plates of white glass as object-carriers, and illuminate them brilliantly from beneath.

The cavity in the front lens might be dispensed with if the crown-glass meniscus could be replaced by a flatter plano-convex lens of diamond; unfortunately it is not possible to give any considerable curvature to the diamond. If the diamond lens could be used many advantages would be gained even with oil of low refractive power, e.g. with an immersion liquid of index 1·5 it would only be necessary to correct for 60° instead of 120° as is the case at present with the most powerful objectives; and in addition to easier correction a larger aperture would be obtained.

The Aperture Question.—We were not a little surprised to receive lately an elaborate discussion on Aperture and Microscopical Vision, written in Spanish, which we should have supposed to be one of the most unlikely languages of Western Europe in which such a subject would be treated of. It is from the pen of Don Joaquin M$^{a.}$ de Castellarnau y de Lleopart,* who in other papers previously published has shown himself to be much in advance of the majority of his countrymen in a knowledge and appreciation of both theoretical and practical microscopy.

The present work is extremely well put together; indeed, it is quite unique in the completeness of its treatment of the question. If there now remained in this country any microscopists who seriously questioned either the fact of an aperture in excess of 180° in air, or

* 'Vision Microscópica. Notas sobre las Condiciones de Verdad de la Imágen microscópica y el modo de expresarlas.' 96 pp., 1 pl., and 3 figs, 8vo, Madrid, 1885 (sep. repr. from Anal. de la Soc. Esp. de Hist. Nat., xiv. (1885) pp. 257–352.

the Abbe diffraction theory, a translation of the author's treatise would, we feel sure, have been of benefit to English readers. It is divided into three parts, the first dealing with diffraction, the second with aperture, and the third with the relation of aperture and power.

There are some terse passages on the aperture controversy of 1881, and the part which this Society took in finally elucidating the question, one of which we reproduce, though as we do not desire to fan into a flame again any of the slumbering embers of the old fires —if, indeed, they are not extinct—we leave the passage in its original Spanish.

"La nueva teoría—la verdadera—sobre la vision microscópica, es aún muy poco conicida. A pesar de que su orígen data de 1873, y de haberse dado cuenta de ella á la Real Sociedad de Microscopia de Lóndres en 1877, su conocimiento no se difundió más allá de un circulo muy pequeño; y apénas era conocida en Alemania, Inglaterra y los Estados-Unidos de América—países en donde la microscopia se encuentra en floreciente estado—ántes de 1881. Desde esta época, su conocimiento ha empezado á extenderse; y de la lucha entre los partidarios de las antiguas y modernas teorías, ha salido victoriosa en términos tales, que hoy nadie se atreve á disputarle el triunfo. Mr. Shadbolt, el más decidido adversario de la 'Teoría Abbe,' y el que, con más vigor le ha hecho la guerra en la Real Sociedad de Microscopia de Lóndres, ha tenido que darse por vencido, y nada en contra ha vuelto á publicar (que yo sepa á lo ménos) desde 1881."

Fine Platinum Wire and Thin Gold Leaves.—Mr. H. T. Read is said * to have made some wire so fine that it is too thin to be seen with the naked eye, though it can be felt. A platinum wire is made the core of a silver tube, and then drawn out with the silver to the thickness of the original platinum wire. This is in turn made the core of another silver tube and again rolled out, and, finally, the silver is dissolved off with nitric acid. It is intended to use this wire as a substitute for spider-webs.

Mr. A. E. Outerbridge,† by electro-plating a known weight of gold upon one side of a sheet of copper-foil of given dimensions, obtains a coating of gold upon the copper whose thickness is readily ascertainable by a simple calculation; then, by using a suitable solvent, the copper may be removed, when the leaf of gold will remain intact. After a series of careful experiments he has obtained, in this way, sheets of gold, mounted on glass plates, which are not more than 1/40,000 mm. thick; and has some specimens which he has good reason to believe are not more than 1/400,000 mm., "about the 1/200 part of a single wave-length of light."

* St. Louis National Druggist, vii. (1885) p. 308.
† Amer. Mon. Micr. Journ., vii. (1886) pp. 37–8.

ALTMANN, R.—**Ueber die Verbesserungs-fähigkeit der Mikroskope.** (On the capacity of improvement of Microscopes.)
[*Supra*, p. 333.]
Arch. f. Anat. u. Physiol. (*Anat. Abth.*), 1886, pp. 61–8.

Baldwin's (N.) Photo-micrographs.
[Of *Amphipleura* in Smith's medium, showing longitudinal (? diffraction) and transverse lines. Also of broken sections of a butterfly's wing taken with the binocular and mounted for the stereoscope.]
The Microscope, VI. (1886) p. 16.
Amer. Mon. Micr. Journ., VII. (1886) p. 18.

BEHRENS, W.—**Klönne & Müller's beweglicher Objecttisch.** (Klönne & Müller's movable stage.)
[*Ante*, p. 127, and *supra*, p. 327.]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 502–7 (2 figs.).

BREVOORT, H. L.—**Illumination by aid of Air-bubbles.** [*Supra*, p. 324.]
Journ. N. York Micr. Soc., I. (1885) p. 203.

Bulloch's (W. H.) Lithological Microscope-stand. [*Ante*, p. 122.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 10–11 (1 fig.).
The Microscope, VI. (1886) pp. 12–13 (1 fig.).

CALLIANO, C.—**Un nuovo regolatore del preparato al Microscopio.**
[Mechanical stage (removable) with rectangular movements. Also acting as a finder by registering the movements on a square (of 2 cm.) divided into square millimetres.]
Giorn. R. Accad. Med. Torino, XLVI. (1883) No. 4.
Arch. Sci. Med., VII. (1883) p. 167.

Carpenter, W. B., Death of. *Journ. Quek. Micr. Club*, II. (1886) pp. 245–6.
Amer. Mon. Micr. Journ., VII. (1886) pp. 1–3.

CASTELLARNAU Y DE LLEOPART, J. M. DE—**Vision Microscópica.** (Microscopical vision.) (*Concld.*) [*Supra*, p. 335.]
Anal. Soc. Esp. Hist. Nat., XIV. (1885) pp. 289–352 (1 pl.).
Sep. repr., 96 pp., 1 pl., and 3 figs. (8vo, Madrid, 1885).

COHEN, E., and J. GRIMM.—**Sammlung von Mikrophotographien zur Veranschaulichung der mikroskopischen Structur von Mineralien und Gesteinen.** (Collection of photo-micrographs for demonstrating the microscopic structure of minerals and rocks.) 2nd ed., 80 phot. pls. (4to, Stuttgart, 1885).

Directory, Our Scientific.
[Further list of English Microscopical and other Societies.]
Sci.-Gossip, 1886, pp. 42, 65, & 88.

DU ROCHER, BOISSEAU.—**Mégaloscope.**
["A Note intended to prove that the optic system of his Megaloscope is absolutely different from Trouvé's Polyscope."]
Comptes Rendus, CII. (1886) p. 403.

EDMUNDS, J.—"**Microscopical Advances.**"
[Rochon was the originator of the use of a transparent cement between the lenses of an achromatic objective, and not Chevalier as suggested by Dr. Royston-Pigott.]
Engl. Mech., XLIII. (1886) pp. 83–4.

ETERNOD, A.—**Tour horizontal pour Microscopistes.** (Horizontal lathe for microscopists.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 507–9 (3 figs.).

EWELL, M. D.—**The relative merits of Filar and Ordinary Glass Eye-piece Micrometers.** [*Supra*, p. 316.] *The Microscope*, VI. (1886) pp. 32–40.

F.R.A.S.—**This Journal.**
[Complaint that he has not received the title-page and index of Vol. V.]
Engl. Mech., XLII. (1886) pp. 446 and 489.

FLEISCHL, E. v.—**Das Hämometer.** (The Hæmometer.) [*Post.*]
Sep. repr. *Med. Jahrb. K.K. Gesell. Aerzte Wien*, 1885, 20 pp. (1 pl.).

GRIMM, J.—See Cohen, E.

GUNDLACH, E.—**Magnification.**
[Reply to Mr. W. H. Bulloch's queries, *ante*, p. 148.]
Amer. Mon. Micr. Journ., VII. (1886) p. 20.
The Microscope, VI. (1886) pp. 42–3.

„ „ **Astigmatism and its relation to the use of Optical Instruments.**
[*Supra*, p. 313.] *Ibid.*, pp. 1–4.
Bull. Rochester (N.Y.) Acad. Sci. (Sect. of Microscopy), 1886, pp. 4–7.

HEURCK, H. VAN—**Le Microscope à l'Exposition Universelle d'Anvers.** (The Microscope at the Antwerp Universal Exhibition.) (*Contd.*)
[Microscopes of Ross and Zeiss—Trouvé Battery and Helot-Trouvé and Van Heurck Photophore—Photo-micrographs.]
Journ. de Microgr., X. (1886) pp. 25–32 (7 figs.).

HITCHCOCK, R.—**Photo-micrography. III., IV.**
[2. Apparatus (*contd.*) (*b*) Microscope and accessories, Camera, &c.—Body-tube should be lined with dead-black cloth. Working with or without an eye-piece. Cameras of Scovill, Walmsley, Atwood, Stein, Aubert, and Sternberg. Amplifier. Size of plates. Focusing arrangements. 3. Illumination, with description and fig. of Kübel's Heliostat.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 5–10 (5 figs.), 48–50 (1 fig.).

HÖEGH, E. V.—**Die achromatische Wirkung der Huyghens'schen Okulare.** (The achromatic action of the Huyghenian eye-piece.)
["It will perhaps be welcome to many to understand the nature of this action, especially as in most books it is only stated, and not explained." The explanation is mathematical, and cannot be abstracted.]
Centr.-Ztg. f. Optik u. Mech., VII. (1886) pp. 37–8.

HOLMAN, D. S.—**Instantaneous Microphotography.** [*Supra*, p. 333.]
Sci.-Gossip, 1886, pp. 43–4.

INOSTRANZEFF, A. V.—**Ueber eine Vergleichungs-Kammer zur mikroskopischen Untersuchung undurchsichtiger Mineralien.** (On a comparison-chamber for the microscopical investigation of opaque minerals.)
[See Vol. V. (1885) p. 1058, and *post.*]
Neues Jahrb. f. Mineral., II. (1885) pp. 94–6 (2 figs.).

ISRAEL, O.—**Ueber eine Erwärmungsvorrichtung als Ersatz der heizbaren Objecttische.** (On a heating arrangement as a substitute for a hot stage.)
[*Post.*] *Zeitschr. f. Wiss. Mikr.*, II. (1865) pp. 459–63 (3 figs.).

JADANZA, N.—**Ueber die Fundamentalpunkte eines centrirten dioptrischen Systems und über das anallaktische Fernrohr.** (On the fundamental points of a centred dioptric system and on the anallactic Telescope.)
Centr.-Ztg. f. Optik u. Mech., VII. (1886) pp. 13–7 (8 figs.).

KELLICOTT, D. S.—**Dallinger's Moist Chamber.** [*Supra*, p. 326.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 26–7.

LAURENT, L.—**Sur l'exécution des Objectifs pour instruments de précision.** (On the execution of objectives for instruments of precision.)
[Describes his method of determining whether the defect of an objective is incorrect curvature or defective centering of the lenses.]
Comptes Rendus, CII. (1886) pp. 545–8 (2 figs.).

Lenses, the best only.
[Exhortation to the student in biology or histology to use them.]
Journ. New York Micr. Soc., I. (1885) p. 224.

LIST, J. H.—**Ueber einen Objecthalter mit Kugelgelenk.** (On an object-holder with ball-and-socket joint.)
[See this Journal, V. (1885) p. 347.]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 341–2 (2 figs.).

MARTINOTTI, G.—**Di una modificazione all' Apparato di illuminazione dell' Abbe.** (On a modification of Abbe's illuminating apparatus.) [*Supra*, p. 322.]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 500–2 (2 figs.).

MICHAEL, A. D.—**President's Inaugural Address.**

[Personal remarks—Future of the Club—Exhortation to younger members to communicate the results of their observations to the meetings "without fear of being laughed at."]

Journ. Quek. Micr. Club, II. (1886) pp. 215–8.

Microscope, Microscopic, Microscopical.

[Recommendation to use "Microscope" for parts of the Microscope, as Microscope-stand; "microscopic" for objects or features too minute to be appreciated by the naked eye; and "microscopical" for uses to which the term "microscopic," as above restricted, would be inappropriate.]

Journ. New York Micr. Soc., I. (1885) p. 209.

MILLER, M. N.—**Photo-micrography.**

[Reply to Editor's criticism on the author's methods that they require expensive apparatus, &c. The highest results "cannot be got without expensive appliances and special surroundings."]

Amer. Mon. Micr. Journ., VII. (1886) pp. 19–20.

Monkeying with the Microscope.

[Advice to medical readers not to purchase a Microscope to "furnish the office," nor to "mount scores of slides," which should not be done "unless for recreation or as a hobby."]

The Microscope, VI. (1886) p. 42, from *Indiana Med. Journ.*

NELSON, E. M.—**The Rev. James Campbell's Fine Adjustment.**

[*Supra*, p. 324.] *Engl. Mech.*, XLII. (1886) p. 443 (1 fig.).

" " **Central *v.* Oblique Light.** [*Supra*, p. 322.]

Ibid., pp. 451–2 (3 figs.), pp. 527–8 (5 figs.).

" " **[Magnifying Power of Lenses.]** *Ibid.*, pp. 515–6.

" " **The New Abbe-Zeiss Microscope Objective.** [*Supra*, p. 321.]

Engl. Mech., XLIII. (1886) pp. 61–2.

" " **Historic Microscopy.**

[Brief descriptions of some simple and compound Microscopes from 1590 to 1831.]

Journ. Quek. Micr. Club, II. (1886) pp. 222–9 and 247.

" " **On a method of equalizing the thickness of slips when using an oil-immersion condenser.** [*Ante*, p. 131.]

Ibid., p. 230.

ONE WHO KNOWS.—**This Journal.**

[Reply to F.R.A.S., *supra*.] *Engl. Mech.*, XLII. (1886) p. 474 and 516.

" " " **Central *v.* Oblique Light.**

[Pointing out that Mr. Nelson's letter, *supra*, in stating that the object of Mr. Stephenson's paper (*ante*, p. 37) was to "discountenance the use of central illumination," &c., was a strange mistake, as the paper "from beginning to end contains not a word or a hint on what Mr. Nelson declares to have been its object!"]

Ibid., p. 469.

OUTERBRIDGE, A. E., JUN.—**Matter, including Radiant Matter.**

[*Supra*, p. 336.] *Amer. Mon. Micr. Journ.*, VII. (1886) pp. 37–8.

PIERSOL, J. A.—**Photo-micrography at the work-table.** [*Post.*]

Amer. Mon. Micr. Journ., VII. (1886) pp. 24–5.

President's Address. *Times*, 15th February 1886; *Sci.-Gossip*, 1886, p. 67.

Presidents, Portraits of. *Nature*, XXXIII. (1886) p. 327.

Professional Microscopy.

["There is, then, a science of microscopy. Its mastery is peculiarly difficult, requiring rare sagacity and dexterity, and a lifetime of devotion, and its study has become a profession. This fact is not known to all, it having grown too fast for any but a watchful eye to keep pace with it. 'There is no science of microscopy—the Microscope is only an instrument,' was said in our hearing a few days ago. A gun is but an instrument; yet is there not a science of gunnery? and its acquisition is an indispensible part of

the professional soldier's education. The importance of a special and systematic course of instruction in microscopy is gaining recognition in some of our best institutions of learning."]

Journ. New York Micr. Soc., I. (1885) pp. 210–1.

REINHARD, C.—**Spirituslampe mit constantem Niveau.** (Spirit-lamp with constant level.) [*Post.*]

Zeitschr. f. Analyt. Chemie, XXIII. (1884) p. 40.
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 229–30 (1 fig.).

ROGERS, W. A.—**Ruled plate for the study and measurement of blood-corpuscles.** [*Post.*] 11*th Ann. Rep. Amer. Post. Micr. Club* (Troy, N.Y.), 1886, p. 13.

ROYSTON-PIGOTT, G. W.—**Microscopical Advances—Ancient and Modern. V. and VI.**

[V. Compensations for residuary aberrations. Mr. J. J. Lister.]

Engl. Mech., XLII. (1886) pp. 483–4.

[VI. A new era dawning for minute research. Gradual destruction of aberration.]

Ibid., XLIII. (1886) pp. 45–6.

SCHREIBER, O.—**Untersuchung von Kreistheilungen mit zwei und vier Mikroskopen.** (Investigation of circle divisions with two and four Microscopes.) [*Post.*]

Zeitschr. f. Instrumentenk., VI. (1886) pp. 1–5, pp. 47–55, 93–104.

SCHULZE, F. E.—**Lupenhalter.** (Lens-holder.)

[For passing round in a class.]

SB. Gesell. Naturf. Freunde Berlin, 1885, p. 86.

SEIFERT.—**Demonstration von Beleuchtungs-Apparaten.** (Demonstration of illuminating apparatus.)

[A.—Fritsche's albo-carbon investigation lamp. B.—Electric incandescent lamps.]

SB. Physikal-Med. Gesell. Würzburg, 1885, pp. 116–9.

STOCKWELL, J. K.—**Astigmatism practically considered in microscopic work.** [*Supra*, p. 313.] *The Microscope*, VI. (1886) pp. 29–32.

Strasburger, E.—**Manuel technique d'anatomie végétale. Guide pour l'étude de la Botanique microscopique.** (Technical handbook of vegetable anatomy.)

[Translation by J. Godfrin of 'Das Botanische Practicum.']

viii. and 405 pp., 118 figs. (8vo, Paris, 1886).

STREETER, W.—**On testing Objects, and resolution of Test Objects.**

["I tell you that which you yourselves do know, show you sweet Cæsar's wounds, poor dumb mouths, and bid them speak for me."]

Bull. Rochester (N.Y.) Acad. Sci. (Sect. of Microscopy), 1886, pp. 7–12.

Telescope and Microscope.

[Quotation of Dr. Chalmers.]

The Microscope, VI. (1886) p. 23, from *Tidings from Nature.*

TROUVÉ, G.—**[Electro-polyscopie v. Electro-mégaloscopie.]**

["M. G. Trouvé *à propos* of a recent communication of M. Boisseau du Rocher on electro-megaloscopy (Vol. V., p. 1061), recalls the results obtained by the method of electro-polyscopy, of which he is the author, and which is intended for the exploration of the cavities of the human body."]

Comptes Rendus, CII. (1886) p. 274.

VIALLANES, H.—**Microphotographie. La Photographie appliquée aux Etudes d'Anatomie microscopique.** (Photomicrography. Photography applied to micro-anatomical studies.) [*Post.*]

vi. and 66 pp., 1 pl. and 4 figs. (8vo, Paris, 1886).

WENHAM, F. H.—**Centering Glass.** [*Post.*] *Engl. Mech.*, XLII. (1886) p. 516.

β. Collecting, Mounting and Examining Objects, &c.*

Net for Catching Small Free-swimming Animals.†—Herr F. E. Schulze's modification of the ordinary gauze net, which, by reason of its sides collapsing when withdrawn from the water, damages the small animals within it, consists of a hemispherical cap of horsehair cloth. Its circular margin is fastened to a light tin ring, and the hinder part of the gauze net is sewn to the inside. Although stiff, it is perfectly elastic, returning to its original form immediately after being tilted forward, which must be done every time the net is emptied of its contents.

As thus adapted, it will be found that the imprisoned animals lie on the smooth, outstretched horsehair part of the net. As the gauze net also has its own ring of tin, the horsehair cap and ring can be pushed over it, and the two are made fast by a kind of bayonet-joint and a couple of pegs fitted to the ring.

Mud Pipette.‡—Herr F. E. Schulze employs the following apparatus on zoological excursions for obtaining small animals:—

It consists of a glass tube about as thick as the finger, and 30–40 cm. long. One end is somewhat narrowed, and the other provided with a projecting rim. An elastic tube, about as thick as a goose quill, is drawn over it, and both are fastened to an ordinary walking-stick by bending a piece of brass wire 3 mm. thick into a figure of 8 shape. The eyes are about 10 mm. in diameter, and are bent towards each other at a right angle. Through one eye another brass wire ring, 8 mm. in diameter, is drawn, and this is fastened to the stick by means of a caoutchouc ring 12 mm. in diameter and 8 mm. broad. The figure of 8 thus hangs down free, the lower limb projecting outwards. The elastic pipe is then drawn first through the lower horizontal eye, and then through the upper vertical eye. The glass pipette depends just beneath the former. The tube is held in the left hand, the stick in the right, and the tube having been compressed, the pipette is sunk into the water. Pressure is now relaxed, the water rises, and the animal having been caught, pressure is again applied, and the stick removed.

Method of Spore Germination.§—In view of the difficulty experienced in growing the spores of those Pteridophytes whose prothallia are destitute of chlorophyll, the following experiments by Mr. D. H. Campbell, though incomplete, may perhaps be of service for further investigations:—

The spores were sown upon the surface of fine earth, in shallow earthen saucers, and covered with small frames constructed as follows:

* This subdivision contains (1) Collecting Objects; (2) Preparing, (*a*) in general, (*b*) special objects; (3) Separate processes prior to making sections; (4) Cutting, including Imbedding and Microtomes; (5) Staining and Injecting; (6) Mounting, including preservative fluids, cells, slides, and cabinets; (7) Examining objects, including Testing; (8) Miscellaneous matters.

† SB. Gesell. Naturf. Freunde, Berlin, 1885, pp. 178–9.

‡ Ibid., pp. 179–80.

§ Bot. Gazette, x. (1885) p. 428.

A shallow box, or rather frame, about four inches across, was made from four narrow strips of wood, the bottom being constructed of fine wire gauze, thus forming a sort of small sieve. This was filled with fine earth pressed firmly down, so as to allow as little air as possible to get in between the bottom of the box and the surface upon which the spores were sown. The spores were thus practically underground, and yet could be readily examined by simply lifting the frame. By this process a number of spores of *Botrychium ternatum* were made to germinate, and small prothallia were obtained. In this case germination did not occur until nine months after sowing the spores.

Germinating Fungus-spores and Pollen-grains.*—Mr. T. J. Burrill says that fungus-spores, as a rule, germinate best when sown *upon* a drop of water in which there is dissolved a small proportion of gum. If the aqueous drop is put on a slide, the spores dusted on the slightly viscid fluid, and the whole kept in a moist chamber for twenty-four hours, at the ordinary temperature of the laboratory, an examination will often be rewarded by an instructive exhibition of germinal tubes.

The same may be said of pollen-grains, though the addition of a little nectar or sugar to the fluid in this case is useful.

Cultivation of Pollen-grains.†—In the cultivation of pollen-grains, those of monocotyledons are most responsive, and of all that have been tried, those of *Tradescantia* are the most serviceable. The pollen-tube begins to develope in a very few minutes, and within an hour becomes many times longer than the grains, and has received the contents. An ordinary moist chamber can be used, constructed of blotting-paper or cardboard, as suggested by Bower and Vines in their 'Practical Botany,' p. 16, and by Goodale in his 'Physiological Botany,' p. 430. The points which experience with this special plant suggests are, according to Prof. J. M. Coulter :—

1. The culture drop, for a quick response, should be a saturated solution of cane sugar.

2. The pollen-grain should be first placed upon the cover-glass, and then the culture drop added. If the pollen is sown on the culture drop, it will remain too far removed from the objective, and the tubes will mostly grow towards the objective, and so be seen in optical section instead of in profile.

3. Pollen should be obtained from flowers that have been open for some time.

"*Tradescantia* is so common, the moist chambers are so simple, and the response so immediate, that it would seem a pity for any student to fail seeing the extine ruptured, and the intine developing into a pollen-tube."

Silver treatment of Medullated Peripheral Nerves.‡—Dr. C. Mondino gives detailed instructions as to his modification of Golgi's silver treatment of peripheral nerves.

This simpler procedure consists in first moistening the nerves *in*

* Bot. Gazette, x. (1885) p. 428.
† Ibid., p. 427.
‡ Arch. per le Sci. Med., viii. (1885) p. 45.

situ with a 2 per cent. solution of bichromate of potassium or ammonia, or with Müller's fluid. The pieces of the nerve are then hardened for twenty-four to forty-eight hours in the same solution, and are next placed in 1/2 per cent. solution of silver nitrate. Less permanent preparations may be obtained somewhat more quickly by adding to 10 parts of the first solution 1 part osmic acid. This is dropped on *in situ*, and after ten or fifteen minutes, the nerve (sciatic of dog) having been cut out, is divided into pieces 1 cm. long and placed in the solution. The after treatment is as before. Examination must be made every day for the first week to see if the time for silver treatment have arrived; a longer action of the silver than twenty-four hours is of advantage. The rest of the procedure consists in teasing out under alcohol and mounting in creosote-dammar.

Preparing Nasal Mucous Membrane.* — Dr. E. Paulsen has obtained very satisfactory results in his study of the glands of the nasal mucous membrane by the use of Flemming's osmium mixture and 1 per cent. osmic acid, or Heidenhain's alcohol-hardening method,† and of de la Field's hæmatoxylin solution for staining. Not only the nuclei but the protoplasmic network were beautifully stained, while the homogeneous intermediate substance remained clear. He distinguishes three kinds of glandular epithelium, (*a*) a portion exhibiting all the characteristics of secreting mucous cells, (*b*) a second portion resembling the cells of the albumen-glands, and (*c*) a third uniting the characteristics of both.

Chloral Hydrate for Preserving Lower Animals.‡ — Dr. A. Föttinger has tried chloral hydrate for the preservation of lower animals. Complete results were obtained with *Alcyonella stagnarum;* when all the polyps in a vessel containing 100 cc. of water were fully expanded, some crystals of chloral hydrate were dropped into the vessel; these dissolved rapidly, and the substance was gradually diffused through the water; after ten minutes a little more chloral was added, and at the end of three-quarters of an hour the whole colony had become insensible. When irritation results in no retraction, the whole colony may be placed in alcohol without any of the crowns of tentacles contracting or losing their normal form. Dr. Föttinger is of opinion that the chloral has nothing but a narcotic action, for they can recover from it, and their tissues are not affected by it. The same result was obtained with the common star-fish, with *Doris stellata*, and with other Polyzoa. Care must be taken that the crystals do not come into direct contact with the object. The drug succeeds very well with Nemertean worms.

Collodion for Fixing on the Glass Objects to be preserved in Alcohol.§—Dr. A. Föttinger also describes his method of using collodion to fix on to glass objects which it is intended to preserve in alcohol. The animal, hardened by alcohol, is withdrawn from the

* Arch. f. Mikr. Anat., xxvi. (1885) pp. 307–21 (2 pls.).
† See this Journal, v. (1885) p. 158.
‡ Arch. de Biol., vi. (1885) pp. 115–25. § Ibid.

liquid and placed on blotting-paper, so as to withdraw much of the alcohol. A drop of collodion having been put on a glass plate, it is placed in it; and the plate is laid horizontally into a flat vessel, which is slowly filled with spirit; after a few minutes the animal adheres sufficiently well to allow of the glass being set vertically. When large objects, such as star-fishes, are being set up, it is sufficient to put drops of collodion at various points on the glass. One great advantage of this method is that the collodion remains transparent in spirit.

Purifying and Hardening Commercial Paraffin.*—A method for purifying and hardening commercial paraffin is recommended by Dr. A. Föttinger. The paraffin is heated in a sand-bath with distilled water to which a small quantity of solid caustic potash has been added. When the paraffin has melted and the potash is entirely dissolved, the mixture is well stirred. After a certain time there is an abundant precipitate; this is allowed to settle, and the paraffin is then poured off, thoroughly washed with distilled water, and then heated afresh; but this time the temperature must be considerably raised, and kept high for several hours. If the paraffin turns yellow it must be washed with a warm weak solution of caustic potash. This method gives a white, very hard, and quite homogeneous paraffin, in which there is no solution of continuity.

Bleaching the Arthropod Eye.—Prof. Grenacher, according to Prof. J. Carrière,† employed the following mixture (as well as one with nitric acid):—Glycerin, 1 part; alcohol (80 per cent.), 2 parts; and hydrochloric acid, 2–3 per cent. The preparation remains in this mixture until the pigment changes colour and becomes diffuse.‡

Separating the Layers of the Wings of Insects.§—Mr. G. Dimmock separates the two layers of the wing of *Attacus cecropia* by the following process:—The wing from a specimen that has never been dried is put first in 70 per cent. alcohol, then into absolute alcohol, and from the latter, after a few days' immersion, into turpentine. After remaining a day or two in turpentine, the specimen is plunged suddenly into hot water, when the conversion of the turpentine into vapour between the two layers of the wings so far separates these layers that they can be easily parted and mounted in the usual way, as microscopical preparations on a slide.

Method of Bleaching Wings of Lepidoptera to Facilitate the Study of their Venation.‖—In the common method of destroying the scales on the wings of Lepidoptera, for the purpose of studying their venation, by means of caustic alkaline solutions, there is danger of not arresting the action at the proper moment, and consequently of destroying not only the portions which it is desirable to remove, but also the scale-supporting membrane, and even the delicate veins themselves. An application of a modification of the chlorine bleaching

* Arch. de Biol., vi. (1885) pp. 115–25.
† Carrière, J., 'Die Sehorgane der Thiere,' 1885, p. 205.
‡ Amer. Natural., xx. (1886) pp. 89–90.
§ Ibid., p. 92, from Psyche, 1884, p. 170. ‖ Ibid., pp. 204–5.

process, commonly used in cotton bleacheries, suggested by Mr. G. Dimmock, obviates the necessity of removing the scales, and leaves the wing perfect.

The most convenient method for applying the chlorine is as follows:—The wings must first be soaked a few moments in pure alcohol, in order to dissolve out the oily matter in them. If this is not done, the surface of the wings acts as a repellent, and will not be moistened by an aqueous solution. When the wings have become thoroughly soaked by the alcohol, they are ready to be removed to a solution of common bleaching powder. This bleaching powder is sold by druggists as "chloride of lime," but it is really a mixture of calcic hypochlorite, calcic chloride, and calcic hydrate. Ten parts of water dissolve the first two compounds, leaving nearly all the third suspended in the solution. The solution should be made with cold water, filtered, and kept in a tightly corked bottle until required for use. When the wings are transferred to this solution the bleaching commences, and in an hour or two the wings are devoid of markings, although the veins retain a light-brown colour. This is due to the fact that chlorine cannot quite decolorize animal matter, or any substance containing nitrogen, as it does vegetable tissue.

After the colour has sufficiently disappeared from the wings they should be transferred to a wash composed of one part of strong hydrochloric acid to ten parts of water. And here it may be added that in case the bleaching does not readily commence upon immersion in the bleaching solution, the action may be hastened by a previous dipping in the dilute hydrochloric acid. In the bleaching solution a crust of calcic carbonate, formed by the union of the calcic hydrate of the solution and the carbonic dioxide of the air, is deposited on the wings, and this calcic carbonate the final wash in dilute acid will remove. As soon as the calcic carbonate has disappeared, and all bubbling, consequent upon its decomposition by the hydrochloric acid, has ceased, the wings should be well soaked in pure water. They may then be secured on cards with a mucilage of gum tragacanth, or upon glass by the proper transfers, through alcohol and chloroform, to Canada balsam.

A solution of sodic hydrochlorite, known as "Eau de Labarraque," or a solution of potassic hydrochlorite, known as "Eau de Javelle," when used in place of the solution of bleaching powder, do not leave a deposit of calcic carbonate on the wings, and thus dispense with the wash of dilute acid. A solution of zinc hypochlorite acts more delicately than a solution of sodic hypochlorite, and may be used in place of the latter, as may also solutions of aluminic hypochlorite, or magnesic hypochlorite.

Modification of Ehrlich's Method for Tubercle Bacilli.*—Dr. G. Fütterer proceeds as follows:—1. Stain sections after Ehrlich's method. 2. Decolorize, in alcohol acidulated with nitric acid (3 drops to a watch-glassful of absolute alcohol), down to a light rose-colour. 3. Immerse for one minute in a well-filtered solution of palladium

* Virchow's Arch. f. Path. Anat., ci. (1885) p. 198.

chloride (1 : 500). 4. Wash in water. 5. Then for some minutes in acidulated alcohol. 6. Cedar oil. 7. Canada balsam.

The advantages of this method are said to be more rapid and more perfect decolorization ; greater resistance of the bacillar stain to the action of alcohol, ether, chloroform, and turpentine oil; and greater distinctness of the tissue structure.

Method for Determining the Acids in Plants when combined with Bases. *—Dr. H. de Vries proposes a modification of the alcohol method for determining the amount of free and combined organic acids in plants. The sap is, when necessary, first freed from albuminoids by heating in a closed flask and filtering. In one portion the acidity is then tested in the ordinary way by curcuma-paper. To the other portion 10 to 20 times the volume of alcohol of 90 per cent. is added, treated with 1/10 normal potash-ley, and with phenolphthalein. The deduction of one of the numbers so obtained from the other gives the portion of acids combined with organic bases and with ammonia.

By this means it can be determined that in rapidly growing organs there is a much larger quantity of organic acids combined with organic bases than free, while in mature organs the latter portion may be as large as the former. Thus, in the sap of mature apices of the stem of *Impatiens Roylii* there was 1·1 per cent. of free acid, 2·6 per cent. combined with bases; in mature leaf-stalks of *Rheum officinale*, 8·2 per cent. of free acid, 9·7 per cent. combined with bases.

Separation of Chlorophyll.†—Herr A. Tschirch proposes a method for separating chlorophyll from the other ingredients of plants which are soluble in alcohol, ether, carbon bisulphide, &c. The alcoholic extract is treated, at the temperature of the water-bath, with barytahydrate, by which a deep green barium cyanophyllate is obtained, insoluble in alcohol. The xanthophyll can be separated by saponification. The barium precipitate is also insoluble in water. If dried with an excess of baryta, or at a temperature of 100 degrees, it is also insoluble in ether and benzin. Dried at a lower temperature, it forms black plates soluble in ether.

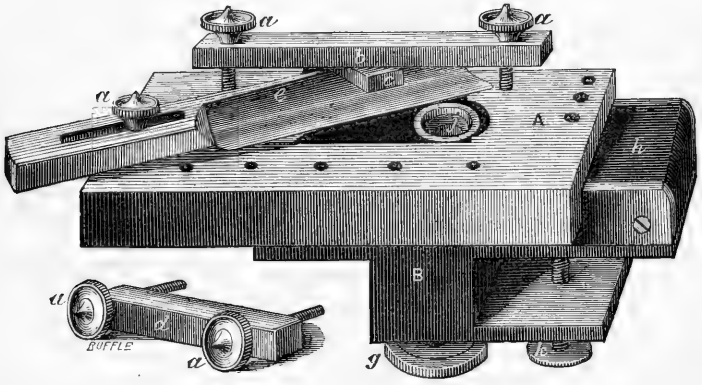
Preparing Starch-grains in Potato.‡—Prof. T. J. Burrill gives the following directions:—Starch-grains in the cells of potato can be beautifully shown by first partially drying the part from which sections are to be made, thereby aiding materially the process of cutting. Remove from a fresh tuber a prism 1/4 in. to 1/2 in. in diameter, and 1 in. or more in length. Expose for a few minutes to moderate heat (hot air from a register is excellent) until the surfaces are quite free from moisture, then allow to remain in the ordinary air of the laboratory for twenty-four hours. The consistence will now be excellent for cutting, and clean cells without ragged remains of ruptured ones may be seen beautifully filled with starch-like baskets of fruit. Mount in water. Stain, if desired, with iodine.

* Maandbl. voor Natuurwet., 1884, No. 9. See Bot. Centralbl., xxiv. (1885) p. 249.
† Versamml. Deutsch. Naturf. Strassburg, 1885. See Bot. Centralbl., xxiv. (1885) p. 314.
‡ Bot. Gazette, x. (1885) pp. 424–5.

Deceptive Results produced by Hardening Solutions.* — For the diagnosis of keratin in animal tissues, Dr. H. Steinbrügge has applied Ewald and Kühne's method to the investigation of the tissues of the ear of mammalia for the presence of keratin as a normal constituent, which was a probability to be inferred from the morphological relationship of the tissues to the ectoderm of the ovum. The sections were digested in a trypsin solution prepared in the usual way from pancreas. Very divergent results were obtained in regard to the degree of resistance to the action of this solution, which was the criterion adopted by Ewald and Kühne for the presence of keratin. Investigation showed that these divergencies corresponded with the degree of action of the hardening solutions employed in preparing the tissues for cutting, and that the criterion in question is worthless.

Providence Microtome. †—The original form of this microtome was designed by Mr. N. N. Mason of Providence, R.I, U.S.A., and was perfected by Rev. J. D. King. In its present form (fig. 71), it

Fig. 71.



is described by the Rev. A. B. Hervey as "perhaps equalled by no microtome made, for extreme precision of movement and consequent accuracy of performance in cutting sections. With a good knife in good order, sections of 10 μ to 25 μ thick can be made without difficulty, and all alike."

It consists of a heavy iron bed B, a knife-carrier A, and the usual apparatus for holding and moving the object to be cut, *g j*. The iron bed which furnishes the clamp *k*, and a solid support for the knife-carrier and object-holder, is 13·8 cm. long, 5·7 cm. wide, and 6·8 cm. deep. Cemented to its top is a brass plate *h*, 6·5 mm. thick. Rising through and above this is the cylindrical tube or object-holder *j*, 29 mm. in diameter. It projects 10 mm. above the

* Zeitschr. f. Biol., xxi. (1885) pp. 631–5.

† Behrens' 'Microscope in Botany' (Amer. ed. by Hervey and Ward), 8vo, Boston, 1885, pp. 188–90 (1 fig.).

surface of the brass plate and to within 0·5 mm. of the upper surface of the knife-carrier. It has an inner cylindrical piston 15 mm. in diameter and a sleeve around this which may be used with the piston, when it is desired to have a larger well, having a diameter of 19 mm. On each side of the brass plate and rising 1 mm. above its upper surface is an iron bar, 7 mm. thick, running the whole length of the bed and screwed fast to it. These are the ways or tracks upon which the knife-carrier slides. The knife-carrier consists of a solid plate of brass, 13 cm. long, 8·6 cm. broad, and 8 mm. thick, with projections along both sides, 6 mm. thick and 13 mm. deep, which fit down over the outside of the iron ways. The inside of these projections and the adjoining under surfaces of the brass plate are planed and polished so as exactly to fit over and upon the smooth iron tracks in such a way that the carrier moves freely, but with the utmost precision, back and forth upon them.

The brass plate A has an oblong opening cut in its middle, 9·6 cm. long and 3·3 cm. wide, through which, when in place, the cylindrical object-holder projects, very nearly to the upper surface of the plate. The plate is provided along its sides and ends with a series of screw-holes, to receive the milled head screws *a* of the clamps *b d*, by means of which the knife *e* is made fast to the carrier, and may be set at any desired obliquity to the line of motion of the carrier. The knife has a heavy strong plano-concave blade with a straight edge, and is laid flat upon the carrier and securely clamped down at heel and point. It, therefore, will not spring in the least and may be depended on to do work of very great precision. It is used for cutting all kinds of wood sections, and such other tissues as can be cut by simply packing in elder pith or imbedding in paraffin.

FIG. 72.

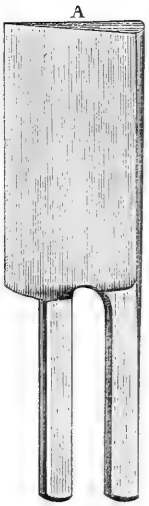


FIG. 73.

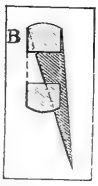
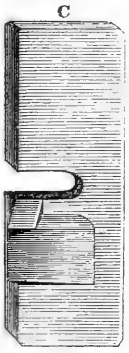


FIG. 74.



Henking's Simple Microtome Knife.*—Dr. H. Henking's knife (figs. 72–74) has a short blade with a bifid handle of the same length A. The measurements of the blade are: length about 5 cm., breadth about 28 mm., thickness of back about 7 mm. Though the back of the blade and the handle are in one and the same straight line, yet the handle diverges from the plane of the blade so that the cutting edge is 2½ mm. lower than the back B. The knife is supported by

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 509–11 (1 fig.).

a brass plate C with a notch to receive the binding screw, and also with a cavity for the admission of the knife blade.

The principal merit of the knife is that owing to the shortness of its blade, it may be easily sharpened by the owner. In order to do this a wooden grip must be fitted to the handle.

Ordinary v. Serial Sections.*—A writer in 'Nature' notices with regret a tendency "in certain histological schools to neglect almost entirely the older and simpler methods of cutting sections. Serial section cutting is now such an important item in all morphological work, that it is apt to be used to the exclusion of the older methods which give in many cases undoubtedly better histological results."

Serial Sections of Celloidin Preparations of Central Nervous System.†—Prof. C. Weigert gives an account of a method devised by him for obtaining a succession of sections, specially adapted for the nervous system. The course of procedure is, he says, so very convenient that he can recommend it even when a series of sections is not required.

The process is completed in six steps, of which the first consists in preparing the glass plates. These of course may be of various sizes; for large preparations, Koch's culture plates may be used, while for spinal cord a plate 4 cm. broad and 15 cm. long suffices. After being cleaned, the plate is covered with a thin layer of celloidin, exactly as a photographer makes a moist plate. It is then set on end and dried.

The second step is to make the sections and arrange them ribandwise on strips of transparent porous paper. In order to withstand stretching when damp, tenacity is a necessary quality of the paper. The width of the strips should be about double that of the sections. The sections are then disposed in a suitable position along the strips by carefully removing them with a brush from the knife. It is important to keep the strips, when covered with sections, moist while their successors are being cut and arranged. This is accomplished by laying them on blotting paper placed in a dish containing some spirit.

The third step is to transfer the sections to the celloidin plate. The strips, section side downwards, are laid upon the celloidin surface just sufficiently moistened, the paper surface is softly pressed and then peeled off. Any superfluous fluid is removed with blotting-paper, but anything like dryness of the sections must be avoided as it is injurious to the after steps of the process, which must be immediately proceeded with. Not more than one or two strips should be transferred to the same plate.

The fourth step consists in covering the sections with a thin and even layer of celloidin. When dry the celloidin may be marked (for recognition of series) with a brush dipped in methyl-blue.

Staining is the next step: immersed in hæmatoxylin, the celloidin

* Nature, xxxiii. (1886) p. 243.

† Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 490–5.

mass separates off from the glass plate, thus setting free the two celloidin layers with their inclosed sections, the whole forming a flexible but tough plate, which may be handled like a rag. Staining and washing are carried out in the usual manner, and after differentiating in the ferrocyanide of potassium, the series are again immersed in water, frequently changed, for at least one hour.

The celloidin section-plate may be now cut up under water into as many pieces as there are sections. These are then dehydrated in 90–96 per cent. alcohol and cleared up in creosote or xylol. Such sections must remain in alcohol much longer than ordinary ones, as the celloidin layers are slow in dehydrating. From the preparation of the plates to the immersion in hæmatoxylin it takes about one hour to produce 100 sections.

The author has recently discovered a medium to replace creosote (which is dear and malodorous), in a mixture of benzine and alcohol. He hopes to be able to publish his results very shortly.

Preparation of Picro-carmine.*—Prof. G. Bizzozero prepares an excellent picro-carmine in the following manner:—

A solution of 0·5 grms. carmine, 3 cc. ammonia, and 50 cc. distilled water, is made in a mortar. In another mortar is made a solution of 0·5 grm. picric acid in 50 cc. water. The picric acid solution is then poured slowly into the carmine solution. The combined solutions are then heated in a water-bath until every trace of ammonia has disappeared. By this time the bulk of the fluid is reduced to half its previous quantity. It is then allowed to cool, and one-fifth of its volume of absolute alcohol is added. The fluid must be kept in a carefully corked bottle. It is not necessary to filter before using.

Picro-chromic Acid.†—This is recommended by Prof. H. Fol as an excellent hardening agent for very small pieces of tissue. It acts slowly, having little power of penetration. It is made as follows:—Picric acid (saturated aqueous solution), 10 parts; chromic acid (1 per cent.), 25 parts; water, 65 parts. A little osmic acid (·005), added shortly before using, is said to strengthen its action much.

The staining capacity of objects is not impaired by this mixture. The objects should be washed in water. The extraction of the acid is more complete and rapid if nearly boiling-hot water is used.

Minot's Picric-acid Carmine.‡—Dr. C. S. Minot's carmine is made as follows:—

Boil 1 grm. best powdered carmine with 200 c.cm. of water, plus an excess of picric acid for half an hour; allow it to stand and cool; decant the clear fluid, add fresh water, and, if necessary, picric acid; boil, cool, and decant; repeat this operation until all the carmine is dissolved. Place the decanted fluid in an evaporating dish, add

* Zeitschr. f. Wiss. Mikr., ii. (1885) p. 539, from Bordoni-Uffredduzzi, 'I Microparassiti,' Torino, 1885, p. 97.

† Fol's Lehrb. d. Vergl. Mikr. Anat., 1885, p. 100.

‡ Whitman's 'Methods in Microscopical Anatomy and Embryology,' 1885, p. 42.

about 1 grm. thymol, and stand in a warm place until the volume is reduced to 25 c.cm.; let the solution cool, filter, wash out the residue, which should be on the filter, with 25 c.cm. water; dilute the filtrate with 50 c.cm. water. By this means a solution ready for use, which will keep indefinitely, and contains carmine and picric acid in good proportions, can be prepared with certainty.

It gives a stronger differential colouring than Ranvier's picro-carmine; but over-staining must be carefully avoided. For staining sections, two to five minutes are sufficient. The fluid stains connective tissue (fibrous) deep red; striped muscle, deep dull red; smooth muscle, blood, and horny tissue, bright yellow; glands, reddish yellow. With the kidney it gives a differentiation of the different portions of the tubules; for the central nervous system it seems to be of little value. If rightly used, it gives a sharp nuclear colouring.

If the aqueous solution is evaporated to dryness, the residue may be redissolved in alcohol, giving an alcoholic carmine dye, which has not yet been tested sufficiently. Apparently the alcoholic solution will keep only a few months. The alcoholic solubility of the dye offers the advantage that sections stained in the watery solution can be washed in alcohol directly.

Differential Action of Safranin and Methyl-green.*—In studying the sexual characteristics of the oyster Mr. J. A. Ryder found that a mixture of these two dyes enabled him to distinguish both ova and spermatozoa in the same follicle, the nuclei of the ova being stained red by the safranin, and the heads of the spermatozoa bluish-green by the methyl-green. The method of preparation is as follows:—

1. After removing the shell the oyster is hardened in chromic acid (1 to 2 per cent.) for several days.

2. Washed in water two days, and then further hardened in alcohol.

3. Soaked for twenty-four hours in water, to remove the alcohol; then imbedded in gum arabic and cut with free hand.

4. Sections freed from imbedding mass by washing in water; then stained in a mixture in equal parts of safranin (saturated alcohol solution), methyl-green (ditto), diluted with eight times its volume of water, two to three hours.

5. Decoloured in 95 per cent. alcohol until clouds of colour no longer appear (five to fifteen minutes).

6. Clarified in clove-oil and mounted in balsam of dammar.

Staining Spermatogems.†—Herr Benda, in his studies on the spermatogenesis of mammals, made use of a modification of Weigert's hæmatoxylin method. Sections preserved in Flemming's solution were fixed to a cover-glass and placed for twenty-four hours in a strong solution of oxide of copper. After careful washing in water, repeated several times, they were placed in 1 per cent. watery solution

* Bull. U.S. Fish Commission, 1883. Cf. Whitman's 'Methods in Microscopical Anatomy and Embryology,' 1885, p. 52.

† Arch. f. Anat. u. Physiol. (Physiol. Abth.), 1886, p. 186.

of hæmatoxylin, until they became intensely coloured, which happened in about five minutes. The sections were then washed in a 1/300 solution of nitric acid, which gave a yellow colour to the preparation; it is possible by stopping the action of the acid when one pleases to have the nuclei alone coloured, or to have also fine shades of colour in the cell-body, ground substance, and so on; the action of the acid is best stopped by replacing the preparations in the copper solution, where they again take on a violet-grey shade.

Picro-nigrosin as a Stain for Nerve-centres.*—Dr. G. Martinotti prepares this staining fluid by mixing crystals of picric acid and nigrosin with rectified spirit in a test-tube and shaking frequently. The supernatant fluid, which is of a deep olive colour, is decanted off, and if any undissolved crystals remain more rectified spirit is added, and so on. Sections obtained in the usual manner are then immersed in the decanted fluid, where they may remain for from two to forty-eight hours. When removed from the staining bath the sections are of a blue colour, and it is impossible with the naked eye to distinguish between grey and white matter. At this stage they may or not be washed with rectified spirit to remove the superficial colouring matter. The sections are next placed in a mixture of two parts alcohol and one part formic acid. When by this treatment the difference between the white and grey matter is sufficiently marked, they are treated with rectified spirit, after this with absolute alcohol, and having been cleared up in bergamot oil, are mounted in Canada balsam dissolved in xylol.

On microscopical examination it will be found that the axis cylinders and the nerve-cells are stained a deep blue colour, and that the processes of the latter may be followed with great ease. The walls of blood-vessels are of a dark-blue colour, while connective tissue and neuroglia appear of a somewhat lighter hue. Leucocytes and neuroglia nuclei are but slightly stained. The myeline sheaths receive a deep greenish-yellow stain. Hence in transverse sections the blue axes stand out surrounded by yellow areas, and when viewed longitudinally the axis cylinder lies between two parallel lines of yellow.

For sclerosis of the spinal cord this method has the great merit of showing up the affected parts most conspicuously, owing to the contrast between the deep blue of the connective tissue and the yellow sheaths of the unaffected nerves. Hence the amount of the degeneration is easily recognized. The author has compared this method against the anilin-blue stain recommended by Schiefferdecker, and has no hesitation in saying that the latter method is inferior to his own.

A special advantage of this picro-nigrosin method is its behaviour towards celloidin, for it is possible to stain sections without removing the celloidin with which they have been impregnated. Now certain stains, and especially some of the anilins, dye celloidin so deeply that it is necessary to remove it from the sections, thus surrendering

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 478–84.

one of the principal advantages of celloidin, while the colour from picro-nigrosin completely disappears under the action of the alcohol and formic acid.

Staining Mucous Glands and Goblet-cells.*—Dr. E. Paulsen has succeeded in staining deeply the network of mucous glands (lingual and submaxillary of calf) with Delafield's hæmatoxylin after fixing in 1 per cent. osmic acid or in Flemming's osmium mixture and hardening afterwards in alcohol for some days. Alcohol preparations were treated after Heidenhain's method. The osmic acid mixture is preferable to the osmium mixture. Good stainings were obtained in a dilute solution after immersion for twelve to fifteen hours; in the undilute solution the same effect was attained in about half an hour. By this the reticulum of the epithelium of mucous gland was sharply stained, while the intervening substance remained clear and uncoloured. The receptivity for colour is unequal, some cells staining more than others, while some are altogether unaffected by the stain.

The author has also with 1 per cent. osmic acid and hæmatoxylin staining after Heidenhain's method, been able to show in Bowman's glands of many mammals that the epithelium unites in itself the characteristic properties of both kinds of lingual glands, both kinds, and even a third with a central mucous zone, occurring within the gland-sheath.

Goblet-cells, which appear in large numbers in nasal mucous membrane, are by the same treatment stained blue or blue-violet.

Staining Capsule Micrococci.†—Dr. C. Friedländer recommends the following for cover-glass preparations:—Pass thrice through the flame; immerse in a 1 per cent. solution of acetic acid for one or two minutes; then blow off the acetic acid with a pipette, and dry in the air. Stain for some seconds in the solution of anilin-water and gentian-violet. Wash again, and examine. The ground-substance is colourless, hence the stained parts, e. g. the capsules, stand out very distinctly.

For demonstrating capsule cocci in sections Friedländer gives the following method:—Stain for twenty-four hours in acid solution of gentian-violet (concentrated solution of gentian-violet in alcohol 50; aq. destil. 100; acid acetic 10). Then decolorize in 1 per cent. acetic acid for 1–2 minutes, dehydrate in alcohol, and clear up in oil of cloves. Some practice is required to hit off the requisite degree of decolorization.

Staining Spirilla in Blood-preparations.‡—Dr. C. Günther recommends that the cover-glass preparations of blood containing spirilla, made in the usual manner and fixed over a flame (or better by five minutes in a thermostat at 75° C.), should be washed for ten seconds in a 5 per cent. solution of acetic acid before being stained. This drives out the hæmoglobin from the blood-discs, which are no longer coloured by the stains, so that when the staining of the preparations is completed the most highly coloured spirilla no longer

* Zeitsch. f. Wiss. Mikr., ii. (1885) pp. 520–1.
† Fortschr. d. Med., iii. (1885) p. 757. ‡ Ibid., p. 755.

meet the eye covered up partly by blue-stained blood-discs, partly by the granular opacity of the ground stain. The acetic acid must be carefully removed before the staining is undertaken. The greater part of the acid is blown off, and after drying in the air the cover-glass is held over an open bottle of strong ammonia, in order to eliminate the last traces of the acid. The excess of fluid is washed off with water and the preparation mounted in Canada balsam.

Staining Bacillus of Syphilis.*—Herrn Doutrelepont and Schütz have, by a special method of staining, demonstrated bacilli in syphilitic indurations, condylomata, papillæ, and gummata. In form, size, and arrangement they perfectly resemble the bacilli described by Lustgarten.

The method is as follows:—The material hardened in alcohol is softened in water for about 10 minutes before cutting. Very thin sections made with freezing microtomes are then placed in a 1/2 per cent. salt solution, and next are carefully spread out in absolute alcohol until all the air bubbles have disappeared. They are next stained in a 1 per cent. watery solution of gentian-violet for 24 to 48 hours.

Decolorization is effected by waving each section for some seconds about in weak nitric acid (1–15 water), and then immersing in 60 per cent. alcohol for 5 to 10 minutes. When of a pale violet-blue colour, the sections are transferred to a weak watery solution of safranin, where they remain for some minutes; next to a 60 per cent. solution of alcohol for a few seconds, then, having been dehydrated in absolute alcohol, are cleared up in cedar oil, and mounted in Canada balsam.

Giacomini's Process for Preserving Microscopical Preparations.†—Prof. C. Giacomini's process consists in imbedding the stained sections (which may be coloured by any reagent whatever) in a layer of gelatin, backed upon either side by a layer of collodion. As many glass plates are required as there are sections. They should slightly exceed the size of the sections. They must be most carefully cleaned in the ordinary manner (with acids, alcohol, ether), then dusted over with talc powder, which is briskly rubbed in with a piece of chamois leather, and finally removed with a soft brush. The glass plates are then coated with a thin layer of collodion (the author uses commercial collodion, and if it be too thick, thins it down with a mixture of equal parts of alcohol and ether). They are then dried in a horizontal position, and when sufficiently firm to bear the imprint of the finger-nail, they are coated over with gelatin. This 8 to 10 per cent. watery solution of gelatin must be already prepared before the collodion process is begun. The whole of the gelatin is placed in half the distilled water for an hour; it is then warmed to a temperature of 50° to 55° C. in a water-bath, and the other half of the water added until a perfect solution is obtained. This is

* Deutsche Med. Wochenschr., 1885, p. 320.

† Gazzetta delle Cliniche, xxii. (1885) November. Cf. Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 531–5.

filtered while hot through a suitable apparatus. It is not advisable to add any antiseptic. The collodionized plate is now immersed in the vessel containing the hot gelatin, and when the collodion and gelatin have united (the disappearance of all streaks from the collodion surface shows this), the section, previously kept in distilled water, is placed thereon by means of a fine brush. The plate is then removed from the bath, and laid carefully in a horizontal position. If the gelatin layer and the section both be thin, 12 to 18 hours are sufficient to dry them. Should any part of the section remain uncovered, a fresh layer of gelatin solution, at a temperature of 50°, may be poured over the plate, held in a sloping position.

Drying may be considered completed when the preparation is quite transparent, and the gelatin surface so firm that it no longer receives the indent of the finger-nail. The gelatin layer may now be marked, if need be, with ordinary ink. Finally, a second collodion layer is run over the gelatin. Endeavour should be made to keep the second layer about as thick as the first. After drying again, the gelatin-collodion layers are stripped off the glass plate by cutting first along the edge, and then raising the collodion-gelatin layers with a scalpel. If the glass plate have been properly cleaned, this is quite easily done. As the collodion-gelatin layers tend to curl up, it is advisable to submit them to a certain pressure. This is best done by placing them between the leaves of a pretty thick book.

With care, 200 sections of the pons varolii may be mounted in one collodion-gelatin layer. The author's researches were chiefly devoted to the central nervous system. He found that preparations treated with Müller's fluid, and afterwards with perchloride of mercury, gave better results than when nervous tissue had been hardened in alcohol, and especially if kept for any length of time. The chief advantages of this method consist in the transparency of the sections and the ease with which they are preserved. Low powers are quite sufficient to enable the course and distribution of the nervous fibres to be followed with ease. The only inconvenience complained of by the author is the impurities which commercial gelatin contains. These, however, are no bar to microscopical investigation.

White Rosin as a Mounting Medium.*—Mr. H. L. Brevoort reports the results of his experiments in mounting with white rosin to be very satisfactory. The method is the following:—On the centre of a clean glass slide, laid on the heating table, put a small piece of rosin of the purest quality. Heat is gently applied until the rosin becomes as liquid as it can be made without burning it. To remove air-bubbles, with a pointed glass rod add to the liquefied rosin and stir in with it, a half-drop of turpentine. A moment or two after the object to be mounted has been placed in the medium, and the cover-glass has been dropped upon it, the slide must be removed from the hot table, and a spring clip applied. In five minutes the mount will be ready for finishing and labelling. For such objects

* Journ. New York Micr. Soc., i. (1885) pp. 202-3.

as hairs and fur-fibres in particular rosin is preferable to balsam as a medium for mounting.

Smith's Newer Mounting Medium of High Refractive Index.*—Prof. Hamilton L. Smith has recently discovered a mounting medium which he regards as superior to any hitherto described. It is even superior to the preparations described last year.† These consisted of stannous chloride in glycerin jelly, giving a refractive index of 1·7, and of realgar in arsenic bromide, with a refractive index of 2·4. The new medium, which has a refractive index considerably above that of the stannous chloride medium, is prepared in the following manner:—

Dissolve $1\frac{1}{3}$ oz. of antimony bromide in two fluid drachms of a 50 per cent. solution of boro-glyceride. This, when cold, makes a very viscid medium, like old stiff balsam, of a dark, sherry wine colour. Mounts made with it in the extremely thin film required are as colourless as with old balsam, and when laid upon white paper, the colour of the medium is scarcely perceptible, if it has not been injured by overheating—certainly less than most mounts in styrax. It is used precisely like Canada balsam. It works easily at a moderate heat, and boils very rapidly. The heat must be continued until the boiling is nearly over, but care must be observed not to overheat, as the glycerin is likely to burn. When entirely cooled, the cover will be firmly attached, as with balsam, and the slide may be cleaned with moist tissue paper, without fear of disturbing the cover.

A finishing ring may now be applied, but Prof. Smith advises that a bit of paraffin should be placed on the slide, melted, and caused to flow around the mount, by tilting the preparation. A vigorous rubbing with a cloth will remove all excess of paraffin, leaving a sloping or bevelled ring round the mount. This operation has preserved mounts for two months already, with no indication of change. Any finishing cement may then be applied.

The medium is only slightly deliquescent, but is decomposed by water, and injured by contact with immersion fluids—hence some protection is necessary.

We now quote from Prof. Smith's letter as follows:—

"The boro-glyceride which I have used was prepared for me by Mr. C. F. Booth, of Tarrant & Co., manufacturing chemists, New York. This substance is a hard, brittle, and glassy compound of glycerin and boracid acid, and will no doubt serve an excellent purpose as a mounting material from its antiseptic properties. I use a 50 per cent. of this in glycerin.

I wish to say here that recently, in looking over some of my earliest mounts in the chloride of tin and glycerin medium that I had thrown aside because of leakage (as this material, before I used gelatin, always remained more or less soft, and so made it difficult to

* Amer. Mon. Micr. Journ., vii. (1886) pp. 3-4.

† See this Journ., v. (1885) p. 1097.

clean off the cover before ringing), I was surprised to find that not only had the leakage stopped, but that the drop outside was indurated, and when removed the whole seemed perfectly sealed, and showed no tendency to the smearing when wiped hard, that had caused me at first to suppose these mounts were spoiled, and they remain up to the present moment now apparently good. The boro-glyceride 50 per cent. solution will not permit as much chloride of tin to be dissolved as I mentioned in the directions for the gelatin preparation. A 25 or 30 per cent. solution will be better here, and this medium still answers admirably for ordinary diatoms.

The gelatin and tin compound is more hygroscopic than the compound of boro-glyceride and antimony; still, if properly made and used will answer admirably and remain unchanged, I believe, for any length of time."

Meates' New Medium of High Refractive Index.—Mr. W. C. Meates describes a still newer medium:—In a clean dry test-tube put 10 grains of bromine, and 30 grains of sulphur. Boil gently until the sulphur is dissolved; then add 13 grains of powered arsenic (metallic); again boil gently until the whole of the arsenic is dissolved. The result is a medium of a light yellow colour with a high refractive index (2·4), and easily melted at a low degree of heat. It does not crystallize. When it is boiling, fumes of bromide of arsenic are given off, which are deposited on and forced up the sides of the test-tube; therefore, when these fumes nearly reach the top of the tube, the boiling should be discontinued for a few seconds and the mixture agitated, in order that the bromide may be again absorbed. Then boil again, and so on until the arsenic is dissolved, when the mixture will be ready for use.

There is no occasion for making more than the quantity indicated, as a small drop, when warmed, no bigger than a small pin's head, taken up on a finely drawn out piece of small tubing, is quite sufficient for a slide. When the slide is warmed it spreads into a very thin layer.

Morris's Mounting Medium.*—Dr. W. Morris suggests another mounting medium, of high refractive index. The method of preparation is said to be exceedingly simple, and the whole process need not take more than two minutes. To equal parts of sulphur and disulphide of arsenic 1/20 part of biniodide of mercury is added; the whole is fused on a piece of mica, then sublimed on to the cover-glass, finally remelted on the cover-glass and mounted in Canada balsam. The very thinnest cover-glass may be used. American slides recently received have a cover-glass with the thickness of 0·009; Dr. Morris's cover-glasses are only 0·004.

Seaman's Mounting Media of High Refractive Index.†—Prof. W. H. Seaman has tried oil of cassia (the refractive index of which is nearly equal to that of carbon bisulphide) making a saturated solution of phosphorus in the oil. This mixture is easier to use because less inflammable than carbon bisulphide, but contains less

* Australasian Med. Gaz., v. (1886) p. 100.
† Amer. Mon. Micr. Journ. vii. (1886) pp. 21-4.

phosphorus, as the latter is not perfectly soluble in oil of cassia as in carbon bisulphide. A ring of liquid glue should be made on the slide, and allowed to dry, drying the diatoms on the cover, adding the solution, and quickly inverting the cover in its place, then removing the surplus squeezed out by blotting-paper, carefully pressing down on the glue ring, and then sealing with balsam. The solution smokes on exposure to the air, but in these preparations there is no evidence of acid flakes.

On endeavouring to make a good solution of sulphur in carbon bisulphide, it did not appear that sufficient dissolved to get the full benefit of the high index of sulphur. He therefore sought a better solvent, and found it in anilin. On making a test mount of mixed diatomaceous material he was surprised at the brilliancy and sharpness of definition, in which it excels any other medium yet tried. The diatoms used were in alcohol. He first placed the required quantity on the inverted cover, dried them, added sufficient medium to cover them, heated the cover to drive the air out of the cavities of the diatoms and cause the fluid to enter, added, if necessary, a little more, inverted in place on the slide on a turn-table, and removing any surplus by a blotter, put a ring of balsam or shellac cement round, thus finishing at one operation. The anilin is not very volatile, and the adhesion of the cover very slight, but with care, using a long-bristled brush and thin balsam, a coat can be got quite sufficient to seal and fix the cover in place, and additional coats may be given when convenient.

Anilin, according to Storer, dissolves its own weight of sulphur; if heat is used it will become supersaturated, and crystals will form on the slide, which are very pretty of themselves, but of course are not desirable with other objects. As Gladstone and others have indicated that high refractive power accompanies complex molecular constitution, it is probable the best solvents for this purpose will be found among the carbon compounds like anilin, chinolin, &c.

Black Ground for Opaque Mounts.*—Mr. W. C. Brittan thinks that the following receipt for a paint that will give a dead black surface as required for the inside tubes of optical instruments, &c., should be in the hands of all who work with the Microscope:—Take two grains of lampblack, and add three drops of gold-size, mix thoroughly, and add 24 drops of turpentine, when again thoroughly mixed it is ready for use. Apply it thin with a camel's hair brush. When dry, the articles will have as fine a dead black as when they came from the optician's hands. This paint will also be found just the thing where a dead black ground is required for opaque mounts.

Exhibiting the Streaming of Protoplasm.†—The streaming motion of protoplasm can be exhibited very satisfactorily, according to Mr. T. J. Burrill, in the thin membrane (upper epidermis of scale-leaf) found between the scales of the bulb of the common onion. All that is necessary to do is to transfer a piece of the fresh membrane,

* The Microscope, vi. (1886) p. 41. † Bot. Gazette, x. (1885) pp. 428–9.

snipped off by a pair of scissors, to a drop of water on a slide, cover, and examine with a power of four hundred or so times. The temperature of a comfortable room is about right; with less heat the movement is very slow. Success is more certain if the bulb has started to grow, as they often do in a cellar. Care should be taken in removing the membrane, for the cell-walls are very delicate, and easily wrinkle, forming unsightly and annoying irregular lines, over what should be the clear open cell.

The material commends itself for its accessibility at any time, and especially in winter when other things may not be readily obtained, and for the extreme ease of preparation.

Examining Embryo-growth in Birds' Eggs.*—Dr. L. Gerlach describes a successful method which he has devised for watching the embryo-growth in birds' eggs through a small glass "window" made at the smaller end. After detaching the end with a bent pair of scissors, a little albumen is taken out, so that the germinal disc of the yolk turns upwards; the liquid is then put back. Gum-arabic solution is spread on the opening, and wadding put round it, then a small watch-glass is fixed on it with gum; collodion and amber-lac being afterwards added. The eggs must lie horizontally in the incubator; development then goes on normally, and may be observed till the fifth day (thus comprising the time most interesting to the embryologist), the egg being taken out, and the window-end turned up.

Examining Iron and Steel.†—Mr. F. L. Garrison considers it is at present difficult to say what will be eventually the practical value of the Microscope in the sciences of engineering. The *rôle* which it seems most likely to play is that of an adjunct to the testing-machine, and not (as some have supposed) a rival to the chemical laboratory. That it will be a most valuable accessory seems, to say the least, highly probable.

As regards preparing the material for examination, the author points out that Mr. J. C. Bayles ‡ has "described the process in such a plain and comprehensive manner, that if his instructions are carefully followed, one need not encounter any serious obstacles after a little experience and the expenditure of a considerable amount of time and patience. Patience and cleanliness are the two most important attributes to be acquired by a student, if he desire success in a work of this characrer. A deficiency in either will be sure to spoil his work, and in the end he will give it up in disgust, wondering what has been the cause of his failures. In grinding the specimens, it is quite unnecessary that they should be ground to an extreme thinness and mounted in Canada balsam, as microscopical objects are usually preserved. This entails a vast amount of labour, to no end whatever. A good and accurate photograph, once obtained, is usually sufficient for any reference that might be desired in the future; besides, with a little care the etched surfaces of the objects can be

* Nature, 1886, p. 497. See this Journal, v. (1885) p. 784.
† Journ. Franklin Institute, cxx. (1885) pp. 300–6 (5 pls.).
‡ See this Journal, iii. (1883) p. 605.

preserved from rust by simply rubbing a few drops of kerosene oil over them with a soft chamois-skin, and then placing them in a tightly corked phial.

The size of the objects to be examined under the Microscope may vary considerably; but the sizes found most convenient range from 1/4 in. down to about 1/16 in. in thickness, and from 1 in. to 1/5 in. in sectional area. If the specimens are extremely thin, there is often much difficulty in mounting them properly on a slide, and in getting the etched surface perfectly parallel to the object-glass. After the surface has been sufficiently treated with acid, and shows under the Microscope no further traces of scratches made in the grinding, it should be carefully dried and cemented to a glass slide with wax or cement, great care being taken to have it in the proper plane parallel to the object-glass: otherwise, it will be impossible to make a satisfactory photograph.

The great difficulty encountered in pursuing the study of the structure of materials is that of making accurate and satisfactory records of what is seen under the Microscope. To effect this, the only accurate and quick means is to photograph. Hence the student must not only be a good microscopist, but also understand the theory and practice of photography, an accomplishment which every engineer will find it useful to acquire."

Some hints are given for photographing and for selecting a Microscope. The use of a condensing lens depends, it is said, upon the ability of the etched surface to reflect light. Thus hard steel reflects light so well that a condenser is not necessary, while in the case of pig, cast, or wrought iron its use is absolutely essential. Ten photographs are given of various kinds of iron and steel, with a description of the characteristic features of the specimens.

Draper's Graphic Microscopy.—Mr. E. T. Draper proposes to continue in a separate form the coloured illustrations which were a special feature of 'Science-Gossip' in 1884 and 1885. The first part has been issued with two plates and accompanying description. Mr. Draper is well known as one of the most expert artists in drawing microscopical objects that we have, and we shall be very glad to hear that his new venture turns out a remunerative one. For this it is necessary that microscopists—who cannot but appreciate such work—should give it more than moral support.

BANTI, G.—**Manuale di Technica Batteriologica.** (Manual of Bacteriological Technique.) From *Lo Sperimentale*, May, 1885.

BAREGGI.—**Modificazione all' allestimento dei preparati Microscopici tinti con colori di anilina allo scopo di renderne più perfetta e durevole la conservazione.** (Modification in preparing microscopical objects stained with anilin colours in order to make them more durable.) [*Post.*]
Gazzetta degli Ospitali, 1884, p. 645.

BELLONCI, J.—**La terminaison centrale du nerf optique chez les mammifères.** (The central termination of the optic nerve in mammals.)
[Methods, *post.*] *Arch. Ital. de Biol.*, VI. (1885) pp. 405.

BELVOR.—**On staining in toto the Central Nervous System with Weigert's Hæmatoxylin.** [*Post.*] *Brain*, 1885, July.

BENDA.—**Ueber die Spermatogenese der Säugethiere.** (On spermatogenesis in the Mammalia.)
[Methods, *supra*, p. 351.]
Arch. f. Anat. u. Physiol. (*Physiol. Abtheil.*), 1886, pp. 186–7.

BERTRAND, E.—**Sur l'examen des Minéraux en lumière polarisée convergente.** (On the examination of minerals in polarized convergent light.)
Bull. Soc. Minéral. France, VIII. (1885) p. 29.

BIZZOZERO.—**Ueber die Mikrophyten der normalen Oberhaut des Menschen.** (On the microphytes of the normal skin of man.)
[Methods, *post.*]
Virchow's Arch. f. Path. Anat. u. Physiol., XCVIII. (1885) p. 441.

" " **Preparazione del picrocarmino.** (Preparation of picrocarmine.)
[*Supra*, p. 350.]
Cf. Bordoni-Uffredduzzi, 'I Microparassiti,' 8vo, Torino, 1885, p. 97.

BORN, G.—**Biologische Untersuchungen. I. Ueber den Einfluss der Schwere auf das Froschei.** (Biological researches. I. On the influence of gravity on the frog's egg.)
[Methods, *post.*] *Arch. f. Mikr. Anat.*, XXIV. (1884) p. 475.

BRASS, A.—**Mittheilungen zur mikroskopischen Technik.** (Communications on microscopical technique.)
[1. Die Einbettungsmethode mit Benzol und das Schneiden leicht zerbrechlicher Objecte. (Imbedding methods with benzol, and cutting very friable objects.)
2. Bemerkungen über die Mikrotommesser und ihre Behandlung. (Observations on microtome knives and their use.
3. Die Anfertigung von zusammenhängenden Serienschnitten. (Making adhering series of sections.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 300–7 (3 figs.).

BREVOORT, H. L.—**White Rosin as a Mounting Medium.** [*Supra*, p. 355.]
Journ. N. York Micr. Soc., I. (1885) pp. 202–3.

BREYER.—**Mikromembranfilter.** (Micromembrane filter.) [*Post.*]
Naturforscher, XIX. (1886) pp. 123–4,
from *SB. Vereins zur Förderung des Gewerbfleisses*, 1886, p. 15.

BRITTAN, W. C.—**A Black Ground for Opaque Mounts.** [*Supra*, p. 358.]
The Microscope, VI. (1886) p. 41,
Amer. Mon. Micr. Journ., VII. (1886) p. 37.
from *The Locomotive.*

Bulloch's (W. H.) Combination Microtome. [*Ante*, p. 166.]
The Microscope, VI. (1886) p. 14.

Buysmann's Medicinal Plants.
[Dried plants, with the floral and fruit parts dissected and separately mounted. Those parts which would be injured by pressure are placed in alcohol in small flat-sided bottles, so that they can be readily examined with a lens. Small parts of flowers are also mounted in the same way, and where they require a higher power than an ordinary lens they are mounted on glass slides for use with the Microscope."]
Journ. of Botany, XXIV. (1886) p. 96.

COX, C. F.—See Leggett, F. W.

DEANS, J.—**Notes on Mounting.**
[Never use asphalt. Directions for making gold-size cells for fluid mounts.]
Scientific Enquirer, I. (1886), pp. 5–6.

DIMMOCK, G.—**A Method of bleaching Wings of Lepidoptera to facilitate the study of their venation.** [*Supra*, p. 344.]
Amer. Natural., XX. (1886) pp. 204–5.

DOUTRELEPONT and SCHÜTZ.—**Ueber Bacillen bei Syphilis.** (Staining bacillus of syphilis.) [*Supra*, p. 354.]
Deutsche Med. Wochenschr., 1885, p. 320.

ENGELMANN, T. W.—**Zur Technik und Kritik der Bakterien-methode.** (On the technique and criticism of bacteria methods.) [*Post.*]
Bot. Ztg., XLIV. (1886) pp. 43–52, 64–9.

Enock's (F.) Entomological Slides.

[A series of slides, showing the mouth-organs of British Hymenoptera, especially bees, accompanied by explanatory drawings, so that a person can see at a glance the name of each part. The specimens are mounted naturally, and the heads are specially prepared for a paraboloid.]

Sci.-Gossip, 1886, p. 44.

ETERNOD, A.—**Armoire à préparations microscopiques.** (Cabinet for microscopic preparations.) [*Post.*]

Zeitschr. f. Wiss. Mikr., II. (1885) pp. 511–3 (3 figs.).

F.—**Ueber Sammeln von Tieren.** (On collecting animals.)

[Brief directions for preserving—principally insects.]

Naturforscher, XIX. (1886) pp. 70–1.

FARHALL, M.—**A simple Cell for Fluid Mounts.**

[Cardboard rings saturated in patent knotting. Fasten to slip with gold size and cover the ring with a mixture of gold size and oxide of zinc.]

Scientific Enquirer, I. (1886) pp. 4–5.

FENNESSEY, E. B.—**A new Microscope Slide.**

[Those who delight in looking at the coursing of the blood through the web of a frog's foot, or the motion of the sap as seen in *Vallisneria*, &c., "will be pleased with the spectacle of the flow of oil towards the flame of a burning lamp. To see this interesting phenomenon it is only necessary to raise the burner partly out of the lamp, then hold it steadily, close enough to the Microscope, which ought to be turned horizontally, and use a 1 in. or lesser power objective, when the current of fluid will be observed writhing and struggling amongst and through the interstices of the cotton wick. The oil may be coloured if thought desirable."]

Engl. Mech., XLIII. (1886) p. 12.

FERRAN, J.—**Ueber die Morphologie des Komma-Bacillus.** (On the morphology of the comma bacillus.) [Methods, *post.*]

Zeitschr. f. Klin. Med., IX. (1885) p. 361.

FLEMMING, W.—**Notizen zur Färbetechnik.** (Notes on staining technique.) [*Post.*] [*Zeitschr. f. Wiss. Mikr.*, II. (1885) pp. 517–9.

FLEISCHL, E. v.—**Ein mikrostroboskopischer Reizversuch.** (A microstroboscopic irritation experiment.) [*Post.*]

Arch. f. Anat. u. Physiol. (*Physiol. Abth.*), 1886, pp. 67–71.

FLESCH, M.—**Zur Kenntniss der Nerven-endigung im quergestreiften Muskel des Menschen.** (On the nerve-endings in striated human muscle.) [Methods, *post.*] *MT. Naturf. Gesell. Bern*, 1885, p. 1.

„ „ **Zur Anwendung der Merkel'schen Doppelfärbung mit Indigo und Carmin.** (On the use of Merkel's double staining with indigo and carmine.) [*Post.*] *Zeitschr. f. Wiss. Mikr.*, II. (1885) pp. 349–52.

„ „ **Notiz zur Watney's Doppelfärbung mit Hämatoxylin.** (Note on Watney's double-staining with hæmatoxylin.) [*Post.*]

Ibid., p. 353.

„ „ **Bemerkungen zur Kritik der Tinctions-Präparate.** (Remarks on staining reagents.) [*Post.*] *Ibid.*, pp. 464–77 (2 figs.).

FRANCOTTE, F.—**Réactifs colorants.** (Staining reagents.)

[Arcangeli's four formulæ, *ante*, V. (1885) p. 1094, with modifications, *post.*]

Bull. Soc. Belg. Micr., XII. (1886) pp. 48–51.

FRIEDLÄNDER, C.—**Microscopische Technik zum Gebrauch bei medicinischen und pathologisch-anatomischen Untersuchungen.** (Microscopical technique in medical and pathologico-anatomical investigations.)

[3rd ed., viii. and 128 pp., 1 pl. (8vo, Berlin, 1886).

„ „ **Notiz, die Färbung der Kapselmikrokokken betreffend.** (Note on the staining of capsule micrococci.) [*Supra*, p. 353.]

Bot. Centralbl., XXV. (1886) pp. 380–1, from *Fortschr. d. Medicin*, III. (1885) p. 757.

Friedländer, C.—**Microscopical Technology.** *Transl.* by S. Y. Howell.

x. and 250 pp., 1 pl. (8vo, New York, 1885).

FRIEDLÄNDER, C., and G. MARTINOTTI.—**La technica microscopica applicata alla clinica ed all' anatomia patologica.** (Microscopical technique applied to clinical work and pathological anatomy.) (Ital. transl. from the last German ed.) 296 pp., 1 pl., and 66 figs. (8vo, Torino, 1885).

FÜTTERER, G.—**Ueber eine Modification der Ehrlich'schen Färbemethode für Tuberkelbacillen im Gewebe.** (On a modification of Ehrlich's staining methods for tubercle bacilli in tissues.) [*Supra*, p. 345.]
Virchow's Arch. f. Path. Anat. u. Physiol., CI. (1885) p. 198.

GARBINI, A.—**Guida alla Bacteriologia.** (Guide to Bacteriology.)
xv. and 145 pp., 34 figs. (8vo, Verona, 1886).

GELPKE, T.—**Notiz zur Anwendung der Weigert'schen Modificirten Hämatoxylin-Färbung auf das periphere Nervensystem.** (Note on the use of Weigert's modified hæmatoxylin stain for the peripheral nerve-system.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 484–9.

GERLACH, L.—**[Examining Embryo-growth in Birds' Eggs.]** [*Supra*, p. 359.]
Nature, XXXIII. (1886) p. 497.

GIACOMI, DE.—**Neue Färbungsmethode der Syphilisbacillen.** (New staining methods for bacilli of syphilis.) [*Post.*]
Corresponzbl. d. Schweizer Aerzte, 1885, No. 12.

GIACOMINI.—**Nuovo processo di conservazione delle sezioni microscopiche.** (New process for preserving microscopic sections.) [*Supra*, p. 354.]
Gazzetta delle Cliniche, XXII. (1885).

Gierke, H.—**Staining Tissues in Microscopy. VII., VIII., IX.**
Amer. Mon. Micr. Journ., VII. (1886) pp. 13–5, 31–5, 53–4.

GOLGI, C.—**Sur l'Anatomie microscopique des organes centraux du système nerveux.** (On the microscopical anatomy of the central organs of the nervous system.)
[Methods, pp. 15–41. *Post.*]
Arch. Ital. de Biol., IV. (1883) pp. 92–123, VII. (1886) pp. 15–47.

GOTTSTEIN, A.—**Ueber Entfärbung gefärbter Zellkerne und Mikroorganismen durch Salzlösungen.** (On decolouring stained nuclei and micro-organisms by saline solutions.) [*Post.*]
Fortschr. d. Med., III. (1885) p. 627.

GÜNTHER, K.—**Ueber die Färbung der Recurrens-Spirillen im Blutpräparaten.** (On the staining of recurrens *Spirilla* in blood-preparations.) [*Supra*, p. 353.]
Bot. Centralbl., XXV. (1886) pp. 379–80.
Fortschr. d. Medicin, III. (1885) p. 755.

GUTTMANN, P.—**Ueber Leprabacillen.** (On leprosy bacilli.)
[Methods, *post.*]
Berlin Klin. Wochenschr., 1885, No. 6.

HANSEN, E. C.—**Einige kritische Bemerkungen über Dr. Hueppe's Buch, 'Die Methoden der Bacterien-Forschung.'** (Some critical remarks on Dr. Hueppe's book, 'The Methods of Bacteria-research.')
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 355–8.

HARRACH, A.—**Der Käfersammler.** (The Insect-collector.)
[Contains directions for preparing microscopical slides of insects.]
308 pp. (8vo, Weimar, 1884).

HAUSER, G.—**Ueber Fäulnissbacterien und deren Beziehung zur Septicämie. Ein Beitrag zur Morphologie der Spaltpilze.** (On pathogenic bacteria and their relation to septicæmia.) [*Post.*] 15 pls. (8vo, Leipzig, 1885).

„ „ **Ueber das Vorkommen von Mikro-organismen im lebenden Gewebe gesunder Thiere.** (On the occurrence of micro-organisms in living tissues of healthy animals.) [*Post.*]
Arch. f. Exper. Pathol. u. Pharmakol., XX. (1885) p. 162.

HAUSHOFER, K.—**Beiträge zur mikroskopischen Analyse.** (Contributions to microscopical analysis.)
[1. On the use of concentrated sulphuric acid. 2. A microscopical reaction for copper.]
SB. K. Bayer. Akad. Wiss., XV. (1885) p. 403.

HENKING, H.—**Ein einfaches Mikrotommesser.** (A simple microtome knife.)
[*Supra*, p. 348.]
Zeitschr. f. Wiss. Mikr., II. (1885), pp. 509–11 (1 fig.).

HEYDENREICH, L.—**Ueber den besten Deckglaskitt.** (On the best cover-glass cement.) [*Post.*] *Zeitschr. f. Wiss. Mikr.*, II. (1885), pp. 333–8.

HILDEBRAND, H. E.—**Ein vereinfachtes Mikrotom von grosser Leistungsfähigkeit.** (A simplified Microtome of great working capacity.) [*Post.*] *Ibid.*, pp. 343–5 (1 fig.).

[HITCHCOCK, R.]—**Preserving Urinary Casts.**

[Dilute carbolic acid. Shellac as the cement.]

Amer. Mon. Micr. Journ., VII. (1886) p. 18.

„ „ **Liquid Preservative.**

["It is frequently desirable to have a liquid preservative of the same specific gravity as water. Probably the nearest approach to such a medium is the one recommended to be used with Deane's gelatin medium, having the following composition:—rectified spirit 1½ oz., water 1½ oz., glycerin 5 fl. dr.]

Ibid., p. 38.

Howell, S. Y.—See Friedländer, C.

HUEPPE, F.—**Ueber die Dauerformen der sogenannten Commabacillen.** (On the permanent forms of the so-called Comma Bacillus.)

[Methods, *post.*]

Fortschr. d. Med., III. (1885) p. 619.

HUNTER, W.—**Recent Histological Methods.**

[*Hardening.*—(1) Weigert's rapid method in Müller's fluid, which is kept at a temperature of 30°–40° C. accelerating the process from 6 weeks to 14 days. It is specially applicable to brain and spinal cord. (2) Gaule's, placing the fresh tissue for 20–30 minutes in a saturated solution of corrosive sublimate and then in alcohol. *Imbedding in celloidin. Cutting.*—In cutting, the so-called dry method must be employed to obtain the full advantages of this method. Staining in the ordinary way. *Imbedding in Paraffin*, cutting and staining (alum carmine). For general purposes celloidin will be found more generally useful than paraffin, especially for nervous tissues. For fine histological or embryological purposes, paraffin is by far the best, and can in no way be equalled by any other known method.]

Journ. of Anat. and Physiol., XX. (1886) pp. 307–16.

IMHOF, O. E.—**[Turntable.]**

[Description of a simple form devised by the author.]

SB. K. Akad. Wiss. Wien, XCI. (1885) pp. 207–8 (1 fig.)

JENKINS, A. E.—**Methods of Study. IV.**

[Staining Methods and Formulæ. Cochineal (Mayer's and Alum). Carmine (Borax, Bermann's, Beale's, Alum-, Acetic Acid-, Acid Borax-, Alcohol-). Double Stains (Carmine and Indigo-Carmine, Picrocarmine, Picro-lithia-carmine, Palladium chloride and Carmine).]

The Microscope, VI. (1886) p. 5–11.

KALKOWSKY, E.—**Ueber die Polarisationsverhältnisse von senkrecht gegen eine optische Axe geschnittenen zweiaxigen Krystallplatten.**—(On the polarization relations of biaxial crystal plates cut at right angles to an optic axis.) [*Post.*] *Zeitschr. f. Krystallog. u. Mineral.*, IX. (1884) pp. 486–97 (1 pl.).

KLEMENT and RENARD.—**Réactions microchimiques à cristaux.** (Micro-chemical crystal reactions.) [*Post.*]

Bull. Soc. Belg. Micr., XII. (1886) pp. 55–6.

KOGANEÏ, J.—**Untersuchungen über den Bau der Iris des Menschen und der Wirbelthiere.** (Researches on the structure of the Iris of man and vertebrates.) [Methods, *post.*] *Arch. f. Mikr. Anat.*, XXV. (1885) pp. 1–48 (1 pl.).

KOROTNEFF, A.—**Zur Histologie der Siphonophoren.** (On the histology of the Siphonophora.)

[Methods, *post.*] *MT. Zool. Stat. Neapel*, V. (1884) pp. 229–88 (6 pls.).

KRAUSE, W.—**Die Retina.** (The retina.)

[Methods, *post.*]

Internat. Monatsschr. f. Anat. u. Histol., I. (1884) p. 225.

L., V. A.—**Cleaning Slides.**

[Bichromate of potash 2 oz., sulphuric acid 3 oz., water 25 oz.]

Scientific Enquirer, I. (1886), p. 3.

LAKER, K.—**Die ersten Gerinnungserscheinungen des Säugethierblutes unter dem Mikroskope.** (The first coagulation appearances of mammalian blood under the Microscope.) [*Post.*]
SB. K. Akad. Wiss. Wien, XC. (1884) pp. 147–58.

LATHAM, V. A.—**On mounting Pathological Specimens.**
[(1) Examination of fresh Tissues. (2) Hardening. (3) Cutting. (4) Staining.]
Sci.-Gossip, 1885, pp. 25–6.

LAVDOWSKY, M.—**Mikroskopische Untersuchungen einiger Lebensvorgänge des Blutes.** (Microscopical researches on some vital processes of the Blood.)
[Methods, *post.*]
Arch. f. Pathol. Anat. (*Virchow*), LXXXVI. (1885) pp. 60–100 (3 pls.).

LEE, A. B.—**Notiz, das Schällibaum'sche Collodium betreffend.** (Note on Schällibaum's collodion.) [*Post.*] *Zeitschr. f. Wiss. Mikr.*, II. (1885) p. 522.

LEGGETT, F. W.—**Silicate of Soda as a mounting medium.**
[Finds it to be a good mounting medium, transparent, and the mount is quickly made. Mr. C. F. Cox, on the contrary, found the soda was deposited in crystals.]
Journ. New York Micr. Soc., I. (1885) p. 213.

LIST, J. H.—**Mittheilungen technischen Inhaltes.** (Technical notes.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 514–6.

LOCKWOOD, S.—**Preparing Feather Crystals of Uric Acid from a Caterpillar.** [*Post.*] *Journ. New York Micr. Soc.*, I. (1885) pp. 217–8.

MARMÉ, W.—**Lehrbuch der Pharmakognosie des Pflanzen- und Thierreiches.** (Handbook of animal and vegetable pharmacology.)
[Contains brief directions for the preparation of each drug for microscopical examination.]
Part I., 272 pp. (8vo, Leipzig, 1885).

MARTINOTTI, G.—**La picronigrosina nello studio delle alterazioni dei centri nervosi.** (Picronigrosine in the study of the alterations of the nervous centres.) [*Supra*, p. 352.] *Zeitschr, f. Wiss. Mikr.*, II. (1885) pp. 478–84.

MATTIROLO, O.—**Skatol e Carbazol, due nuovi reagenti per le membrane lignificate.** (Two new reagents for lignified membrane.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 354–5.

MAYER, S.—**Ueber die blutleeren Gefässe im Schwanze der Batrachier-larven.** (On the bloodless vessels in the tail of Batrachian larvæ.)
[Methods, *post.*] *SB. K. Akad. Wiss. Wien*, XCI. (1885) p. 1.

MAYS, R.—**Histophysiologische Untersuchungen über die Verbreitung der Nerven in den Muskeln.** (Histophysiological researches on the extension of the nerves in the muscles.)
[Methods, *post.*] *Zeitschr. f. Biol.*, XX. (1885) p. 449.

MELTZER, S. J., and W. H. WELCH.—**Zur Histophysik der rothen Blutkörperchen.** (On the histophysics of the red blood-corpuscles.)
[Methods, *post.*] *Centralbl. f. d. Med. Wiss.*, 1884, p. 721.

MIRFIELD, E. H.—**Turn-table.**
[Lever for holding brush and raising or lowering it.]
Engl. Mech., XLII. (1886) p. 451 (2 figs.).

MOLISCH, H.—**Berichtigung.** (Correction.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) p. 359.

MONDINO, C.—**Sulla struttura delle fibre nervose midollate peripheriche.** (On the structure of the medullated peripheral nerve-fibres.)
[*Supra*, p. 342.] *Arch. per le Sci. Med.*, VIII. p. 45.

MORRIS, W.—**[New Mounting Medium.]** [*Supra*, p. 357.]
Australasian Med. Gazette, V. (1886) p. 100.

New Slides.
[Hinton's *Trichina*—Piffard's botanical—Collins's *Eozoon*.]
Sci.-Gossip, 1886, p. 67.

NISSL.—**Untersuchungsmethoden der Grosshirnrinde.** (Methods of investigation for the brain cortex.)
[Methods, *post.*] *Ber. Naturf.-Versamml. Strassburg*, 1885, pp. 506 and 135.

Ost, J.—**Ueber die Leistungsfähigkeit der Mikrometerschraube.** (On the performance of the micrometer-screw [of microtomes].) [*Post.*]
Zeitschr. f. Wiss Mikr., II. (1885) pp. 295–300.

Paulsen, E.—**Färbung von Schleimdrüsen und Becherzellen.** (Staining of mucous glands and goblet cells.) [*Supra*, p. 353.]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 520–1.

Pengra, C. P.—**Preserving Urinary Casts.**
["There is no better medium than the mother liquid.]
Amer. Mon. Micr. Journ., VII. (1886) p. 39.

Prudden, J. M.—**Delafield's Hæmatoxylin Solution.**
[Reply to query as to the discoverer (Prof. J. Delafield) and original directions for making.]
Zeitschr. f. Wiss. Mikr., II. (1885) p. 288.

Renard.—See Klement.

Ribbert.—**Zur Färbung der Pneumoniekokken.** (On staining pneumonia cocci.) [*Post.*]
Deutsche Med. Wochenschr., 1885, p. 136.

Rohrbeck, H.—**Neuerungen an bacteriologischen Apparaten.** (Improvements in bacteriological apparatus.)
Gaea, XXI. (1885) No. 6.

Rössler, R.—**Die Bildung der Radula bei den cephalophoren Mollusken.** (The formation of the radula in the cephalophorous Mollusca.)
[Methods, *post.*]
Zeitschr. f. Wiss. Zool., XLI. (1885) pp. 447–82 (2 pls. and 1 fig.).

Sandmann, G.—**Ueber die Vertheilung der motorischen Nervenendapparate in den quergestreiften Muskeln der Wirbelthiere.** (On the distribution of the motor nerve-end-apparatus in striated vertebrate muscle.)
[Methods, *post.*]
Arch. f. Anat. u. Physiol.—Physiol. Abtheil., 1885, p. 240.

Schulze, F. E.—**Entwässerungsapparat.** (Dehydrating apparatus.) [*Post.*]
S.B. Gesell. Naturf. Freunde Berlin, 1885, pp. 175–7.
Arch. f. Mikr. Anat., XXVI. (1886) pp. 539–42 (2 figs.)

„ „ **Neues Netz zum Fangen kleiner frei-schwimmender Thiere.** (New net for catching small free-swimming animals.) [*Supra*, p. 341.]
SB. Gesell. Naturf. Freunde Berlin, 1885, pp. 178–9 (1 fig.).

„ „ **Schlammsauger.** (Mud-pipette.) [*Supra*, p. 341.]
Ibid., pp. 179–80.

Schütz.—See Doutrelepont.

Seaman, W. H.—**Mounting Mediums with high Refractive Indices.**
[*Supra*, p. 357.] *Amer. Mon. Micr. Journ.*, VII. (1886) p. 21–4.

[Sections, Ordinary v. Serial.] [*Supra*, p. 349.] *Nature*, XXXIII. (1886) p. 243.

Seeds of Orthocarpus purpurascens.
[The fully ripe seed has become a favourite object for exhibition under the Microscope. Its chief interest centres in the white net-like sac in which the kernel is encased.]
Journ. New York Micr. Soc., I. (1885) p. 224.

Serrano y Fatigati, E.—**Nota sobre la cristalizacion en el campo del microscopio del acetato potásico.** (Note on the crystallization of acetate of potash in the field of the Microscope.)
Anal. Soc. Españ. Hist. Nat., XIV. (1885) *Actas*, pp. 79–80.

Slack, H. J.—**Pleasant Hours with the Microscope.**
[Rotifers.] *Knowledge*, IX. (1886) pp. 144–5 (5 figs.).

Smith's (H. L.) New Mounting Medium of high refractive Index.
[*Supra*, p. 356,]
Amer. Mon. Micr. Journ., VII. (1886) pp. 3–4.

Spengel, J. W.—**August Becker's Schlittenmikrotom.** (A. Becker's Slide-Microtome.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 453–9 (2 figs.).

Stein, S. v.—**Einfache Vorrichtung für das Mikrotom zur Einbettung der Präparate.** (Simple contrivance for the microtome for imbedding). [*Post.*]
Centralbl. f. d. Med. Wiss., 1884, p. 100.

STEIN, S. v.—**Eine neue Methode, Hämoglobin-Krystalle zu erhalten.** (A new method of obtaining hæmoglobin crystals.)
[Methods, *post.*] *Centralbl. f. d. Med. Wiss.*, 1884, p. 404.

STELZNER, A.—**Die Entwicklung der petrographischen Untersuchungsmethoden in den letzten 50 Jahren.** (The development of petrological methods in the last 50 years.)
Festschr. Gesell. Isis, 1885, p. 25.

STOWELL, C. H.—**How to examine Epithelium.**
[Directions for preparing and examining columnar, ciliated, and pavement epithelium.]
The Microscope, VI. (1886) pp. 25–8 (6 figs.).

STRENG, A.—**Ueber einige Mikroskopisch-chemische Reactionen.** (On some microchemical reactions.)
[Tests for silver, arsenic, antimony, barium, tartaric acid, and sulphuric acid.]
Ber. Oberhess. Gesell. f. Natur- u. Heilk. Giessen, XXIV. (1885) pp. 54–5.
[Phosphoric acid, potassium, sodium, lithium, calcium and strontium. barium, magnesium, aluminium.]
Neues Jahrbuch f. Mineral., I. (1885) pp. 21–42.

TOISON, J.—**Sur le numération des éléments du Sang.** (On counting the elements of the blood.)
[Methods, *post.*] *Journ. Sci. Méd. Lille*, 1885, 4 pp.

UFFREDUZZI, G. B.—**I Microparassiti nelle Malattie da Infezione. Manuale technico.** (The micro-parasites of infectious diseases. Technical manual.)
322 pp., 2 pls. and figs. (8vo, Torino, 1885).

UNNA, P. G.—**Zur Färbung der Leprabacillen.** (On staining the leprosy bacillus.) [*Post.*]
Monatsch. f. Prakt. Dermat. Ergänzungsh., 1885, p. 47.

VINASSA, E.—**Beiträge zur pharmakognostischen Mikroskopie.** (Contributions to pharmacological microscopy.) [*Post.*]
Zeitschr. f. Wiss. Micr., II. (1885) pp. 309–25 (4 figs.).

VIRCHOW, H.—**Ueber Zellen des Glaskörpers.** (On cells of the vitreous body.)
[Methods, *post.*] *Arch. f. Mikr. Anat.*, XXIV. (1884) pp. 99–109.

VRIES, H. DE.—**Over eene methode om im plantensappen gebonden zuren te bepalen.** (On a method of determining the acids in plants when combined with bases.) [*Supra*, p. 346.]
Maandblad voor Natuurwetenschappen, 1884, No. 9.

WALL, O. A.—**Glass Slides for Mounting.**
St. Louis Nation. Druggist, VIII. (1886) pp. 24 and 39.

" " **Protect Slides against Frost.**
["It is advisable to take it for granted that frost may injure the slides, and to act accordingly by keeping them in a moderately warm room."]
Ibid., p. 39.

WARLOMONT, R.—**Le Bacille de la tuberculose.** (*Bacillus tuberculosis.*)
[Methods, *post.*]
Bull. Soc. Belg. Micr., XII. (1886) pp. 44–8, from *Rev. Médicale*, Louvain.

WEIGERT, C.—**Eine Verbesserung der Hämatoxylin-Blutlaugensalzmethode für das Centralnervensystem.**) An improvement in the hæmatoxylin ferrocyanide of potash method for the central nervous system.) [*Post.*]
Fortschr. d. Med., III. (1885) p. 236.

" " **Ein neues Tauchmikrotom besonders für grosse Schnitte.** (A new immersion microtome, especially suited for large sections.) [*Post.*]
Zeitschr. f. Wiss. Mikr., II. (1885) pp. 326–33 (2 figs.).

" " **Ueber Schnittserien von Celloidinpräparaten des Centralnervensystems zum Zwecke der Markscheidenfärbung.** (On series-sections of celloidin preparations of the central nervous system for staining nerve-sheaths.)
[*Post.*] *Ibid.*, pp. 490–5.

WELCH, W. H.—See Meltzer, S. J.

WHITMAN, C. O.—**Osmic Acid and Merkel's Fluid as a means of developing nascent histological distinctions.** [*Post.*]
Amer. Natural., XX. (1886) pp. 200–3.

PROCEEDINGS OF THE SOCIETY.

ANNUAL MEETING OF 10TH FEBRUARY, 1886, AT KING'S COLLEGE, STRAND, W.C., THE PRESIDENT (THE REV. DR. DALLINGER, F.R.S.) IN THE CHAIR.

The Minutes of the meeting of 13th January last were read and confirmed, and were signed by the President.

The President said that some of the Fellows present might not be aware that they had just lost by death one who was well known to them; he referred to the late Mr. P. H. Lealand. His genial urbanity to all who came in contact with him, and his long connection with his firm of Powell and Lealand (to whom the science of microscopy was so largely indebted for those optical productions, the excellence of which was so well appreciated, and in which Mr. Lealand took an honourable part), justified a notice of the fact that he was no longer amongst them, and an expression of their regret at his death, as well as of sympathy with his surviving relatives.

Mr. Crisp said that, owing to a curious and probably unintentional operation of their bye-laws, it would not be necessary to make the meeting special in order to elect Dr. Dallinger as President for a third year. While it was provided that a Fellow should not be elected for more than two years, it was also provided that at Annual Meetings alterations in the bye-laws could be made without notice. All that was necessary, therefore, was to pass a resolution, which he now proposed, "That notwithstanding bye-law No. 27, or any other bye-law, the Rev. Dr. Dallinger be, and he is hereby declared, eligible for election as President of the Society for a third year."

Mr. Michael having seconded the motion, it was put to the meeting, and carried unanimously.

The List of Fellows proposed as Council and Officers for the ensuing year was read as follows:—

President—Rev. W. H. Dallinger, LL.D., F.R.S.

Vice-Presidents—*J. William Groves, Esq.; *John Mayall, Esq., jun.; Albert D. Michael, Esq., F.L.S.; *Prof. Charles Stewart, M.R.C.S., F.L.S.

Treasurer—Lionel S. Beale, Esq., M.B., F.R.C.P., F.R.S.

Secretaries—Frank Crisp, Esq., LL.B., B.A., V.P. and Treas. L.S.; Prof. F. Jeffrey Bell, M.A., F.Z.S.

Twelve other Members of Council—Joseph Beck, Esq., F.R.A.S.; A. W. Bennett, Esq., M.A., B.Sc., F.L.S.; Robert Braithwaite, Esq., M.D., M.R.C.S., F.L.S.; *Rev. Edmund Carr, M.A.; *Frank R. Cheshire, Esq., F.L.S.; *G. F. Dowdeswell, Esq., M.A.; James

* Have not held during the preceding year the office for which they are nominated.

Glaisher, Esq., F.R.S., F.R.A.S.; John Matthews, Esq., M.D.; John Millar, Esq., L.R.C.P., F.L.S.; Urban Pritchard, Esq., M.D.; William Thomas Suffolk, Esq.; *Charles Tyler, Esq., F.L.S.

Mr. Guimaraens and Mr. Powell having been appointed Scrutineers, the ballot was proceeded with, and upon the result being subsequently reported to the President, he declared that all the Fellows who had been nominated were duly elected to serve as Council and Officers during the ensuing year.

The Treasurer's Account was read (p. 372). The Treasurer (Dr. Beale, F.R.S.) said he thought the Fellows would consider this to be a most satisfactory account. He was anxious, nevertheless, to see their resources still further increased, in order that they might be able to do better still. They wanted an increased number of Fellows in order to give them the means of improving the Journal, although it had already become a most valuable periodical, and had attained a very high degree of excellence, mainly through the fostering care of their friend Mr. Crisp. What they wanted now was to see it a self-supporting enterprise, and if each Fellow would do his best to increase their numbers, the Journal would not only repay its cost, but they might have more plates, and in other ways extend its influence.

A motion for the adoption of the Treasurer's Report and for a vote of thanks to him for his services was moved by Dr. Millar, seconded by Professor Stewart, and carried unanimously.

The Report of the Council was read (pp. 370–3).

The adoption of the Report was moved by Mr. W. W. Reeves, and seconded by Mr. Spencer, and carried unanimously.

Mr. Cheshire in eulogistic terms moved that the thanks of the Society should be given to the Secretaries for their valuable services during the past year.

Mr. Vezey seconded the motion.

The President said that the Fellows all knew how much they were indebted to the Secretaries for their services to the Society, and without being invidious he might say especially to the one on his left, and there could be no doubt as to the cordial way in which this resolution would be received. The motion was carried by hearty acclamation.

Mr. Crisp said he was sorry that Prof. Bell was unable to be with them that evening, being absent from London on account of ill-health, and he begged therefore to return thanks on Prof. Bell's behalf, as also for himself, so far as he was intended to be included in the resolution.

The President then read his Annual Address (pp. 193–207).

Prof. Stewart proposed that the best thanks of the meeting be given to the President for his address, to which he had listened with

* Have not held during the preceding year the office for which they are nominated.

the greatest pleasure, and which it would be contrary to precedent to discuss.

Mr. Crisp, in seconding the motion, thought it would not be out of place to point out, in reference to the President's remarks on the benefits derived from wide apertures, that what promised to be another very important advance in the construction of objectives had just been made. Prof. Abbe had for a long time been trying to obtain an optical glass which would get rid of the secondary spectrum, and he had recently succeeded in doing this. The secondary spectrum was eliminated, and nothing was now left but a small tertiary spectrum. He hoped that before long they would be able to judge of some objectives for themselves. The Fellows had already cordially approved the announcement that the President had consented to accept office for a third year, and they were aware how regularly he attended the meetings, though at considerable effort to himself; he therefore proposed to add to Prof. Stewart's motion that their thanks be also given to the President for accepting the office for a further period.

The motion was then put to the meeting, and carried unanimously.

The President said he was much gratified by the very cordial manner in which his address and this vote of thanks had been received. He could only repeat what he had said before, that he had given for many years the whole of his leisure time, and some which had not been quite leisure also, to studies of this kind. He loved the work, and should always feel it to have been a very great honour to have held the position he did in connection with a Society which made the use of the Microscope its primary object.

The President moved a vote of thanks to the Auditors and Scrutineers for their services, and

Dr. Millar having seconded the motion, it was carried unanimously.

New Fellows:—The following were elected *Ordinary* Fellows:—

Messrs. John Christie, A. N. Disney, M.A., Julio Gardia, W. H. Weightman, and R. R. Whitehead.

REPORT OF THE COUNCIL FOR 1885.

Fellows.—During the year 1885, 53 new Fellows were elected, a number in excess of the average of recent years; 25 Fellows have died or resigned (2 compounders, and 23 annual subscribers); 3 Honorary Fellows have also died.

The deaths of the year, unfortunately, include the names of three of the leading authors of works on the Microscope in the English, French, and German languages. The President has already expressed the sense of the Society at the loss which microscopy has sustained in the death of the author of 'The Microscope and its

Revelations,' Dr. W. B. Carpenter. Prof. C. Robin, the well-known French histologist, and an Honorary Fellow of the Society, was the author of the standard work on the Microscope in France, which has passed through three editions; while Dr. P. Harting, another Honorary Fellow, was the author of the exhaustive and learned historical and practical treatise on the Microscope which, originally written in Dutch, is better known through its German translation. The death of Dr. F. Ritter v. Stein (the third Honorary Fellow) was referred to in last year's report. He was succeeded as there mentioned by Dr. Flögel, whilst the second vacancy has been filled by Prof. H. de Lacaze-Duthiers, who is well known as one of the foremost of French zoologists. The third vacancy has not yet been filled.

The number of Fellows now stands as follows:—606 Ordinary Fellows, 49 Honorary Fellows, and 82 Ex-officio Fellows, or 737 in all.

Finances.—The additions to the List of Fellows represent a net increase in the revenue of the Society for the year of 62*l.* 9*s.* 6*d.* The total income received, other than for compositions, was 959*l.* 1*s.* 8*d.*, so that during the current year it is expected that the Society's revenue will reach 1000*l.*, which it will be agreed represents a very satisfactory state of the Society's finances.

Library and Cabinet.—Owing to the unfortunate, and at one time serious illness of the Librarian, the Catalogue of the Library which was just ready, was delayed. It is now, however, again in order for printing and will be proceeded with forthwith, when the arrangements for lending books from the Library will come into force.

The Cabinet Committee on entering upon their labours found that a proper revision of the Cabinet would require a considerable amount of time to complete satisfactorily, and they are not at present able to present their report.

Additional shelves have been added to the Library to provide for the ever-increasing number of books.

An Abbe Apertometer has been placed in the Library for the use of Fellows who may desire to verify the aperture of their objectives.

Journal.—The principal improvement in the last volume of the Journal is the extension of the Index. The names of the authors no longer appear alone, but are followed by the title of the paper or article of which they are the authors. Whilst this adds considerably to the length of the Index, it will, it is believed, be found of great practical use. The contents both of the separate numbers and of the whole volume also, now include the names of the authors, while the former (on the wrappers) are now classified, much facilitating reference to any particular paper. An alteration of type has also improved the Bibliographical lists.

Mr. E. Thurston, of King's College, kindly undertook a portion of the Microscopy β section during the year, but, on his leaving for India, his place has been filled by Dr. R. G. Hebb, and that of Mr. B. B. Woodward, who was obliged to resign on account of ill-health, by Mr. J. Arthur Thompson.

THE TREASURER'S ACCOUNT FOR 1885.

Dr.

1885.	£	s.	d.
To Balance brought from 31st December, 1884	193	7	1
„ Interest on Investments	86	5	3
„ Admission Fees	100	16	0
„ Annual Subscriptions	772	0	5
„ Compositions	94	10	0
„ Journals and Reprints sold by Assistant-Secretary	17	5	6
„ Screw tools sold	1	5	2
	£1265	9	5

Cr.

1885.	£	s.	d.
By Rent, Gas, and Attendance	95	18	0
„ Salaries, Reporting, and Commission	193	9	6
„ Books and Binding	116	0	5
„ Expenses of Journal	503	10	0
„ Postage of Journal	62	5	9
„ Reprinting Journal, Vol. II. (1879) No. 1	22	12	6
„ Stationery and Miscellaneous Printing	17	18	5
„ Coffee at Evening Meetings	19	10	0
„ Fire Insurance	1	16	0
„ Petty Cash	31	11	8
„ Subscription to Mr. Bolton's Bottles	2	2	0
„ Abbe Apertometer	3	0	0
„ Cabinet Fittings	3	5	0
„ Elliott and Fry for use of Sir R. Owen's photograph	1	1	0
„ Lantern at Annual Meeting	1	15	0
„ Balance remaining 31st December, 1885	189	14	2
	£1265	9	5

L. S. Beale, *Treasurer.*

Investments, 31st December, 1885.

1200*l.* Freehold Mortgages. 959*l.* 12*s.* 6*d.* Three per cent. Consols (including 100*l.* Quekett Memorial Fund).

The foregoing Annual Account examined and found correct, January 28th, 1886.

Thomas Curties
Frederick W. Hembry } *Auditors.*

The Council considered and ultimately approved a proposal for publishing in the Journal the portraits of the Presidents of the Society. To issue the whole (21) as full-page portraits involved a greater cost than the Council saw their way to undertaking, while to spread them over a series of years did not appear to be desirable. It was therefore decided that the portraits of 16 of the Presidents, from 1840 to 1878, should be issued in two groups with full-page portraits of the first President of the Microscopical Society of London (Sir R. Owen, K.C.B.), and the first President of the Royal Microscopical Society (Mr. Glaisher, F.R.S.). No little difficulty was experienced in collecting the photographs for the groups, the only ones obtainable in some cases being old and faded and in others unsuitable for technical reasons. The satisfactory character of the result is due to the trouble and attention given to the matter by Mr. J. Mayall, jun., one of the members of the Council.

MEETING OF 10TH MARCH, 1886, AT KING'S COLLEGE, STRAND, W.C., THE PRESIDENT (THE REV. DR. DALLINGER, F.R.S.) IN THE CHAIR.

The Minutes of the meeting of 10th February last were read and confirmed, and were signed by the President.

The List of Donations (exclusive of exchanges and reprints) received since the last meeting was submitted, and the thanks of the Society given to the donors.

	From
Hudson, C. T., and P. H. Gosse, The Rotifera or Wheel Animalcules. Part 1, pp. 1–40, 7 pls.; Part 2, pp. 41–80, 7 pls. (8vo, London, 1886)	*The Publishers.*
William Sharon v. Sarah Althea Hill. Oral Argument for Complainant by W. M. Stewart. 106 pp., 13 tables and 5 letters. (8vo, San Francisco, 1885)	*Dr. Hanks.*
Ditto, ditto, Closing Argument for Complainant, by W. H. L. Barnes. 224 pp., 55 tables and 4 letters. (8vo, San Francisco, 1885)	"
Spruce, R., Hepaticæ of the Amazon and of the Andes of Peru and Ecuador. xi. and 588 pp., 22 pls. (8vo, London, 1885)	*The Publishers.*
Walker, W. C., and H. H. Chase, Notes on some New and Rare Diatoms. 6 pp. and 2 pls. (4to, Utica, N.Y., 1886)	*The Authors.*
Viallanes, H., La Photographie Appliquée aux Études d'Anatomie Microscopique. vi. and 66 pp., 4 woodcuts and 1 pl. (8vo, Paris, 1886)..	*The Author.*

Mr. J. Beck said he thought it might be of some interest to the Fellows, seeing that they were subscribers to the Marine Biological Association, to hear some description of his recent visit to the Zoological Station at Naples. Mr. Beck then gave a description of the Station, and said it was certainly the most perfect which had ever been established. He had seen most of the large aquaria in existence, but had never seen one where the arrangements were so complete, or the work was carried out in so thorough a manner. Mr. Beck remarked particularly on the special attention which was given to the preservation of specimens, so as to exhibit them as far as possible in their

natural condition. He had brought with him to the meeting a specimen of *Tubularia* and other organisms, to show the way in which they were preserved, including some red coral with the polyps extended permanently, in a beautiful way. The plan of doing this was practically a secret, and the endeavours to imitate it had as yet only met with partial success here. The preparations were for sale, and could be obtained by any one at an exceedingly moderate price according to a published list. The establishment was being enlarged so as to afford room for putting up additional tables, and he recommended every one to visit it who went near that part of Italy. He proposed to deposit in the Library specimens similar to those which he exhibited, so that they could be referred to by any Fellows who might be interested in the subject.

The President thanked Mr. Beck for the interesting description which he had given them as to the station, and also for the promised specimens.

Dr. Crookshank exhibited and described an elaborate and very complete photo-micrographic apparatus made for him by Messrs. Swift, which possessed some special advantages in the focusing arrangements, and in the facility with which it could be used in a vertical as well as a horizontal position.

Mr. Crisp, in exhibiting some Microscopes and apparatus of somewhat special construction, said that the Bishop of Oxford had recently been extolling the study of language and literature in opposition to that of science, on the ground that the one was a study of mind, while the other dealt only with matter. If the Bishop were asked what the instruments before them represented, he would no doubt answer "matter." In fact, however, the great interest which the objects before the meeting had—at any rate to him (Mr. Crisp) —was from the point of view of "mind." That they were made of wood or iron or brass was entirely a secondary consideration. The essential point was the interesting evidence which they afforded of the working of the human mind. Take, for instance, the apparatus for moving a slide across the field of view. That was a problem that had been solved many years ago in this country, first by the simple process of two movable plates (the ordinary mechanical stage), then by one plate, and more recently without any plate at all. Compared with this simplicity, how strange had been the workings of the mind that had devised Klönne and Müller's Bacteria Finder, which he exhibited. Mr. Crisp then described the following instruments and apparatus, commenting upon the evidence they afforded of the specialities of the various minds concerned in their production, viz.:—

Helmholtz's Vibration Microscope, for observing the mode of vibration of tuning-forks, strings, and other vibrating bodies (*supra*, p. 305).

Thoma's Microscope, for observing the circulation of the blood in the mesentery of dogs and other small mammals (*supra*, p. 309).

Reichert's Microscope, with new mechanical stage, allowing the slide to move on the surface of the stage, without any intermediate plate (*supra*, p. 307).

Jung's Objective-holder, with an ingenious arrangement for releasing the objective (*ante*, p. 132).

Westien's Lens-holder, with universal nut for loosening all the parts by one turn of the screw (Vol. V. (1885) p. 316).

Prof. S. Exner's micro-refractometer was exhibited and described by Mr. Crisp. The designer claimed that by a movable diaphragm over the eye-piece he was able to detect differences in the structure of the different parts of blood-corpuscles, insects' eyes, &c. (*supra*, p. 328).

Mr. E. M. Nelson described a Microscope (exhibited by Mr. Crisp) fitted by Messrs. Swift with the new form of fine adjustment invented by the Rev. J. Campbell, a clergyman in Shetland, which consisted in cutting two different threads on the screw—32 and 30 respectively—giving a rate of motion corresponding to the difference between the two (*supra*, p. 324).

Mr. J. Mayall, jun., understood that Mr. Swift thought the arrangement would hardly be likely to serve its purpose for students' Microscopes, for which it had been more especially recommended, as it could not be produced cheaply.*

Mr. J. Mayall, jun., described a new form of fine adjustment (exhibited by Mr. Crisp) applied to the ordinary Jackson form. It had been designed by Messrs. Anderson and Sons to give two different speeds by means of threads having a pitch of 40 and 100 threads to the inch (*supra*, p. 325).

He also exhibited a Huyghenian eye-piece which had been made by Mr. Hilger, with lenses of rock crystal. It had been expected that it would give good results; but having tried it carefully, he could hardly tell the difference between this and others of similar power with glass lenses by Messrs. Powell and Lealand.

Mr. Crisp reported the discovery by Prof. Abbe and Dr. Schott (after several years of work) of a new optical glass, by which the secondary spectrum in objectives was eliminated. Two objectives made from it were exhibited (by Mr. Stephenson and Mr. Crisp) with the special eye-pieces which were designed for use with them (*supra*, p. 316).

Mr. Stephenson, in reply to the President, said that to enable the Fellows to judge of the excellence of the new objectives—one of which had been very handsomely presented to him by Mr. Zeiss—he had brought it to that meeting. He had placed under the instrument a slide of *Amphipleura pellucida* in phosphorus, and there could be no question, in his opinion, of the fineness of the definition, while the colourless image and great flatness of field could not fail to strike the observer. The President, in his last address, spoke of the great advantage to practical observation which he had experienced in the increased aperture of modern objectives, and, just in the same way,

* Mr. Baker informs us that he finds the arrangement works admirably, and that he applies it to all his Students' Microscopes.

it would, he believed, be found that the greater refinement of definition, incident to more perfect achromatism, must, when combined with the present enormous apertures, yield, in future research, results still further in advance. He congratulated Prof. Abbe, and microscopists in general, on the happy combination from which so much might be expected.

Mr. E. M. Nelson said that the opportunity had been afforded him by Mr. Crisp of trying the other objective. He first used it upon *P. angulatum*, and found that it gave a very beautiful picture. He was able to use a larger cone, and to see much more clearly the small bar of silex which he had mentioned on a former occasion. On trying *Isthmia nervosa* with the whole aperture of Powell's condenser and a solid cone, the secondary markings came out remarkably well, and he was able to trace a fracture most beautifully. He next tried *Coscinodiscus*, and here there was a great change observed, for instead of the silex coming out a pinkish colour, as usual, it was grey. He then examined *Amphipleura pellucida* with an oblique beam of light (1·4 N.A.). The diatom was mounted in Prof. Smith's medium, and he never saw such a picture—so sharp and distinct.

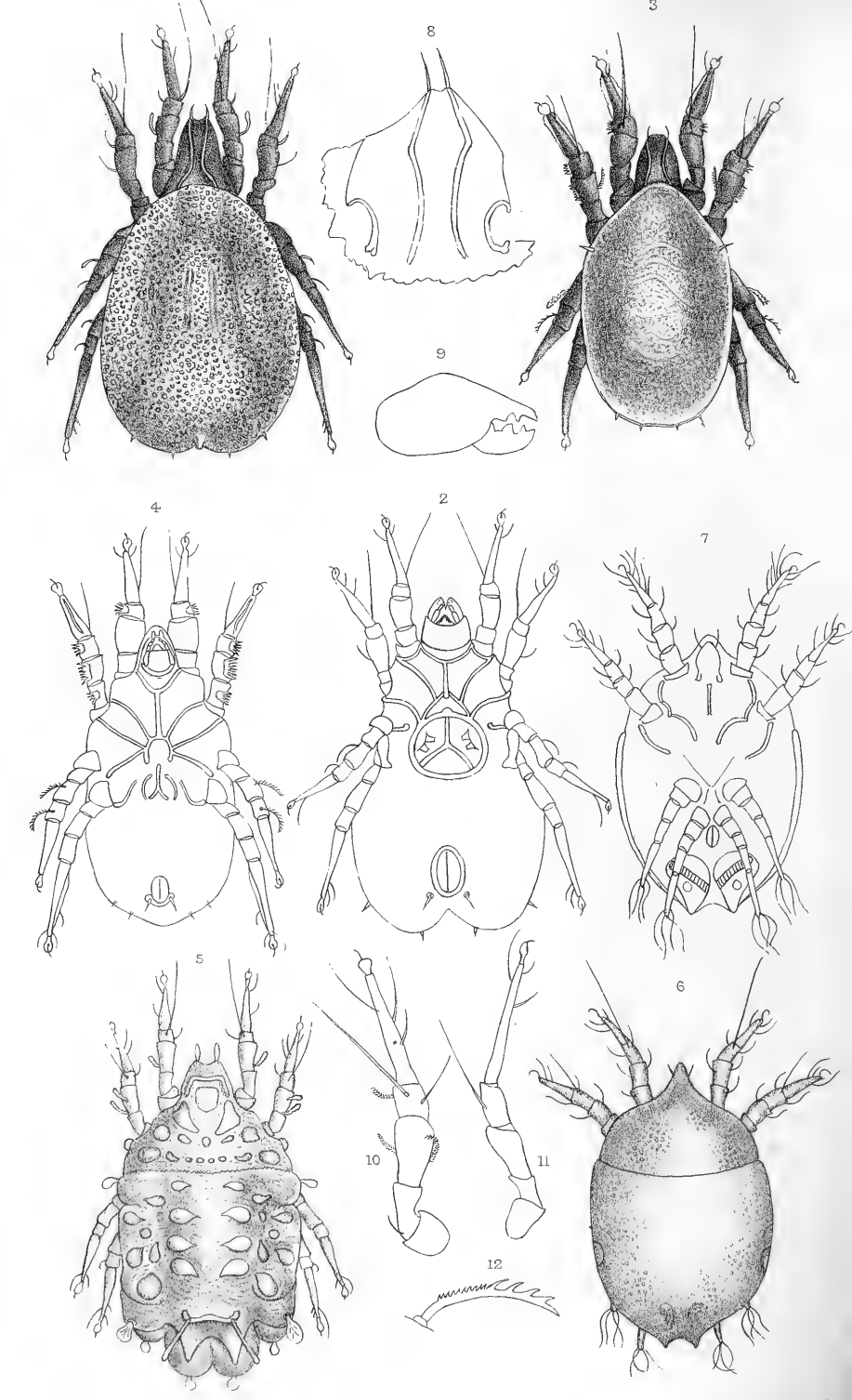
The President said that they had been for some time anticipating the pleasure of seeing these lenses, and particularly so after what was mentioned about them at their previous meeting, but it was a pleasant surprise to him to find them in London on his arrival that afternoon. It was a matter of much satisfaction to have the opinions of Mr. Stephenson and Mr. Nelson, and still more so to hear from them that the good reports which had already reached them had not been exaggerated. There was no doubt a great field opened up by this new departure, and he might say for himself that, although he had spent a great deal of money in obtaining the most perfect lenses possible for the purposes of his own investigations, he should be very glad to avail himself of any advantages which might be offered by the new objectives.

Mr. A. D. Michael gave a *résumé* of his paper "On the Life-history of an Acarus, one stage of which is known as *Labidophorus talpæ;* and on an unrecorded species of *Disparipes*." The subject was illustrated by drawings upon the black-board, and by mounted preparations exhibited under Microscopes.

The President, in expressing the thanks of the Society for this communication, said it was very pleasant to see the earnest work which was being done around them, especially when it was so successful as it was in the hands of Mr. Michael.

Mr. W. C. Meates' note on 'A new Medium of High Refractive Power for Diatom Mounting' was read (*supra*, p. 357).

Mr. A. Y. Moore's slides of stained *Amphipleura pellucida* were exhibited, and the advantages of staining as applied to diatoms discussed, Mr. Stephenson pointing out that diatoms had been stained many years ago, but that the result had not been found sufficiently satisfactory to warrant a repetition of the experiment.



A.D.Michael del. et nat. lith.

West, Newman & Co. lith.

Glyciphagus Crameri.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

JUNE 1886.

TRANSACTIONS OF THE SOCIETY.

VIII.—*Upon the Life-history of an Acarus one stage whereof is known as Labidophorus talpæ, Kramer; and upon an unrecorded species of Disparipes.*

By Albert D. Michael, F.L.S., F.Z.S., F.R.M.S.

(*Read 10th March*, 1886.)

Plates X. and XI.

In the year 1877 Dr. Kramer of Schleusingen published a paper upon two *Acari* which he had discovered parasitic upon the mole.* It was freely asserted by some acarologists that neither of these species were adult, and that they were but immature hypopial forms. The question of what a *Hypopus* really is, and what were true *Hypopi* and what were not so, was less understood then than now. Time, however, showed most satisfactorily that one of Dr.

EXPLANATION OF PLATES.

Plate X.

Fig. 1.—*Glyciphagus Crameri*, female, dorsal view × 130.
„ 2.— „ „ „ ventral view × 130.
„ 3.— „ „ male, dorsal view × 160.
„ 4.— „ „ „ ventral view × 160.
„ 5.— „ „ fully grown nymph.
„ 6.— „ „ hypopial nymph, dorsal view × 160.
„ 7.— „ „ „ „ ventral view × 160.
„ 8.— „ „ adult female; hood of rostrum × 450.
„ 9.— „ „ „ male; mandible × 380.
„ 10.— „ „ „ female; 1st left leg from above × 200.
„ 11.— „ „ „ „ 4th right leg from the inner side × 200.
„ 12.— „ „ „ „ a hair from the 1st leg × 500.

* "Zwei parasitische Milben des Maulwurfs," Archiv f. Naturg., xliii. pp. 249–59.

Kramer's species, *Pygmephorus spinosus*, was an adult creature, and a perfectly good and very interesting species. With regard to the other *Acarus*, which Kramer called *Labidophorus talpæ*, it appeared probable that this really was an immature (hypopial) form.

Before proceeding further, I may as well, for the sake of clearness, remind my readers what a *Hypopus* is. I trust that I have elsewhere * satisfactorily shown that the hypopial stage is one assumed by some of the nymphs of certain *Acari* for the purpose of enabling them to endure more adverse conditions of heat and drought than the ordinary nymph can survive, and thus adhere to insects, &c., which may be exposed to hot sunshine, &c., and be transferred by them to new localities; whereby the distribution of the species was ensured; and that the hypopial stage occupied the period between two ecdyses in the ordinary nymphal life-history, and also, I think, showed that some *Acari* which were adult sexual forms assumed a very close resemblance to the true *Hypopus*, except in the mouth-organs, with the object of ensuring distribution in the same manner as the hypopial nymphs.

What rendered it almost certain that *Labidophorus talpæ* was a hypopial nymph, was that in 1879 Dr. G. Haller, then of Bern, discovered, parasitic upon the squirrel, an *Acarus* of which the

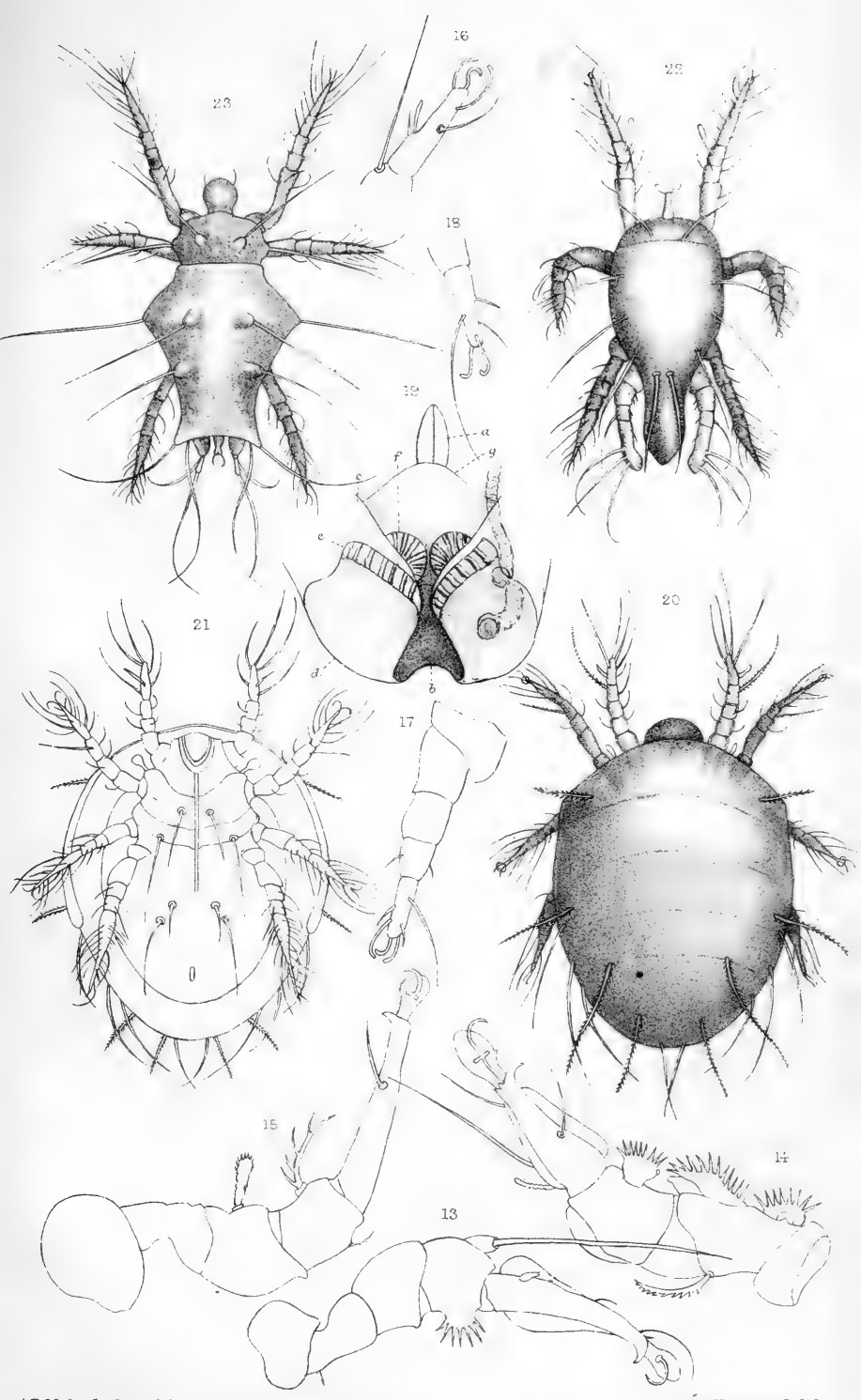
---

PLATE XI.

Fig. 13.—*Glyciphagus Crameri*, adult male; 1st right leg from without × 380.
„ 14.— „ „ „ 2nd left leg from within × 450.
„ 15.— „ „ „ 3rd „ „ × 450.
„ 16.— „ „ hypopial nymph; 1st tarsus.
„ 17.— „ „ „ „ 3rd left leg from without.
„ 18.— „ „ „ „ 4th tarsus, showing the two claw-like hairs turned upward.
„ 19.—*Glyciphagus Crameri*, hypopial nymph, posterior apparatus for holding hairs on the ventral surface. (*a*) anus; (*b*) channel wherein the hair lies; (*c*) large lips or wing-like processes, which lie over the hair, and usually overlap each other a little when there is not any hair there (they are not drawn so for the sake of clearness); (*d*) chitinous plates on the inner side of the lips; (*e*) chitinous band near the edge of the inner surface of the plate, with hard transverse ridges on its inner side, which are only seen through in the figure from the transparency of the chitin; (*f*) circular chitinous plates with radiating ridges on the under side of the abdomen; (*g*) plate sloping down, which serves to turn the hair away from the anus. On the right side is indicated the retractor muscles of the labia, &c.
„ 20.—*Disparipes exhamulatus*, adult female, dorsal view × 250.
„ 21.— „ „ „ „ ventral view × 250.
„ 22.— „ „ „ male, dorsal view × 350.
„ 23.— „ „ larva.

---

* "The Hypopus question," Journ. Linn. Soc.—Zool., xvii. (1884) pp. 371-94.



A.D. Michael ad nat. del.

West, Newman & Co. lith.

Glyciphagus Crameri. 13–19.
Disparipes exhamulatus. 20–23.

hypopial nymph closely resembled *Labidophorus talpæ*, almost the only differences being size, and that the hind tarsi of Haller's species terminated in very long single spines, whereas Kramer's terminated in a bunch of short, fine hairs. Haller found his *Acarus* in great numbers and in all stages on the squirrel, and called the adult *Dermacarus sciurinus*, and he gives an exhaustive description and illustration of his creature at all ages in his paper.* The hypopial nymph, however, was not first discovered by Haller; it had been figured and described, somewhat imperfectly, long before by C. L. Koch,† a fact which Haller is careful to point out. Koch had treated it as a separate species, and classed it among the *Dermaleichi*; it was Haller who traced its life-history, and assigned to it its proper place.

During some investigations which I made into the life-histories of *Pygmephorus spinosus*, Kramer's other mole-parasite, I very frequently met with his *Labidophorus talpæ*; I felt that this must probably be a hypopial nymph, and that it would be very interesting to trace its life-history; but, less fortunate than Haller with his squirrel-parasite, I was not even able to find on the mole any *Acarus* which was at all likely to be the adult form; and, indeed, except the species I was investigating, I could not find on it any *Acarus*, the whole life-history of which was not well known to me. I tried, therefore, to rear the *Hypopus* in confinement and observe what adult form it changed into. I was not, however, as successful in this as I have been in similar efforts with other species; I could not get the *Hypopus* to live away from the mole, and of course I could not keep the mole under observation. For some years I have, from time to time, continued this inquiry; catching moles when I had the chance, and usually obtaining the *Hypopus*; but still failing to rear it.

As I was spending the Christmas of 1885 in one of our Midland counties, I again utilized the occasion to pursue the subject. I caught twelve moles, and obtained plenty of *Labidophorus*, but there the matter ended. I was still unable to discover any conditions which would enable me to keep them in health away from the mole. At last it struck me that if I obtained and searched the mole's nest instead of the moles themselves, I might possibly find the creature in the adult stage, or in some stage which would be easier to rear than the *Hypopus*. I therefore proceeded to dig up moles' nests, and obtained about a dozen. I was careful to mark those which, from external appearances, I thought were fresh nests; in these nests I found several species of *Acari*, and among

* "Zur Kenntniss der Tyroglyphen und Verwandten," Zeitschr. f. Wiss. Zool., xxxiv. (1879) pp. 261–73.

† 'Deutschlands Crustaceen, Miriapoden, und Arachniden,' Regensburg, 1834–9, Heft 33, fig. 7.

them was one which struck me as being likely to be the adult form of *Labidophorus*, but the question was how to prove this and to ascertain whether what was merely a conjecture would turn out to be an actual fact. The mode which I adopted for this inquiry was twofold; in the first place I put some adults of the newly found species in a cell, hoping to breed the larva; then the young nymph, and then the *Hypopus* from them. In the second place I found in the mole's nest, with these adults, an immature *Acarus* in the ordinary nymphal stage; which, although it was very different from the adults, I suspected was the nymph of the species. I found these of various ages, quite young, and nearly full grown. I selected a number of specimens which I thought would soon undergo their final ecdysis and become imagos, and placed them in a cell by themselves; I also selected a number of young specimens, which I put in a separate cell; I did my best to keep the inhabitants of both cells in a healthy condition, and I submitted each to very frequent and careful microscopical examination. This last method had the desired result before the first process had time to be completed. I was soon very pleased to see that some of the older nymphs became inert, and by watching them while in this condition I was enabled to see the nymphal skin split in some instances and to see what I had suspected to be the adult actually emerge from the nymphal skin; so that this part of the investigation was complete. The cell of younger nymphs was equally fortunate; these arrived in a healthy condition at the period of ecdysis, and, to my great satisfaction, I actually saw, in one or two instances, the hypopial nymph, Kramer's *Labidophorus talpæ*, emerge from the skin of the young ordinary nymph, just as the imagos had done from the full-grown specimens. Thus the life-circle was traced, and it was at last certain what was the adult form of Kramer's *Hypopus*.

It now remains to say something as to the position of the creature among the *Acari*, and as to its more interesting features. It would seem at first natural to place it in Haller's genus *Dermacarus*, it being decidedly allied to his species; on the other hand, I found with it two other new species which I think fairly belong to the genus *Glyciphagus*. Although not very typical species of that genus, they are certainly so closely allied to the *Glyciphagi* of Robin's second sub-genus, viz. *G. palmifer* and *G. plumiger*, that it would scarcely be desirable to place them in a different genus. On the other hand, they are as closely allied to the present species as that species is to Haller's *Dermacarus*, and the present species possesses the principal characters of the genus *Glyciphagus*, except the strongly developed hairs; it has the rough skin like shagreen, the tubular projection (bursa copulatrix) in the middle of the hind margin of the females, which is so characteristic of the genus, but

which was absent from Haller's species, and most of the other generic characters. The species also possesses some features not characteristic of the genus, because they are not found in all species, but which, as far as I know, have not hitherto been observed in any other genus. Therefore, although Haller was right in making a new genus for his *Dermacarus sciurinus* at the time when he did so, yet he might possibly desire to reconsider the question now that intermediate species have been found, and I think it safer, at present, to place the new species in the genus *Glyciphagus*, but I have given *Dermacarus* in a bracket as a note of the close connection.

With regard to the specific name, I should have wished to retain Kramer's name, but it is obviously impossible to retain his generic name, and as the description attached to his specific name is based entirely on the *Hypopus*, which is totally different from every other stage, I fear it would be unwise and misleading to retain it; moreover, I have not ever found the adult form or ordinary nymph or larva upon the mole. I wish still somehow to retain in the name of the species something to connect it with Dr. Kramer, as that excellent acarologist was the first to draw attention to any stage of the creature; therefore, although I do not ordinarily think it desirable to call species after men, I propose to call this "*Crameri*."

With regard to the more interesting features of the creature itself, irrespective of its life-history, probably the most striking is the armature, or ornamentation, whichever it may be, of the first two pairs of legs of the male, and this is, as far as I know, quite without parallel in the *Acarina*, except that a development of the same class, but far less in degree, exists in one other species of *Glyciphagus*, viz. *G. ornatus*, a species discovered and described by Kramer in 1881,* in which the tibial joints of the first and second legs of the male bear at the distal edge of their under sides an appendage which Kramer describes as a comb-shaped hair, of which the stem is feathered along the median line, like the other hairs of the creature, but on each side stand out a close single row of flat spikes, exactly like the teeth of a comb; there are five to six of these teeth on each side of the hair on the first leg, and ten to eleven on each side of that on the second leg.

In the present species (male only) the first two pairs of legs are remarkably strong, thick, and curved; the tarsus is considerably and gradually diminished in thickness from the proximal toward the distal end, but the actual distal end is suddenly thickened to form a recurved hook in the median line on the under side. Along the median line of this joint, both above and below,

* "Ueber Milben," Zeitsch. f. d. Gesammt. Naturw., liv. (1881).

runs a strong chitinous blade, which is widest at the proximal end. On the tibia this blade is replaced above by a great chitinized papilla which bears the very large tactile hair; below, however, the blade is present along the anterior part of the leg, but is cut at its edge into about seven great comb-like teeth radiating like a fan, but directed downward.

It will be seen that the difference from Kramer's species here is that this comb-like arrangement is in single row directed downward along a median blade on the joint itself, instead of being on each side of a hair springing from the distal edge, and this difference is kept up in the still more curious second leg, in which case the blade is present on the upper and under sides of the tarsus and on the upper side of the tibia, but on the under side of the latter joint is a fan-shaped comb-like blade, similar to that on the first leg, but more projecting, and on the under side of this leg the comb-like blade is carried all along the great second joint of the leg, and is there cut into two divisions, the proximal having the teeth (about eight) radiating from an almost semicircular blade, and the distal being long, with the teeth (about twelve) directed more forward. The whole forms a very singular leg. That these blades and comb-like processes may in their origin be modified hairs seems probable, both from Kramer's species and from the position of some curious serrated hairs in the present species (fig. 13, second joint above; fig. 15, third and fourth joints below).

The curious apparatus at the posterior end of the hypopial nymph, apparently for holding the hairs of the mole, seems to differ somewhat from the corresponding part in Haller's species. It consists of a median concave channel in which the hair lies longitudinally; this is overlapped by a flexible, lip-like organ on each side, the two lips slightly crossing when there is not any hair beneath them. They are provided with powerful retractor muscles, which draw them closer to the body. Each lip bears a large chitinous plate on its inner surface, and on the inner side of this plate is a strong chitinous band with transverse ridges; on the abdomen, immediately below each band, is a circular chitinous plate with radiating ridges, and the hairs are firmly held between the bands and the circular plates.

I have utilized the present paper to illustrate and describe another unrecorded species, the life-history of which I worked out some time since, and which is so far connected with that hitherto referred to that it forms a good example of a species which in the adult form assumes the hypopial appearance, as contrasted with the foregoing species, which has a true nymphal hypopial stage. In the paper before referred to, I gave the life-history of an *Acarus* which I called *Disparipes bombi*, the adult female being found on humble-bees, and having an extremely hypopial appearance. It is,

moreover, provided with a remarkable hooked holding claw on the front leg, which resembles those found on *Pediculus*, *Pygmephorus*, and other creatures living more or less parasitic lives on hairy animals. Neither the male nor the immature stages of this *Acarus* have, to my knowledge, been found on the bee. At the end of that paper I ventured to suggest that there were many undescribed species belonging to the same genus; the present species is one of these. I have not, however, found the adult females in any parasitic or semi-parasitic condition. All the specimens of that sex which I have found have been free-living creatures, inhabiting moss from old wood, &c. The adult male and the larva I have not ever found at all; the way in which I obtained them was as follows:—In the spring of 1885 I obtained some adult females of the species at the New Forest. I did not obtain them there for the first time; I knew the species well before, but I took advantage of having a good many healthy specimens to endeavour to trace the life-history; I concluded that they were adult females, from their resemblance to those of *D. bombi*. I had traced the history of that species by confining the adult females in a cell, the bottom of which was covered with damp blotting-paper, and into which I placed a small piece of cheese. I tried the same plan with the present species, but the *Acari* did not seem to take kindly to the cheese. I then took out the cheese, leaving the blotting-paper, which had become smeared with cheese, and was kept damp; in this way a fungoid growth was promoted, upon which the creatures throve well: they now laid eggs, and I was able to breed the larvæ from these eggs, and the adult male and female from the larvæ. I have not ever obtained the larva or the adult male any other way. In this species, as in *D. bombi*, there is not any nymphal stage; the change from hexapod larva to imago being direct, without the intermediate, immature, octopod stage usual in the *Acarina*.

Although the female is, as far as I know, a free-living creature, yet its hypopial appearance suggests that it may probably use other animals as a means of conveyance; but on the other hand, the front leg is without the great claw adapted to hold hairs; the claw is almost abortive on that leg, which has become a tactile organ. I have utilized this absence of the hook for the name which I propose for it, viz. *Disparipes exhamulatus*.* The absence of this hooked claw may of course mean that during its parasitic period its host is hairless; but when taken in conjunction with the fact that I have not hitherto found it parasitic on anything, and that I do find it in a non-parasitic condition, it may not improbably indicate that the creature, although descended from a species like

* Exhamulatus, deprived of a hook (*hamula*, a little hook).

bombi, has abandoned its parasitic life, and has lost the need for the hair-holding claw, which has become obsolete, but has not yet lost the hypopial form. I fear that the course of development will hardly assist in this inquiry, as the hypopial form is only present in the adult, even in *bombi*, and is quite absent both from the male and the immature stages.

The male and the nymph of the present species will be found sufficiently curious.

Glyciphagus (Dermacarus) Crameri n. s.

Pl. X. and Pl. XI. figs. 13–19.

	♀	♂
Average length, about	·36 mm.	·25 mm.
„ breadth „	·21 „	·13 „
„ length of legs, 1st pair, about	·15 „	·12 „
„ „ „ 2nd „ „	·13 „	·10 „
„ „ „ 3rd „ „	·17 „	·12 „
„ „ „ 4th „ „	·20 „	·14 „

Colour dull reddish-brown, of medium depth of tint; the male a trifle darker than the female. When the creature has just emerged from the nymphal skin the hinder part of the abdomen of the female is lighter than the anterior portion; at this time, in both sexes, there is a pinkish shade, and the tint of course is lighter.

Texture dull and rough, rather granular, the female more strongly so than the male.

Female (figs. 1 and 2).

Cephalothorax as seen from above, about one-fifth of the total length; narrow; lateral margin (behind the rostrum) concave; the posterior part of the cephalothorax is, however, as wide as the anterior margin of the abdomen, or nearly so. Rostrum slightly truncated, or concave anteriorly. There are two very short rostral hairs. A narrow, raised, longitudinal ridge starts from near the rostral hair on each side, and, after following the line of the rostrum for a short distance, curves toward the median line, and after the middle of the cephalothorax curves outward again and runs as far as the abdomen. Mandibles short, powerful, chelate; tridentate on each limb of the chela. The mandibles do not usually project beyond the rostrum when not in use. There is a strongly chitinized concavity at each side of the cephalothorax near the base, which holds air when the creature is immersed in liquid. It appears to be partly closed by a membrane, and to have a nerve running to it, possibly it may be a sense organ. It is found in both sexes. The chitinous skeletal pieces of the under surface of

the cephalothorax are as follows:—Some short distance behind the labium is a curved transverse band concave anteriorly; from the centre of this band the sternum runs straight backward in the median line; just passing an imaginary line drawn so as to join the hind edges of the coxæ of the second pair of legs; then the sternum bifurcates; the branches are much narrower than the true sternum, and they join the vulval ring (hereinafter spoken of) at its antero-lateral part. The epimera from behind the first pair of legs join the lateral branches of the sternum a little in front of the centre; those from behind the second pair of legs, or the apodemata prolonging them, join the vulval ring almost at the same point as the same branches. The short epimera from behind the third legs do not join any other sclerites.

Legs of moderate length, the fourth pair about reaching the posterior margin of the abdomen. The two front pairs thicker than the two hind pairs. The first joints (coxæ) rounded, the proximal ends of the second joints small, thence the leg is gradually increased in thickness until the distal ends of the bell-shaped third joints, whence it gradually becomes thinner up to the distal end of the tarsus. The tarsus is nearly as long as the three joints preceding it, varying a little in the different legs. There is a setiform tactile hair on the fourth joint (tibia) of each leg, those on the two front pairs being the largest. There are two strongly serrated hairs on the second and one on the third joint of the first leg, and one on the third joint of the second leg; the serration of these hairs is usually coarser at the distal than at the proximal ends (fig. 12). There are also a few fine hairs on the tarsi, and one or two on some of the other joints. The tarsi are terminated by a long-shaped caruncle and fine single claw (as usual).

Abdomen a long heart-shape, with the point anterior, and the two rounded lobes forming the hind margin; between them, slightly on the dorsal surface, is the little tubular projection (bursa copulatrix) characteristic of the females of the genus. The lobes are considerably raised and rounded on the dorsal surface; they occupy the whole central part of nearly half the abdomen; anterior to them is a single broad lobe, less raised, occupying the central part of the greater portion of the rest of the abdomen with two irregular ridges upon it and a depressed trench outside it. Exterior to this the abdomen (except its posterior part) has a broad raised band, sloping upward towards its outer edge; this band has a small raised lobe in the centre of its anterior part. There are four minute points round the hind margin and a pair near the anterior margin. The vulva of oviposition is very large; placed far forward, between the coxæ of the third and fourth pairs of legs, and is surrounded by a strong, chitinous, elliptical ring, the transverse axis of which is the longer; this ring has a short, blunt, anterior,

central projection. Inside the ring are the labia; the two ordinary (lateral) labia are very widely separated posteriorly, and between them is an unpaired, posterior, almost triangular labium opening downward and backward. The anus is far back, much smaller than the vulva, and is a long-shaped ellipse; there are a pair of short spines behind it.

Male (figs. 3 and 4).

It will be seen by the measurements that this sex is considerably smaller than the female, but not more so than is usual in the genus.

Cephalothorax. This does not differ much from that of the female, except in being somewhat shorter and broader in proportion—a remark which will also apply to the mandibles. There are, however, necessarily some differences in the epimera apodemata and sternal sclerites as follows. The band behind the labium and the sternum are nearly similar, the latter being rather longer and its posterior bifurcation forms a small close arch instead of the wide open arch formed by the corresponding parts in the female. The epimera from behind the first, second, *and third* legs, with the corresponding apodemata, join this arch. There are short epimera from behind the fourth leg not joined to any other sclerite. The intromittent organ is placed in the median line between the coxæ of the fourth pair of legs; it is large, somewhat conical, and points forward; its point, when at rest, lies within the above-named sternal arch. It is divided proximally into two diverging blades, and is protected on each side by a small, curved, chitinous band.

Legs. It is here that the main difference from the female will be found; and, moreover, these organs are probably the most singular and interesting part of the creature, except its life-history; the first two pairs are very remarkable. Instead of the comparatively thin legs of the female, those of the male are extremely thick and heavy; the coxæ, tibiæ, and third joints being thicker than they are long (figs. 13 and 14). The most remarkable feature, however, consists in certain projections from the under side of the two front pairs of legs. From the median line of the under side of the tibia of each of these legs there stands out a projection bearing a flat, fan-shaped blade of clear colourless chitin edged by seven to nine very deeply cut teeth or spikes, radiating outward. On the under side of the second joint of the second leg are two blades of similar texture; the proximal round, with a thickened central boss; the distal curved but longer in shape; and both these are edged with radiating spikes similar to those on the projection from the tibia. The tarsi of the two front pairs of legs have broad curved blades, both above and below, in the median line; and there is one

on the upper side of the tibia of the second leg; but all these have plain edges without spikes. The under side of each tarsus terminates in a short, stout, recurved point or hook. There is a very long tactile hair on the tibia of each first leg, springing from a large papilla; and there are a few other fine hairs on the tarsi, and a short thick hair on the upper side of the tarsus of the second leg. There is a curved, strongly serrated hair on the upper side of the second joint of the same leg; a curious curved hair with a few very long pectinations on the under side of the tibia of the third leg; and a rough, club-like hair on the under side of the third joint of the same leg. There are a few other hairs of minor importance.

Abdomen almost elliptical, but somewhat prolonged anteriorly, the hind margin rounded and entirely devoid of the bi-lobed shape of the female. The centre of the notogaster is arched, but not strongly so; the margin is very slightly raised, and usually has a few wrinkles in addition to its otherwise rough texture. There are a pair of short points at the antero-lateral angles, and two pairs round the hind margin. The anal arrangement is similar to that of the female, but smaller.

The Nymph (fig. 5).

Colour pure white when young, rather yellowish-white when fully grown.

Texture dull, semi-transparent, finely but irregularly wrinkled.

Cephalothorax large, fully one-third of the total length; its hinder part as wide as the abdomen. Rostrum rather concave, blunt; rostral hairs thick, almost leaf-like. Behind the rostrum is usually a transverse ridge with returned ends. The dorsal surface of the hinder part of the cephalothorax is ornamented or protected by numerous small plates of clear colourless chitin, of various shapes; the arrangement of these plates is usually about as follows, viz.: commencing from the rostrum, a comparatively large shield-shaped plate in the median line with a curved, more or less triangular plate on each side of and partly behind it; then a transverse row of about five smaller round or oval plates; and further back still, close to the abdomen, a second row of about eight plates, of which the two outer are the largest and are usually oval; the next pair smaller, and of the pine-shape, common in the patterns on Indian textile fabrics; and the two inner pairs very small and round.

Legs of moderate length, the fourth pair not reaching the hind margin, thinnish, coxæ rather large, other joints of about even thickness throughout, except the tarsi, which diminish gradually. There are the usual tactile hairs on the tibiæ of the first two

pairs; and a short, thick, curved hair on each third joint of the first pair, and each second and third joint of the second pair of legs; a few other fine hairs. Claws and caruncles as in the perfect forms.

Abdomen almost square, except that the hind margin is cut into four rounded lobes, of which the central pair are the larger and further back. Above these two central lobes, and a little further forward, are two large conical papillæ, or apophyses, directed upward and backward. In front of these is a transverse ridge with the ends turned forward, and bearing two large rough hairs. The notogaster is nearly, but not quite, flat; the central part being slightly arched and divided by a narrow and shallow depression from the slightly raised and rounded edge, which is also rather lobed at the anterior and posterior ends. The notogaster bears a number of plates of a similar nature to those on the cephalothorax; the forms and arrangement of which are usually much as follows, viz.: two longitudinal rows, each of about four pine-shaped plates, on the arched central portion; and on each lateral border, proceeding from before backward, first two pine-shaped plates turned different ways, then two small roundish plates, then two more pine-shaped plates, and finally a single large irregular-shaped plate. There are three pairs of broad, spatulate hairs, or scales, on the hind margin; and one pair on the antero-lateral angles.

Hypopial Nymph (figs. 6 and 7).

This, as before stated, has been carefully described by Kramer; and the almost precisely similar hypopial nymph of *Dermacarus sciurinus* has been most elaborately described and figured by Haller; I therefore do not think it necessary to repeat the descriptions here; but for the benefit of those who cannot readily refer to the papers of these Acarologists, and to complete the plates, I have figured the hypopial nymph, which is an extremely interesting creature.

Disparipes exhamulatus n. s.

Pl. XI. figs. 20–23.

	♀	♂
Average length, about	·18 mm.	·14 mm.
„ breadth „	·14 „	·08 „
„ length of legs, 1st pair, about	·06 „	·09 „
„ „ „ 2nd „	·07 „	·06 „
„ „ „ 3rd „	·07 „	·07 „
„ „ „ 4th „	·09 „	·06 „

The main differences from *D. bombi* beyond size are in italics.

Female.

Colour yellowish chitinous brown, of medium tint; the white excretory organs show through the dorsal surface.

Texture polished, particularly the anterior part of the carapace, which is slightly transparent.

General Form oval; *not quite so short and broad as in D. bombi* when living, but becomes so after death. Form varies a little according to the action of the muscles.

The anterior portion is covered by a semi-lunar carapace resembling that of *Limulus;* this projects beyond the body anteriorly and laterally, and extends about to the insertion of the third legs. The three anterior pairs of legs are covered by the carapace when the creature is at rest, but *project further beyond it than in bombi* at other times. Body behind the third legs covered by a projecting carapace divided into *four* segments.

Cephalothorax small, distinctly divided from the abdomen (when seen from below). Rostrum short, broad, folded down on the ventral surface, and similar to other species of the genus. The ventral surface has a median straight sternum, with apodemata running to the epimera of the legs as in *D. bombi.* At the edge of the body between the first and second pairs of legs are *two small globular organs on short peduncles* very similar to the pseudo-stigmatic organs of the *Oribatidæ.*

Abdomen smaller than the carapace, but large in proportion to the cephalothorax, approaching the circular form. There is a large *serrated* hair at each antero-lateral angle of the carapace, one pair of *similar hairs* on the hind part of the lateral, and *two on the hind margin,* but all springing from the dorsal surface some distance within the margin. There are also four pairs of unserrated curved spines on the actual margin.

The Legs. *The first leg has not got the enlarged and fused tarsal and tibial joints, nor the great holding claw which are found in D. bombi;* the absence of these characters forms the principal distinction between the species. The first leg of this species appears to be a tactile organ, the claw is quite rudimentary. The fourth leg has what appears to be some indication of a caruncle. In other respects the legs correspond fairly to those of *bombi.*

Male.

Colour semi-transparent white.

Texture rough and leathery, not hard nor chitinous.

General Form an oval, with the broad end foremost and the small end produced so as to be rod-like, or it might be called peg-top shaped, if so homely a comparison be admissible.

Cephalothorax *divided from the abdomen by a line,* but

without breaking the shape of the whole. Rostrum small and colourless, articulated as in the female, fairly corresponding to that of *D. bombi*, but with *spatulate or leaf-like rostral hairs*, which give a singular appearance. One pair of long hairs on the dorsal surface of the cephalothorax.

Abdomen the same width as the cephalothorax anteriorly, but after less than two-thirds of its length becoming much narrower, almost rod-like, and ending in a point posteriorly. There are four pairs of very long spines round the oval part, the fourth pair being at the commencement of the rod-like portion.

Legs. First pair long, nearly straight, with very small single claw and numerous spines and hairs. Second leg shorter and more recurved. Each leg of these two pairs bears a large and singular sausage-shaped projection from the upper portion of the tibia, which is most unusual. Third pair very similar to the second, but straighter; both these pairs have the usual double claw. Fourth pair thick, incurved, about reaching the end of the abdomen; blunt-ended; clawless, but with three very large curved setæ on the outer side near the end of the tarsus and one smaller seta on the tibia.

Larva.

This is very different from that of *D. bombi*. White, not very transparent. Rostrum very distinct, rounded, with one pair of short, curved, rostral hairs; remainder of the cephalothorax much broader; sharply divided from the abdomen by a nearly straight constriction. On its dorsal surface are two papillæ bearing very long, straight hairs; and two similar hairs stand out laterally from about the middle of the edge. The abdomen widens and thickens rapidly after the line of juncture with the cephalothorax until it has attained about one-third of its length; after which it diminishes equally rapidly; this produces the effect of two paired, and extremely large, mamillary projections from the side of the abdomen; and from the point of each of these springs a hair, which is considerably the largest on the body, and quite straight. These hairs stand out horizontally and laterally, giving a very strange effect. The posterior angles of the abdomen are produced, forming large papillæ, from which long curved hairs spring; there is another large hair just below them, and there are two pairs of papillæ bearing long straight hairs on the notogaster. On the hind margin, but lower in level, are a pair of papillæ, produced into short tube-like structures, each of which bears a long incurved hair, and has a shorter downwardly curved hair at its base. Between the two last-named papillæ is an unpaired projection in the median line bearing two short recurved hairs at its tip.

IX.—*On Micrococcus Pasteuri (Sternberg).*

By George M. Sternberg, M.D., F.R.M.S.,
Major and Surgeon U.S. Army.

(*Read 12th May*, 1886.)

At the January meeting of this Society, an interesting paper was read by Mr. Dowdeswell * upon the microbe of fowl-cholera. His microscopical and experimental researches have led him to the conclusion that the microbe of fowl-cholera is identical with that of the form of rabbit-septicæmia described by Davaine.

It is not quite certain that "Davaine's septicæmia" is identical with that form of rabbit-septicæmia which Koch, Gaffky, Dowdeswell and others have induced by injecting putrefying infusions of beef, &c., beneath the skin of a rabbit. According to Klein, "Davaine's septicæmia is distinguished from Koch's septicæmia in the rabbit by this, that Davaine's septicæmia is easily transmissible to guinea-pigs, but not to birds." †

But there can be little doubt as to the identity of that form of septicæmia which Mr. Dowdeswell has studied experimentally with the infectious disease which Koch ‡ and Gaffky § had previously induced in rabbits by injections of similar material; and also with the microbe of fowl-cholera.

Toussaint insisted upon the identity of the microbe of fowl-cholera with that of experimental septicæmia in a communication to the French Academy of Sciences made in 1880,‖ and in Germany this identity is, I believe, generally conceded by bacteriologists. Mr. Dowdeswell's experimental researches ¶ and the figures illustrating his recent paper, published in this Journal, fully sustain this view.

But the inference made in the same paper that the micrococcus which I have described under the name of *M. Pasteuri*, is also identical with the microbe of fowl-cholera and of that form of rabbit-septicæmia which he has studied, is a mistake, which has evidently arisen from an imperfect acquaintance with the morphological and physiological characters of *M. Pasteuri.*

The object of the present paper is to call attention to those characters which distinguish this *micrococcus* in a very definite

* See this Journal, *ante*, p. 32.

† 'Micro-Organisms and Disease,' London, 1885.

‡ 'Untersuchungen üb. d. Aetiologie d. Wundinfections-Krankheiten,' Leipzig, 1878.

§ MT. a. d. K. Gesundheits-amte, Berlin, 1881, pp. 93–114.

‖ Comptes Rendus, xci. (1880) pp. 301–3.

¶ Proc. Roy. Soc., Nos. 221 and 223, 1882.

manner from the *bacterium*, or "bacillus" which has occupied the special attention of Mr. Dowdeswell. It differs from the latter not only in its morphology, but in the fact that *it is not fatal to fowls.*

I shall refer to these points of difference later, but desire first, as briefly as possible, to record the history of this organism as known to us by experiment.

In September 1880, while engaged in certain investigations in New Orleans, I injected a little of my own saliva beneath the skin of a rabbit, as a control experiment. To my surprise the animal died, and I found in its blood a multitude of oval micro-organisms, united for the most part in pairs or in chains of three or four elements. Further experiments showed me that the blood containing this organism was infectious in the smallest amount, and that its infectious and pathogenic properties were due to the presence of this oval micrococcus; which, moreover, produced identical results when isolated in pure cultures. My first paper giving an account of these experiments was published in April 1881.* I have since repeated the experimental injections with saliva, blood, and pure cultures of the organism, over and over again, and have recorded my results in various published papers, and in 'Bacteria.'†

Shortly before the publication of my first paper, Pasteur announced to the French Academy of Sciences his discovery of a "new disease" which he had produced in rabbits by injecting subcutaneously a little saliva obtained from the mouth of a child who died from hydrophobia in one of the hospitals of Paris. I at once recognized this "new disease" of Pasteur as identical with the infectious disease in rabbits, which I had previously induced by the subcutaneous injection of my own saliva. In my book referred to I say, "There can no longer be any doubt that this disease was identical with that which the writer has previously produced by inoculating rabbits with his own saliva; and, consequently, that the natural inference of Pasteur that this 'new disease' was due to the fact that the child from whom the material which produced it was obtained, had died of hydrophobia, was an error. Subsequent experiments by Vulpian and others soon made it plain that a mistake had occurred, and nothing more has been heard from Pasteur concerning his new disease. But the results reported are entirely in accord with the deductions of the writer as to the etiological *rôle* of the micrococcus." ‡

On another page (369) of the same work I give an account of Koch's experiments, in which he induced fatal septicæmia in rabbits by injecting a putrid infusion of beef beneath their skin.

* Nat. Board of Health Bull. Washington, ii. (1881) p. 781. Also in Studies from Biological Lab. Johns-Hopkins Univ. Balt., ii. (1882) pp. 183-200.

† New York, 1884.

‡ Op. cit., p. 367.

Here I fall into the same mistake which Mr. Dowdeswell has made, in assuming that the infectious disease which resulted from such injections is identical with that which I have described, and that it is due to the same micro-organism.

My own earlier experiments showed that there is a difference in the pathogenic potency of the saliva of different individuals, and I have since learned that the saliva of the same individual may differ in this respect at different times. Thus during the past three years injections of my own saliva have not infrequently failed to cause a fatal result, and in fatal cases death is apt to occur after a somewhat longer interval, 72 hours or more; whereas in my earlier experiments the animals almost infallibly died within 48 hours. This difference is also shown by the experiments of Clapton * and of Fränkel.† The results obtained by these observers are entirely in accord with those which I had previously reported, and show that the buccal secretions of healthy individuals in various parts of the world contain this micrococcus, but that it is not uniformly present in these secretions; or, if so, that it has not in all cases that degree of pathogenic power which is required to insure a fatal result when it is introduced beneath the skin of a rabbit.

Recent experiments have shown that this micrococcus is usually, if not uniformly, present in the sputum of patients suffering from pneumonia, and that the rusty sputum characteristic of this disease, when injected beneath the skin of a rabbit, induces the form of septicæmia which I have described with greater certainty than does the injection of the buccal secretions of persons in health. I cannot in the present paper go into details with reference to this interesting and significant fact, nor would it be proper here to discuss the etiological question involved. I must refer the reader who is especially interested in this question to my papers published in the 'American Journal of the Medical Sciences,'‡ and especially to a paper which will appear in the next number of that Journal (July 1886). Also to the recent paper of Fränkel,§ and to the experiments of Zalamon,‖ and of Salvioli,¶ who have injected pneumonic exudate into rabbits, with results which are identical with those obtained by me in experimental injections of the same material, and of my own saliva.

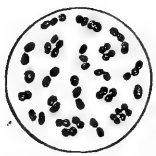
In my paper above referred to (July 1885) I have given the name *M. Pasteuri* to this micrococcus, which has so long occupied my attention. In the same paper I make the mistake of assuming the identity of this micrococcus with that described by Friedländer, and generally known as the "pneumonia-coccus of Friedländer."

* Medical Times (Philad.), June 17, 1882, pp. 627–31.
† Zeitschr. f. Klin. Med., x. (1886) pp. 401–61. ‡ July and October 1885.
§ Op. cit. ‖ Progrès Médicale, 1883, No. 51.
¶ Arch. per le Scienze Med., viii. (1884) No. 7.

This inference was based upon morphological resemblance, as indicated by Friedländer's description of his coccus, and upon the fact that I had demonstrated the frequent, if not constant, presence of my *M. Pasteuri* in the rusty sputa of patients with pneumonia. I have since had an opportunity to study the characters of Friedländer's coccus in a culture obtained from Mr. Watson Cheyne, and also in one presented to me by Dr. Frobenius during a recent visit to Berlin, and I recognize essential differences in the mode of growth of the two organisms, which make it apparent that they are not identical, or, as I suggested, simply "pathogenic varieties of the same species."

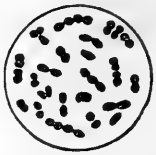
Friedländer has shown that his coccus, or "bacterium," does not kill rabbits, and it grows readily at comparatively low temperatures, 20° to 25° C. On the other hand, *M. Pasteuri* is fatal to rabbits and requires for its development a temperature not obtained in temperate climates, except by the use of an incubating oven, 30° to 35° C. Moreover, the nail-shaped growth of the cultures in gelatin, which Friedländer's coccus presents, is quite different from the appearance presented by a culture of *M. Pasteuri* in agar-agar. The fact that a temperature above the melting point of gelatin is required for the development of the last-mentioned organism makes it impossible to cultivate it in solid gelatin, but it grows readily in an incubating oven in liquefied flesh-pepton-gelatin, or in an infusion of the flesh of a chicken or rabbit which has been rendered neutral or slightly alkaline, or in veal broth. On the surface of agar it forms a slightly elevated, nearly transparent film, and in "stick-cultures" in the same material it grows to a limited extent along the line of the needle, forming a rather nebulous and colourless line, not unlike that produced in the same material by the "bacillus" of rabbit septicæmia. It is distinguished

FIG. 75.



Micrococcus Pasteuri from blood of rabbit inoculated subcutaneously with normal human saliva (Dr. S.). Magnified 1000 diameters.

FIG. 76.



M. Pasteuri from blood of rabbit inoculated subcutaneously with fresh pneumonic sputum from a patient in the seventh day of the disease. Same amplification as fig. 75.

from the last-mentioned organism by the fact that it does not kill fowls or pigeons; by its failure to grow in suitable culture-media at the ordinary room temperature; and by its morphology.

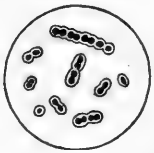
Figs. 75 and 76 are from camera lucida drawings, and represent

the organism as it appears in the blood of an infected rabbit, or in active growth in a culture-medium, when stained with one of the anilin colours. There is no localization of the staining material at the ends, as in the microbe of fowl-cholera and rabbit septicæmia;

FIG. 77.

Surface culture of *M. Pasteuri* showing development of long chains. Same amplification.

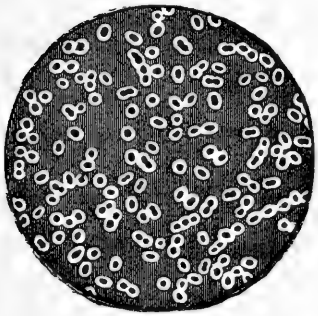
FIG. 78.



Surface culture of *M. Pasteuri* from blood of rabbit injected with pneumonic sputum, showing the so-called "capsule" of Friedländer. Same amplification.

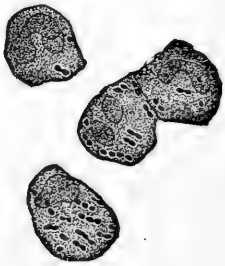
and the appearance of diplococci is not deceptive as in the case of that organism. Our *M. Pasteuri*, although when in active growth of an oval form, and often so elongated as to be lance-oval or rod-shaped, is nevertheless a micrococcus. In surface cultures, where

FIG. 79.



From a photo-micrograph made by the author of this paper in 1881, and used in April of that year to illustrate a paper on "A fatal form of septicæmia in the rabbit induced by the subcutaneous injection of human saliva." The preparation is from the blood of a rabbit recently dead, and is stained with an aqueous solution of iodine and potassic iodide. Magnified 1000 diameters. Photographed with Zeiss's 1/18-in. hom. im. objective.

FIG. 80.



Copied from illustration accompanying the paper of Salvioli in the 'Archivio per le Scienze Mediche,' Turin, vol. viii., No. 7, fig. 2. "Cells of the pleuritic exudation containing pneumonia-cocci, mounted in Canada balsam." Stained with gentian violet. Amplification not stated (about 1000, G. M. S.).

the development is less rapid than in the blood of a rabbit or in a suitable liquid culture-medium, it commonly approaches more nearly a spherical form, and frequently grows into chains of con-

siderable length (fig. 77). If we adopt the classification of Zopf, it should be placed in the genus *Streptococcus*. In fig. 78 we have represented the mucinous envelope or "capsule" which Friedländer for a time supposed to be peculiar to his so-called "pneumonia-coccus," but which is now known to be present under certain circumstances in several different micro-organisms of this class. When we examine with a good objective a drop of blood obtained from an infected rabbit just dead, or a drop of a fluid culture, this mucinous (?) envelope appears as a transparent halo surrounding the cocci; and in stained preparations it is more or less apparent according to the method of staining employed, and certain circumstances not well determined. I have very rarely seen it developed to the extent shown in fig. 79, which is copied from the photo-micrograph to which Mr. Dowdeswell refers in his paper. The more usual appearance is that seen in fig. 80, which indeed may be taken as a typical representation of the organism as seen in stained preparations.

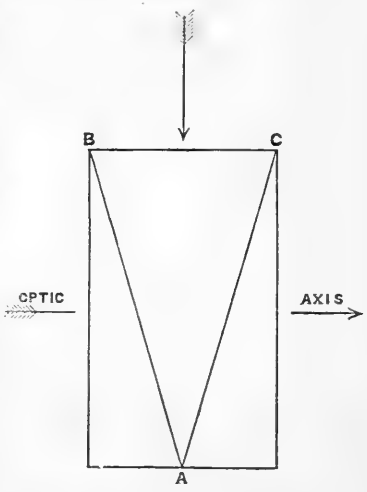
X.—*New Polarizing Prism.* By C. D. Ahrens.

(*Read* 14*th April*, 1886.)

I once more trespass upon the time of the meeting by bringing to the notice of the Fellows a new polarizing prism, and I do so because it has been much commended by some of the leading physicists.

The prism, although constructed on the same general principle as the Nicol prism, has the great advantage over the latter of being much shorter, while giving about the same angular field. It may be described as consisting of two Nicol prisms placed side by side, the plane of junction between the two being abolished by making the middle portion out of one wedge of calc-spar. The actual mode of construction will be seen from fig. 81.

Fig. 81.



A rectangular parallelopipedon is cut from a natural crystal of calc-spar in such a direction that the optic axis lies at right angles to its length, the proportion of the length to the breadth being as 1 : 1·8. This block is then divided into three wedges by cuts made in the directions A B and A C, the acute edges of the wedges being at right angles to the optic axis. The planes of section are next polished and cemented together with balsam, so as to make up again the original parallelopipedon. Finally, the ends are polished, the bottom end in the figure being carefully ground away until the edge A of the middle prism just appears as a fine line.

If, now, a beam of common light enters normally the face B C, that component of it which forms the ordinary ray is, when it reaches the balsam film, totally reflected towards the sides of the prism, while the extraordinary component passes on and emerges as a plane-polarized beam. The same result occurs in the case of all rays incident within a certain range of the normal; in fact, the prism acts precisely like a Nicol prism, but the totally reflected rays pass off towards *both* sides of the prism, and not towards one only.

This prism possesses the following advantages:—

(1) The terminal faces are at right angles to its length; hence there is very little loss of light through partial reflection of the incident rays, and the lateral displacement of the transmitted beam is scarcely perceptible when the prism is rotated.

(2) It gives about the same angular field of plane-polarized light as an ordinary Nicol prism, viz. 26°, while it is very much shorter, its length being little more than $1\frac{1}{2}$ times its breadth. The actual dimensions of one of the finished prisms are 35 mm. × 20 mm.

One or two points must be attended to in using it.

(1) It should be so placed that the beam of light may enter the face B C, and not the face in which the edge of the middle prism lies; otherwise, the emergent beam is mixed with light which has entered on either side of the line of junction, and been partially reflected at the balsam film.*

(2) The prism must be so placed that the edge A of the middle wedge does not come into focus. This edge can with care be reduced to a line no coarser than a hair, but it cannot be abolished entirely. Hence the prism is not adapted for use as an analyser for the Microscope, the junction-line interfering with the distinctness of the image. As a polarizer it answers perfectly if placed in the proper position below the stage, transmitting a broad, clear beam, while it takes up less than half as much space in length as a Nicol prism of the same breadth. As an analyser for the lantern it has been tried by Mr. Lewis Wright and others, and found to answer extremely well.

* This, however, may be avoided by mounting the prism in a tube which projects about an inch beyond its end, like the hood of a photographic lens; but this is not required, of course, if the prism is placed as above directed.

SUMMARY

OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(*principally Invertebrata and Cryptogamia*),

MICROSCOPY, &c.,

INCLUDING ORIGINAL COMMUNICATIONS FROM FELLOWS AND OTHERS.*

ZOOLOGY.

A. VERTEBRATA:—Embryology, Histology, and General.

a. Embryology.†

Origin of the Amnion.‡—Mr. J. A. Ryder points out how, on a mechanical principle, the amnion may have arisen during "development of development."

In those Teleostei in which the zona radiata closely surrounds the ovum, the embryo becomes slightly pushed into the yolk, so that a fold is produced at each end, which the author regards as a commencement of the amniotic folds of higher forms. In those fishes in which the zona is not so firm, the embryo can enlarge outwards, but in others, as above, the embryo has to push its way into the yolk, and partly takes its place as the yolk is absorbed. When, as in mammals, there is no yolk in the yolk-sac, there is a greater space for the embryo to be inpushed. The presence of a highly developed brain necessitates an inpushing anteriorly, and gives rise to a more marked and earlier "headfold." The amniotic folds never meet in the Teleostei, because of the early escape of the embryos from the egg, and also on account of the large amount of yolk which prevents the complete inpushing.

The author describes the mechanical cause of the inversion of the layers in guinea-pigs, &c., which he regards as one extreme stage of this series; the Teleostei forming the opposite extreme.

Germinal Vesicle.§—M. C. van Bambeke discusses the various opinions of v. Wielowiejski, E. Zacharias, and Ed. van Beneden, as

* 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 processes of Evolution, Development, and Reproduction, and with allied subjects.

‡ Amer. Natural., xx. (1886) pp. 179–85 (3 figs.).

§ Bull. Acad. R. Sci. Belgique, xi. (1886) pp. 14–28.

to the meaning of the structures observed in the germinal vesicles of various animals, and the relation of this ovarian nucleus to the nuclei of ordinary cells.

It is found that acidulated methyl green stains the chromatin or network of the germinal vesicle, but leaves uncoloured certain structures within it. The nuclei of male cells are rich in chromatin, which is stained by methyl green; and they have no nucleolus, or only a very small one. On the other hand, the nucleus of the female cell has one or several large nucleoli, and is poor in chromatin. From this v. Wielowiejski confirms, by micro-chemical tests, the homology between the polar bodies of the egg-cell, and the cast-off remnants of division of the sperm-mother cell. M. van Bambeke studied the germinal vesicle in a large number of Arachnids, Isopods, and insects, and confirms to a certain extent the results of previous observers. He describes the varieties of the germinal vesicle in different Arachnids; and concludes that this structure is a nucleus, the characters of which differ notably from those of ordinary nuclei.

The objects were prepared by the following methods, either stained with methyl green direct, or after certain fixing reagents:—(1) osmic acid, 1 per cent.; (2) glacial acetic acid; (3) Fleming's mixture β; (4) mixture of 3·5 grm. chromic acid; 14 grm. acetic acid in 700 gr. water. The author considers methyl green the staining agent, *par excellence*, for chromatin, though it is not an absolute test for its presence.

Development of the Mole.*—Mr. W. Heape finds that the ripe ovarian ovum of the mole is surrounded by a thick zona radiata, pierced by fine canals, and a very delicate vitelline membrane; nothing comparable to a micropyle in the zona, nor any follicular cells within it were observed. The yolk consists of homogeneous vesicular bodies, and of minute highly refractile granules, contained within the meshes of a protoplasmic reticulum. The nucleus is rounded or oval, and contains a single central nucleolus, together with a varying number of smaller or larger granules. Beneden's description of the ejection of the vesicle to form the polar bodies and the subsequent non-nucleated condition of the ovum appears to be erroneous. Segmentation commences with the appearance of two and then of four segments, and is afterwards irregular; the segments themselves are of irregular size, and do not appear to be divisible into two kinds (epiblastic and hypoblasts) as Beneden supposes. After entering the uterus the segments divide into an outer hyaline layer, and an inner deeply granular mass. Mr. Heape suggests that the vitelline matter which was originally contained in all the segments alike, has passed to the inner ones, so as to allow of the outer multiplying more rapidly and flattening out to form the wall of the blastodermic vesicle. The epiblast of the vesicular embryo is derived from the whole of the outer layer, and by far the greater part of the inner mass of segments, the rest of which forms the hypoblast; the mesoblast arises from both primitive layers.

* Quart. Journ. Micr. Sci., xxvi. (1886) pp. 157–74 (1 pl.).

Ovary of Echidna.*—Dr. G. A. Guldberg finds that during the whole of its development the ovarian egg completely fills the ovarian follicle, and is only surrounded by a unilaminate layer of follicular epithelium; this, later on, forms a permanent investment round the egg, and is distinguishable from all known forms of eggs in other orders of mammals. During development the protoplasm of the egg undergoes a differentiation into small and larger yolk-spheres; then increases in size until at last only a small part of the less differentiated protoplasm surrounds the peripherally placed nucleus. Two poles can then be distinguished in the egg, one the nuclear, and the other the vitelline. The egg is generally at least 2·5 mm. in diameter before it leaves the ovary, and it may be as much as 3 mm. The ovarian membrane then chiefly consists of a "chorion," which is formed by the follicular epithelium. The nucleus is distinguished not only by its size, but also by the number of smaller paranuclear spots.

The observations of Dr. Guldberg show that the egg of the Echidna approaches in many points to the Sauropsidan type, and the view of Poulton that we have here to do with unequal segmentation appears to be correct.

Monstrosities with Double-hearts.†—M. S. Warynski records various experiments, undertaken by himself and Prof. H. Fol, on the production artificially of double hearts in chicks, and gives a *résumé* of the various works on the development of the heart from Pander, 1817, to Kölliker, and Hensen in 1876.

The union of the pair of "cardiac blastemas" takes place about the thirty-sixth hour of incubation; and it was between the twenty-fourth and thirty-sixth hour that the author's experiments were made. While the earlier authors, holding the idea that the heart was formed from a single "blastema," considered that a double heart was produced by the subsequent division of the organ, the later observers, finding the double origin, explain the monstrosity by a non-union of the two halves, owing to some arrest in normal development. The cause of this arrest or interference was unknown.

This form of monstrosity ordinarily has some other abnormality associated with it, so that the embryo usually dies before being hatched; but the author was able to produce a double heart in a chick, which was otherwise normal. The mode of procedure is as follows:—The blunt edge of a scalpel is carefully and lightly drawn backwards along an embryo, between twenty-four and thirty-six hours old, from just behind the head, without injuring any tissues; the duration and force of the pressure must be carefully regulated, as otherwise the embryo will present various abnormalities. If all goes well, the embryo will continue to develope normally, with the exception of possessing two hearts.

But this normal development is very exceptional, as the duality of the heart is usually accompanied by some such abnormality as

* Jenaisch. Zeitschr. f. Naturwiss., xix. (1885) Supp. ii., pp. 113-22 (1 pl.).
† Recueil Zool. Suisse, iii. (1886) pp. 261-311 (1 pl.).

omphalo-cephaly, acephaly, heterotaxy, curvature of the spine, &c. Now, the author was able, by varying pressures on different parts of the embryo, to produce such monstrosities, which he describes and figures.

The older observers considered that the amnion was in some way connected with these teratological phenomena, but M. Warynski, in the course of his experiments, destroyed the amnion, and yet the embryo continued to develope normally. By means of transverse sections through later stages of embryos, in which duality of the heart was suspected, the author was able to study the vascular system: each heart consisted of an auricle, a ventricle, and a bulbus; the two bulbi unite to form a truncus, which then divides to form the aortic arches. There existed some asymmetry in the venous system.

The reasons are given at some length for the opinion that the curvature of the body is due to rapidity of the increase of growth; moreover, the arrest of development of one part of an embryo having a given rapidity of increase, induces an exaggeration of this rapidity in some other part. By pressure on an embryo before any curvatures have made their appearance, he obtained a vermiform embryo, which normally should have exhibited well-marked cranial and dorsal flexures. By injury to the fore-brain a very much greater dorsal flexure was caused, whereas the cranial flexure was absent. In natural conditions the pressure on the embryo is probably caused by the cooling of the egg during incubation; by means of removing a portion of the shell from an incubated egg, and letting the egg cool, the author found that the yolk gradually approaches the shell on the side of the blastoderm, as the cooling goes on, till ultimately the whole blastodermic surface presses close against the shell; in this way the duality of the heart, arising from the cooling of the egg, is usually accompanied by other teratological effects, since the pressure has occurred over the whole embryo.

Eggs of Bony Fishes.*—Herr P. Owsiannikow first describes the egg-capsules of the perch and of the trout; and in the course of his account he remarks that he has never observed the entrance of leucocytes, as described by His and others. The egg-membranes of *Lota vulgaris* are next described, and then the ovaries of those that have spawned are considered; the author discusses the eggs of *Osmerus eperlanus*, and the egg-membranes and yolk of *Acerina vulgaris*. *Gasterosteus*, *Coregonus*, *Esox*, and *Anguilla fluviatilis* are next taken in hand; and then the formation of the ova in the ovaries of *Perca fluviatilis*. The eggs of the lamprey, their fertilization and early development, form the subject of the concluding part of the essay, which is essentially descriptive, and requires the assistance of the plates to be adequately understood.

Pelagic Stages of Young Fishes.†—Prof. A. Agassiz describes the pelagic stages of young fishes, which, for the sake of convenience, he divides into (1) those with one or more oil-globules, and (2) those

* Mem. Acad. Imp. St. Petersbourg, xxxiii. (1885) 54 pp. (3 pls.).
† Mem. Mus. Comp. Zool. Cambridge, xiv. (1885) (19 pls.).

without oil-globules. Most eggs are laid singly, when they have a better chance of escaping their enemies than those that are laid in masses surrounded by a jelly. The eggs are at first transparent, but as development proceeds chromatophores appear, which then become pigmented. The eggs, except those in masses, float at the surface with the embryo downwards. The first fins to appear are the pectorals: after the closure of the blastopore and the disappearance of Kupffer's vesicle, the tail and caudal fin appear. Immediately on leaving the egg the embryo is mainly dependent for locomotion on the dorsal and ventral fins (leptocardiac fin); as growth proceeds, the pectoral fins become more useful. The comparatively large size of the notochord is a marked feature. A striking regularity is observed in the appearance of the same stages of development of identical species, as well as in the spawning and rate of development.

A Suggestion from Modern Embryology.*—Mr. H. W. Conn thinks that recent observations and theories may explain the difficulty in the doctrine of descent, which is caused by the appearance of a highly developed fauna in the Silurian epoch; about five-sixths of the orders and sub-orders now existing being represented in it. Modern embryology teaches us that the various sub-kingdoms are all direct modifications of the most primitive multicellular animal; the recent theories of Sedgwick "would make the history of all animals much shorter by showing that all the sub-kingdoms may be regarded as resulting directly from modifications of the gastrula by slight changes in its shape." As slight variations at the bottom of a diverging series produce much greater effects than variations higher up, we may shorten the time necessary to be assumed prior to the Silurian, and explain the presence of such a large number of our present existing types. It must have taken a long time to develope the Protozoan into the gastrula, but as soon as the latter was developed various great types arose, not serially but simultaneously. Slight variations in simple types would cause the descendants to separate still further; later on there would be an increase in the abundance and diversity of small branches. Mr. Conn thinks that Silurian vertebrates were more abundant than our present knowledge would lead us to suppose.

Evolution without Natural Selection.†—Mr. C. Dixon, basing himself on a number of ornithological data, urges that isolation, climatic influences, use and disuse of organs, sexual selection, and interbreeding, are the determining factors in natural selection; but he forgets that the first four of these are, in the Darwinian sense, factors in "natural selection." Dealing with interbreeding, he distinguishes (1) interbreeding among the individuals of a species; (2) that between sub-species, local races,and representative forms; and (3) interbreeding "which, by absorbing a closely allied form, gradually works the extinction of a species." The book appears to be most

* Science, vi. (1885) pp. 481–2.

† Dixon, C., 'Evolution without Natural Selection; or, the Segregation of Species without the aid of the Darwinian Hypothesis.' 8vo, London, 1885.

valuable for the number of observations which it contains on the variations of birds in connection with their geographical distribution.

Experimental Testing of the Theory of the Regulation of the Relation of the Sexes.*—Herr C. Düsing has for eight months experimented with guinea-pigs. When there was a want of males, 69 males and 80 females were produced; when of females, 10 males and 11 females; and under normal conditions 12 males and 20 females. The only conclusion to be drawn from these observations is that, as a rule, more female than male guinea-pigs are born. For four months experiments were continued with white mice by Herr Düsing, and for seven by Dr. Walter. The result of these experiments were—with a want of females, 71 males and 74 females; with a want of males, 114 males and 112 females; and under normal conditions, 2 males and 5 females were born; here again the numbers are too small to allow of any further conclusion than that, as a rule, the numbers of white mice born are nearly equally divided between the two sexes.

Herr H. Hoffmann has for seven years been making with plants experiments to test the influence of food on sex, and he comes to the conclusion that when there is plenty of nourishment the female, and when there is a scanty supply of it the male sex predominates; this is a result which is in accordance with those of preceding observers, and with Düsing's theory.

β. Histology.†

Organization of the Cell.‡—Prof. O. Bütschli has a criticism of Herr A. Brass's essay on the organization of the animal cell, in which he points out the vagueness with which Brass mentions the forms that he has examined, and urges that the species of ciliate infusorians are quite definite and constant in their special characters. Brass's statement that Infusoria are able to alter the form of their body is contrary to the experience of every one who has made himself acquainted with the group; no one has, as Brass asserts, definitely given the name of spermatozoa to the "Nebenkernen"; the statement that the chromatin of the nucleus consists of reserve material is not demonstrated, and is quite incorrect. The objections raised by various observers to the views taken by Ehrenberg as to the organization of Infusoria have been justified by all subsequent research. It is not correct to say that the protomerit of Gregarines is always imbedded in the walls of the intestine, though it is true of what Schneider called the epimerit; no competent observers support the statement that there is a nucleus in the protomerit; and all known evidence is against the view resuscitated by Dr. Brass that the conjugation-stages are rather evidences of division by fission.

Structure of the Nucleus.§—Mr. A. Bolles Lee, in a notice of Prof. J. B. Carnoy's 'Biologie Cellulaire,' shows that the usual views as to the structure of the nucleus are erroneous.

* Jenaisch. Zeitschr. f. Naturwiss., xix. (1885) Suppl. ii., pp. 108–12.
† This section is limited to papers relating to Cells and Fibres.
‡ Morphol. Jahrb., xi. (1885) pp. 228–42.
§ Arch. Sci. Phys. et Nat., xiii. (1885) pp. 119–27.

After pointing out that the cell consists of a membrane inclosing a reticulated protoplasm, the "cytoplasm," containing in its meshes numerous granules, the "enchylema," he describes in greater detail the structure of the nucleus itself. This too consists of a membrane inclosing a protoplasmic reticulum, the "caryoplasm," in which is a continuous and greatly twisted filament of "nuclein." Carnoy gives numerous figures of the nucleus in many different varieties of cells. The "nuclein" (or "chromatin") exists as a continuous filament, and not as a network, as is usually stated and figured; it consists of a wall or case with contents. The wall is readily seen in cells of the tissues of insects, and is rendered very distinct by means of methyl-green; by chemical tests it is found to consist of plastine. The contents are sometimes homogeneous, sometimes formed of rings or discs. As a rule this "nuclein" is coiled throughout the nucleus; but it may sometimes be centralized and then forms a nucleolus.

The "caryoplasm," like the "cytoplasm," which it resembles in chemical composition, consists of a reticulum of protoplasm, in the meshes of which is the "enchylema." No "chromatic reticulum" is really present, such an appearance being due to faulty methods of preparation or of staining. Methyl-green is the best staining agent for the purpose. When the nucleus divides, the cytoplasm becomes part of the caryoplasm of the new cells, and part of the caryoplasm of the old cell becomes the cytoplasm of the new nuclei. The nuclear membrane is completely closed; the appearance of pores in it is due to a reticulum on its surface. Thus a nucleus differs from a cell only in having the "nuclein" instead of a nucleus.

Goblet-cells and Leydig's Cells.*—Dr. J. H. List emphasizes the frequent ambiguity in the use of the term "mucous-cells" ("Schleimzellen"), and proposes the disuse of the phrase, and the consistent distinction of (*a*) goblet-cells and (*b*) Leydig's cells.

(*a*) *The goblet-cells*, distinguished by F. E. Schulze into those with, and those without a definite basal portion containing the nucleus ("befusste" and "unbefusste"), are first discussed, and the various modifications due to constriction, presence or absence of neck and of stoma, &c., are noted. In those without a definite basal portion the nucleus lies in the theca close to the basal wall, and two types are distinguished, according as the thecal wall is or is not continued into a stalk. In some cases Dr. List saw hints of a connection between the stalk and nerve-fibres. The best instance of goblet-cell with a distinct basal portion containing the nucleus was afforded by the cells in the upper lip of *Cobitis fossilis*. Within the theca he distinguishes the threadwork of chromophilous strands ("Filarmasse"), and the apparently homogeneous, viscid, less readily stainable intermediate substance ("Interfilarmasse"). No direct connection between the cellular threadwork and the nuclear network was observed. The best results were obtained by double-staining with hæmatoxylin-glycerin and eosin.

(*b*) *Leydig's cells* may be thus summarily distinguished from the

* Arch. f. Mikr. Anat., xxvi. (1886) pp. 543–52 (1 pl.).

ordinary goblet-cells:—(1) In the former no stoma could be detected, (2) nor appendages like the stalk or the basal process of the latter; (3) in the goblet-cells the nucleus always lies (in the unstalked types) close to the base of the theca, in Leydig's cells it generally lies centrally, distant from the membrane; (4) on the external surface of the smooth thecal wall in the goblet-cells those markings were never apparent which are characteristic of Leydig's cells, those namely which were long since described by Langerhans as rib-like, and which have been interpreted by Flemming as the expression of intercellular bridges; (5) the goblet-cells empty their contents by the stoma, and are to be regarded as unicellular glands, while the function of Leydig's cells still remains doubtful.

Mucous Threads of the Sea-stickleback's Nest.*—Prof. K. Möbius has traced to their origin the mucous filaments which bind together the nest of the marine stickleback (*Spinachia vulgaris* Flem.).

The mucinous substance, whose chemical characteristics are described, is formed from the epithelial cells lining the canals of the kidney. Some of these epithelial cells are at the time of mucin-production even morphologically modified—the nucleus becomes flat and retreats to the base of the cell. The product which first appears in the meshes of the cell-network is not stained by hæmatoxylin (mucogen), but this is changed from within outwards, first into granular and then into hyaline mucin. After the mucin is excreted the cell-nuclei disappear and the cells degenerate and probably perish. Prof. Möbius compares the micro-chemical and histological changes of the mucin-producing cells with Heidenhain's general theory of the differences between actively secreting and quiescent glandular cells, and indicates the relative interest of his observation. He notes the probably similar origin of the nest filaments of *Chironectes pictus*, and suggests that the pathological "fibrin-cylinders" in human urine may possibly have a similar history.

He also indicates the possible evolution of the instinct; a state of renal hypertrophy is associated with reproductive functionality in the testes, the enlarged kidneys cause an abnormal pressure, from which the stickleback tries to relieve itself by rubbing against foreign objects, to which the squeezed-out mucin adhered. At this time, however, he is in close company with the female and near the bunches of eggs glued to water-plants; there, therefore, he found the nearest and most convenient place for getting rid of the burdensome mucin, and thus became a nest-spinner.

γ. General.†

Geographical Distribution of Pelagic Marine Animals.‡—Herr C. Chur ascribes the wide distribution of pelagic forms to four causes; they are of great geological age, and existed long before the elevation of the continents, while the appearance of the latter has given rise to currents which are of great significance in distribution;

* Arch. f. Mikr. Anat., xxv. (1885) pp. 554–63.

† This section is limited to papers which, while relating to Vertebrata, have a direct or indirect bearing on Invertebrata also.

‡ Zool. Anzeig., ix. (1886) pp. 35–9, 71–5.

they are provided with powerful locomotor organs; they or their germs may become attached to powerful swimmers, wood, or the feet of swimming birds; and, lastly, they are aided by the wind, for when floating on the water they offer a broad surface.

The author then proceeds to discuss the results of recent observations which confirm the idea just enunciated; as examples of geologically old forms we may take the Protozoa, and especially the Foraminifera, several of which have been found by Brady to be cosmopolitan in their distribution; the Cetacea and perhaps some Cephalopods are good examples of strongly swimming forms; the cosmopolitanism of many pelagic Crustacea and the localization of Cœlenterata is explained by the resistent chitinous shell of the one and the delicacy of the tissues of the other set of forms; at the same time, some cœlenterate species are very widely distributed.

Influence of High Pressures on Animal Tissues.* — M. P. Regnard has investigated the increase of weight in organs and tissues subjected to high pressures (100–400 atmospheres), and he finds a great increase in the quantity of water in the tissues; it is not yet certain whether this is due to water directly entering, or whether it combines with the albuminoids, and, after the removal of the pressure, escapes and infiltrates the tissues.

B. INVERTEBRATA.

Mollusca.

Formation of Chromatophores in Cephalopoda.†—In working out the development of the chromatophores in *Sepiola Rondeletii* M. C. Phisalix comes to the same conclusion as Blanchard, Girod, and others, that the fibres radiating from the cell are not muscular but connective tissue. In the centre of a mass of yellowish pigment a large rounded vesicle appears, with the nucleus at the periphery of the protoplasm, as in a fat-cell; in this cavity refringent coloured granules collect. The cells surrounding this vesicle equatorially are arranged in a radial fashion; their nuclei elongate, and their protoplasm becomes converted into fibrils, while their central ends become continuous with the protoplasm of the central cell. The nucleus of this latter soon loses its structure, but retains its size and shape; the large vacuole of the cell is surrounded by a ring of smaller vacuoles, and the coloured granules in this vacuole move about; this has given rise to the idea that the chromatophores may be amœboid.

Embryology of Patella.‡—Dr. W. Patten communicates a most interesting investigation on the embryology of *Patella*.

1. *Preparation of the embryos.*—The opaque, blueish-green ova were rendered partly transparent by a preparation of acetic acid and glycerin. For studying the more complicated internal changes, sections were made of embryos killed in acetic acid, preserved in alcohol, and stained with alcoholic borax-carmine or Kleinenberg's hæmatoxylin.

* Comptes Rendus, cii. (1886) pp. 173–6.
† Ibid., pp. 775–7.
‡ Arbeit. Zool. Inst. Univ. Wien, vi. (1886) pp. 1–26 (5 pls.).

2. *Fecundation of the ova.*—The mature ova, which measure 0·12 mm. in diameter, are protected by a very thick transparent chorion, whose surface is covered with shallow indentations, and between these a larger number of smaller dots, also pits, but, unlike the former, in connection with fine lines or canals which extend radially from the outer to the inner surface of the chorion. The micropyle at the animal pole is a funnel-shaped projection, with a large irregular opening, within which lay a number of highly refractive globules. From the bottom of the micropyle two very large polar globules arise, of which one, becoming much the larger, exhibits a globular distal enlargement, in which an indistinct nucleus may be detected. Four or five may be present, but only one has this globular extremity. A layer of finely granular protoplasm was frequently observed at the animal pole, where the polar globules arise. After the detachment of the globules, a remnant is still seen, persisting as late as the stage with eight segmentation-spheres.

3. *Segmentation.*—The ovum divides after the general molluscan type, the earlier stages much resembling those of *Planorbis*. A meridional division into two unequal parts, is followed by a successive, not simultaneous, meridional division of the larger and smaller sphere, at right angles to the former; a third division parallel to the equator, a little nearer the animal than the vegetative pole, acts successively on the four spheres, producing stages with five, six, seven, and eight spheres. Beyond this stage the rhythm was not followed owing to the abundant percentage of abnormal types. A blastosphere with a slightly excentric and oval cavity results. Four large, coarser cells at the vegetative pole constitute the beginning of the endoderm. The thick chorion falls away at an early stage in segmentation.

4. *Gastrulation.*—The beginning of gastrulation is marked by the increase in size and inward growth of the four primitive endoderm-cells above-mentioned, of a wedge-like shape, at the end of segmentation; they assume an oval form, and expand inwards into peculiar club-shaped cells which nearly fill the segmentation-cavity. During the inward growth, at first two, and then four or five cells at the apical pole, becoming ciliated, form the beginning of the apical plate; and at the same time the velum is established by the appearance of cilia upon each one of a double row of cells round the equator. The radial symmetry of the embryo is soon disturbed by the appearance of two large cells, one on each side of the four endoderm-cells, which begin the transformation of the embryo into a bilateral organism. These two "endo-mesoderm" cells divide, and one half becomes the primitive mesoderm-cell, while the other, after remaining some time in the mouth of the blastopore, is pushed in to become one of the endoderm-cells lining the cavity of the mesenteron. The embryo becomes somewhat lengthened through the elongation of the endoderm-cells and the increase of the ectoderm-cells between the velum and the mouth of the gastrula. The cells of the embryo-cap lose their wedge-like form, and become somewhat flattened.

5. *Migration of the blastopore and appearance of the dorso-ventral axis.*—The cells filling the mouth of the blastopore divide per-

pendicularly to their long axis, and the outer parent cells divide again parallel to the same, thus increasing the number of cells at the mouth of the gastrula to eight. About the twentieth hour the blastopore begins to shift from its basal position towards the future ventral surface. It comes to occupy the apex of a V-shaped furrow directed towards the velum, and is much reduced in size. The rest of the furrow is occupied by ectoderm-cells, which arrange themselves regularly, circularly at the apex. The diverging arms of the V become parallel, the furrow is deepened at the basal end to form a round opening like that at the apex, only smaller. When the blastopore is closed, the ectoderm-cells, which formed the sides and floor of the furrow, constitute the walls of the stomodæum. The endoderm-cells, resulting from the division of the primitive four, are at first irregularly arranged in the segmentation-cavity, but are finally disposed as the walls of a slit-like cavity appearing in the centre of the mass. The endo-mesoderm cells leave their median lateral position, approach one another on the future dorsal side, and dividing at right angles to their long axis form the *primitive mesoderm-cells*. The ends of the endo-mesoderm cells persist on the dorsal edge of the blastopore, and are forced, by its closure, inwards to form part of the endoderm-lining of the mesenteron. The mesoderm-cells come together in the median longitudinal, dorso-ventral plane, and give rise to two V-shaped rows of smaller cells, which afterwards divide to form double rows. Two lateral swellings on each side of the blastopore, as it becomes ventral, unite as the latter moves forward, and form a median protuberance which developes into the foot. The mechanism in the shifting of the blastopore is traced to the changes in cells on the dorsal side of the embryo. The velum increases greatly; on each side of the main median band of cilia there is a band of *support-cells*, the anterior due to the decrease of the original anterior band of cilia, the posterior, a new development specially well marked on the dorsal side of the embryo. The *shell-gland* appears shortly before the closure of the blastopore as a plate of thickened cells, including most of the dorsal surface posterior to the velum. The cells of the embryo-cap increase in number and decrease in size. Two cells, one on each side of the apical plate, project conspicuously, retaining their rounded ends, which become filled with highly refractive granules, and covered with extremely fine, straight, motionless, radiating hairs. At the very pole a tuft of fifteen to twenty long inactive cilia is formed. To these larger and longer hairs, as distinct from the smaller, probably directive cilia, Dr. Patten would ascribe sensory functions.

6. *From the closure of the blastopore to the formation of the nautiloid shell.*—The endoderm-cells arrange themselves more regularly, though very unequally, round the mesenteric cavity. The body-cavity appears as a space between the walls of the mesenteron and the ectoderm. The further development of the mesenteron and the œsophagus is described. The mesoblastic chords grow forward as far as the velum, where the cells become isolated, and elongated with pointed ends. Some mesoderm-cells freed from this anterior extremity of the chord, form a layer on the dorsal surface of the mesenteron, and

gradually grow toward the ventral side. Half-a-dozen or more of these are specially modified as muscle-cells which serve to draw the embryo into the shell. Another group extends forward and ventrally, surrounding the œsophagus and the probable auditory sacs. A few arrange themselves around the inner wall of the velum, and others connect these with the cells round the œsophagus. Some are also always found in the spaces between the outer walls and the mesenteron, probably forming blood-corpuscles. The primitive mesoderm-cells persist as late as the twentieth hour. The invagination of the shell-gland, and the formation of the nautiloid shell are then described, as also the changes in the foot, the appearance of the auditory organs, and further progress which it is impossible to summarize. Owing to the rapid abnormal development of the embryos, Dr. Patten has not yet been able to contribute any definite results as to the development of the nervous system.

Development of the reproductive elements in Pulmonata.*—Herr G. Platner continues his researches on the development of the reproductive elements in Pulmonates. He has been able to watch the process of copulation in confined Arions, and to trace the stages in the maturation and fertilization of the ova. In *Helix*, even when copulation had been observed, atrophy always set in, and the ova never reached maturity.

1. *Karyokinesis in the sperm-cells of Helix.*—To what he has previously communicated on this subject, Herr Platner adds the following account of the origin and fate of the spindle-fibres. When the chromatin of the regular coil is about to concentrate itself in the granular equatorial plate, the spindle-fibres are seen neither meeting at the poles, nor pursuing a straight course, but extending from the equator towards the poles, and instead of ending sharply, bending round to be continued on the other side. The spindle-fibres are really the persistent framework of the regular coil, the chromatin of which has been concentrated at the equator, while the unstained ground-substance persists *in toto*. It seems probable that the microsomata are not solid, but disposed on the framework of the coil like pearls on a string. The spindle is formed from the coil framework by the concurrence of the individual segments of the latter in one point at the poles, thereby becoming more stretched and entering into intimate connection with the protoplasmic masses. In the usual rapid division, the spindle-fibres seem suddenly to disappear, but when division is slow their history can be traced. The pole-plates separate from the spindle-fibres, fall into granules, and become regular nuclei; the spindle-fibres contract more and more towards the equator, fuse together, and form triangular or hook-shaped structures, attached by their apex to the equator. After division this structure retires from the periphery towards the centre; the limbs of the hook become longer and more distinct, diverging towards the centre and then bending in and finally meeting. The closed figure thus formed from the spindle-fibres is *the accessory nuclear*

* Arch. f. Mikr. Anat., xxvi. (1886) pp. 599–621 (2 pls.).

body—the "Nebenkern." An exactly analogous process is observed in cases where the division of the protoplasm does not occur; here also the accessory body arises directly from the spindle-fibres. Between the framework of the coil, the spindle-fibres, and the accessory body, there is thus a genetic connection; all three are modifications of the same element. The process is probably as follows. After the chromatin of the nucleus has divided into microsomata, these arrange themselves in regular curved rows; the accessory body enters the nucleus and forms the framework of the coil; the latter persists as the spindle-fibres, while the chromatin concentrates in the granular equatorial plate; the spindle-fibres come into direct connection with the protoplasm at the poles; after division of the chromatin substance, the resulting pole-plates form anew regular nuclei, and the "anaphasis" either repeats inversely the stages of the "prophasis," or the accessory nuclear body arises directly from the spindle-fibres. Which of these two cases occurs depends upon the degree in which the protoplasm is associated with the division. Herr Platner adds some further remarks on the number and origin of the elements of the equatorial granular plate, and a critical notice of recent contributions by Carnoy and Gilson.

2. *Oogenesis and Spermatogenesis in Arion.*—The earliest stages of the reproductive organ exhibit primitive sexual-cells, or rather irregular nuclei imbedded in a homogeneous substance. In the centre of the nuclei a formation of granules occurs, and a finely granular protoplasm begins to be formed round about. These elements increase considerably in number, and apparently directly; they form (*a*) primitive ova; (*b*) spermatogonia and basal cells; (*c*) nutritive cells furnishing the yolk; and (*d*) nuclei of the alveolar wall and of the follicular membrane. The latter are reserve germs, and form a new generation after the expulsion of the contemporary sexual cells. The sexual cells in the alveoli are distinctly separable into a peripheral layer consisting chiefly of ova, and a central zone of spermatogonia. The latter are characterized by the presence of a single large nucleolus, which appears along with the bent rods forming the accessory body. The origin of the latter as an outgrowth from the nucleus has been already described. Becoming gradually rounded off, it exhibits a distinct membrane, and internally an irregular distribution of chromatin over a network of faintly stained strands. The ova are at first distinguished from the spermatogonia only by their peripheral disposition, the greater development of their protoplasm, and their much larger, more oval nucleus. A rapid growth is the natural result of the direct supply of abundant food insured by their peripheral position. They increase in number in a manner exactly analogous to that above described in the case of *Helix*. Within the nucleus are seen not only the proper germinal spot, of a roundish form, at first interrupted by projecting elevations, but another round body, which Platner terms the nucleolus. He compares the presence of these two bodies with similar phenomena observed by Leydig, Trinchese, Van Beneden, and V. la Valette St. George. When the ova of *Arion* have attained their final form, the

accessory nuclear body is no longer visible, having probably remained as a portion of the nucleus at the last division. In the formation of the spindle, the origin of the fibres from the unstained substance was clearly seen, and this is, in developing ova, contained in the germinal spot. In progressive changes the spot exhibits a variable but small number of clear vacuole-like bodies; a clearer stained and a darker portion become distinguishable, the latter representing Van Beneden's "corpuscule germinatif." Meanwhile, the surrounding protoplasm is becoming modified; within the meshes of the network of fine granular threads, yolk-granules appear, from the centre outwards. This differentiation of the protoplasm is for the most part effected at the cost of the nutritive cells. The mature ova no longer form a continuous peripheral layer, but lie in scattered clumps, with the spermatogonia between them. The intermediate substance between the clumps is composed of the connective-substance cells described by Leydig or the plasma-cells of Brock. With the growth of the alveoli these gradually degenerate and disappear. The nuclei of the alveolar wall which furnish the reserve germs, do not, therefore, originate from the intermediate substance, but from the sexual cells. The basal cells are formed from sexual cells with granular nuclei, which after serving for a time as the nutritive centres of spermatocyte groups, degenerate and disappear.

3. *Oogenesis in Helix.*—In *Helix* the ova are formed at intervals, there is no strict peripheral disposition, the primitive ova multiply with mitosis, and their final form exhibits a single germinal spot. The function of the nutritive cells is beautifully seen. At first directly apposed to the ova, they come gradually to lie in cavities, and are finally indistinguishable from the surrounding protoplasm. The assimilation takes place rapidly. These so-called yolk-nuclei are, in this case, at least, in no way parallel to the accessory nuclear body of sperm-cells. Herr Platner agrees with other investigators as to the absence of a vitelline membrane.

Parasitic Gastropods.*—Drs. C. F. and P. B. Sarasin state that the *Linckia multiformis* of Ceylon has two parasites, one internal and one external, both of which are prosobranchiate gastropods. The ectoparasitic form is always found on the lower surface of an arm, and is so set that the anterior portion of the right margin of the shell has free communication with the outer world. The surface of attachment is almost as large as the wide mouth of the shell, and it is fixed by a number of elevations which make their way into the cutis of the *Linckia*; this surface is not, however, the true foot, for its centre is occupied by the pharynx, which acts like a proboscis and makes its way perpendicularly into the skin of the host. The true foot is a small semilunar fold on the hinder surface, and the remnant of the velum forms a second semilunar fold on the anterior surface. There are no tentacles, but auditory vesicles are present. The muscular pharynx has a pumping action, and the radula is wanting. There are well-developed salivary glands, which, possibly, have an

* Zool. Anzeig., ix. (1885) pp. 19–21.

acid secretion which acts on the carbonate of lime of the star-fish host. There is one gill. The adult has a shell about 1 centimetre long, and is, on the whole, like *Ancylus;* it appears to belong to the genus *Concholepas.*

The presence of the entoparasitic form may be recognized by a conical swelling on the arm of a *Linckia,* and close examination will reveal the presence of a small round hole from which the apex of the shell of the gastropod projects; it is without doubt a *Stylina.* The adult shell is a centimetre long and has eight coils; it has an extraordinarily long and muscular proboscis, which may extend for 1·5 cm. At the base of the proboscis is a false mantle which clearly acts as a respiratory pump. The proboscis itself extends along the wall of the cœlom of its host; there is no pharynx and no radula. Nor is there any operculum. There are eyes and auditory vesicles, but no tentacles; the sexes are separate, and the genital products appear to escape into the sea. Only about two per cent. of the *Linckiæ* are troubled by these parasites. Further details and figures are promised.

Spawning of Doris.*—By carefully watching the eggs as they passed down the oviduct, M. E. Bolot was able to ascertain the function of the various regions of the "albuminous gland" of *Doris.* The eggs were seen to receive their various coats in different regions of the gland, which is therefore really made up of glands which in other gastropods are usually separated from one another. The fertilized ovum enters a large canal beset with branching tubes, which are lined by large irregular nucleated cells; this region is the true albuminous gland, where the first coat is deposited round the ovum. In the next part of its course the shell is deposited in the "shell-gland," the cells lining which differ from the albuminous cells only in their smaller size. These two regions constitute Hancock's "opaque portion" of the albuminous gland. Following this is the "jelly-gland," made up of convoluted tubes, forming the external edge of the whole gland; the cells lining this region are elongated, very granular, and arranged in a single layer; they deposit a jelly ("masse glaireuse") which binds the eggs together in a cylindrical string, which passes into a slit-like cavity and passes out of the body as a ribbon-shaped string. It is possible to separate the eggs of *Doris* from this jelly, when laid, by carefully acting on them with acetic acid. *D. testudinaria* is remarkable amongst Nudibranchs for possessing a "prostate" on the *vas deferens,* such as occurs in other gastropods.

Central Nervous System of Tethys leporina.†—Prof. H. de Lacaze-Duthiers points out that the difficulty with regard to the central nervous system of *Tethys* lies not in the topography of its lozenge-shaped central mass, but in the interpretation of the morphological value of its constituent parts. He regards it as being composed of three groups of ganglia; the cells of which it is made up are contained in pyriform sacs, arranged in a racemose fashion; the largest pouches are central and inferior, the smallest on the superior

* Comptes Rendus, cii. (1886) pp. 829-31. † Ibid., ci. (1885) pp. 135-9.

margin and in the middle. After maceration six secondary groups —two superior, two inferior, and two lateral—can be made out. We have to do here with a remarkable approximation of the cerebral, pedal, and asymmetrical ganglia, for nerves converge to this central mass from all the organs of the body. The author describes in detail the careful dissections which were necessary to elucidate the structure of this complex mass, and, comparing it with those which he has previously described, says that, whereas in all of them all the pedal and asymmetrical ganglia were found on the anterior surface of the œsophagus, they are, in *Tethys*, with one exception, all united into a dorsal mass; that exception is the extremely small genital asymmetrical ganglion.

Shell-formation in Lamellibranchs.* — Dr. F. Müller describes the mode of shell-formation in Lamellibranchiata. His investigations relate chiefly to *Anodonta*, *Unio*, and *Cyclas*, of which chipped-off edges and sections were studied. The decalcification was effected by means of dilute chromic acid, picrocarmin was used for staining, and celloidin was found to be the only satisfactory imbedding material.

The general result of Dr. Müller's research is to corroborate Nathusius in his account of the shell-growth by intussusception and not by secretion. He does not, however, exclude the possibility that apposition of organic elements may occur on the inner surface of the shell, at those places where the shell is permanently united with the body, i. e. from the muscles. The outer margin of the shell, that is the thickened periostracum, and the inner surface next the mantle are always soft. The calcification both of the prismatic and mother-of-pearl layers, is due to small, roundish, irregularly distributed bodies, which gradually increase in all dimensions, and become prismatic by mutual pressure.

During the metamorphoses of the young mussel, the shell has a fibrillar structure; the lamellation is secondary, probably beginning along with the calcification. The original fibrillar structure is associated with the development and differentiation of the shell-muscles. The organic substance of the shell has a cellular origin.

In their development the fibrils follow the directions of the mantle-muscles. They assume a radial course at the ligament, but elsewhere run parallel to the surface of the mantle, following the direction of the muscle-fibres which run transversely round the animal, just under the epithelium, and which uniting with the tooth-pad, the pallial line, and the periostracum, thus exert influence on the fibrils.

These transverse muscle-fibres aid in the opening of the shell. Those radially disposed on the back of the animal flatten the ligament in contracting, and thus also aid in opening, as those also do which ascend on each side from the foot and are attached to the tooth or tooth-pad. The muscle-fibres uniting the dorsal-muscle insertions on either side act as adductors. The bundles of cross muscles on the margin of the mantles, which are by one end attached to the shell on the pallial line, and by the other to the free portion of the perio-

* Zool. Beitr. (Schneider), i. (1885) pp. 206–46 (3 pls.).

stracum, effect by their contraction the apposition of the soft shell margins, and a consequent perfect closure of the shell.

Opening of the Shell of Mussels.*—Dr. J. Pawlow has investigated the mechanism of the opening of the shell in *Anodonta cygnæa*. There is a nerve-ganglion 6–8 mm. in front of the anterior adductor which gives off several branches. Some of them go to the ganglion on the ventral surface of the posterior adductor. Observations were made by clamping one valve of the shell to a firm board and connecting the other by a silk thread with the short arm of a lever, the longer arm of which works on a slowly rotating drum. An uninjured mussel makes spontaneous movements, the valves being slowly opened a little and closed again more quickly. After separation or irritation of its proper ganglion, each muscle can be studied separately.

The author sums up his conclusions as follows:—"Two classes of nerve-fibres supply the adductor muscles,—(*a*) motor causing contraction, and (*b*) inhibitory interrupting the contraction and effecting relaxation. The motor nerves of each muscle spring from the nearest ganglion; but all the inhibitory fibres originate in the anterior ganglia. The latter pass to the anterior adductor by the short nerve-branches which pass to it from the anterior ganglia. They reach the posterior muscle through the connectives. The posterior ganglion thus functions as motor centre for the posterior adductor; and the anterior ganglia act similarly on the anterior adductor. The motor cells of the ganglia on either side may be stimulated to activity, either by peripheral nerve-fibres (of the mantle or gills), or by certain fibres of the connectives. The anterior ganglia are able to produce relaxation in either anterior or posterior adductors."

Resting position of Oysters.†—Mr. S. Saunders considers that Mr. J. T. Cuningham‡ is right in stating that oysters are usually found with the left (convex) valve uppermost; and that Prof. Huxley is also correct in stating that young oysters are invariably attached by this left valve. The discrepancy is explained by the fact that the oyster, during its first or second year, becomes detached either by the dredger or by natural means. The oyster, falling on its convex valve, will get turned over by the motion of the water, and then remain on its flat valve, being now free from disturbance by the water. Moreover, if it remains attached by the convex valve, the mud, &c., would tend to remain in its concavity and thus injure the soft parts, whereas if the flat valve be undermost the motion of the water can more easily sweep away any foreign matter from the shell.

'Challenger' Lamellibranchiata.§—Mr. E. A. Smith confines himself chiefly to descriptions of the shells of the Lamellibranchs collected during the voyage of H.M.S. 'Challenger.' He urges the priority of the term Pelecypoda given to the group by Goldfuss. Only about 500 species were obtained, and the greater number came from shallow waters; only one new genus is described. Lamelli-

* Pfluger's Archiv, xxxvii. (1885) pp. 6–31 (1 pl.).
† Zoologist, x. (1886) pp. 114–5. ‡ See this Journal, *ante*, p. 52.
§ Reports of the Voyage of H.M.S. 'Challenger,' xiii. (1885) 341 pp. (25 pls.).

branchs seem, in many cases, to have wide areas of distribution and to be found also at very different depths; as a rule, very deep forms tend to be colourless and of thin structure; on the whole, Mollusca seem to be comparatively scarce at great depths.

Molluscoida.

a. Tunicata.

Alternation in the Heart of Tunicates.*— M. F. Lahille gives the results of numerous experiments on the reversal of the action of the heart in *Salpa maxima* and *Phallusia mamillata*.

The number of beats in each direction is not regular, but it is found that the number of "cardio-visceral" beats is greater than that of "cardio-branchial" beats, before a reversal takes place: he gives tables showing these numbers under various circumstances. Immediately after its capture, the beats varied from 4 cardio-visceral and 2 cardio-branchial, to 9 and 7 respectively. As the length of captivity increased, the number of pulsations before a reversal took place increased; but still the cardio-visceral beats were in excess: for instance, 26 beats before a reversal; then 12 cardio-branchial beats; or even 60 and 48. Under the influence of a current of oxygen, the number of pulsations decreased, and tended to become normal: with carbonic acid, the inverse result was obtained: the number of pulsations increases, and the cardio-branchial exceed the cardio-visceral pulsations, e. g. 60 and 52 between reversals. The same thing happens as the captivity is prolonged; from which he concludes that the difficulty in keeping *Salpæ* alive in aquaria arises from their great need of oxygen. The pulsations, either visceral or branchial, occur once in every $2\frac{1}{2}$ seconds, either normally, or with oxygen, or with carbonic acid.

With *Phallusia mamillata* the same general results were obtained; but the number of pulsations between reversals is greater, and more irregular; sometimes the cardio-visceral pulsations exceeding the branchial; sometimes the reverse is the case. The time between each contraction varies from 9 to 11 seconds. Carbonic acid does not seem to influence the number of pulsations, but the intervals between contractions are longer. The removal of the intersiphonal ganglion sometimes increases, sometimes diminishes, and at other times does not affect the number of pulsations; but in all cases it appears that the passage of blood to the branchia is more difficult than towards the viscera; the blood seems to flow back slightly from the branchia. The author intends to explain these results in a future paper, and to try the action of alkaloids and anæsthetics, &c., on these forms and on the *Synascidiæ*.

Budding of Salpæ.†—Herr O. Seeliger, after an historical review of what is known with regard to the budding of *Salpæ*, gives a detailed account of the formation of the stolo prolifer.

* Bull. Soc. Hist. Nat. Toulouse, xix. (1885) pp. 13–23.

† Jenaisch. Zeitschr. f. Naturwiss., xix. (1885) pp. 573–677 (10 pls.).

This first appears as a small elevation just behind and to the left of the end of the endostyle; it soon consists of two cell-tubes, one within the other, and having the intermediate space filled by a cell-mass. The outer layer of the stolon is clearly an evagination of the ectodermal tegumentary epithelium of the embryo; the space is a continuation of the primary cœlom, and the cells that fill it are mesodermal in origin. Huxley's account of the endoderm of the stolon as arising from the pericardium of the embryo is explained by the observation that the endodermal evagination extends to and fuses with the pericardium; the characters of the mesoderm are described in detail, and the author then passes to an account of the growth and torsion of the stolon; as it grows it surrounds the hind-body, and as it twists its distal end comes to lie ventrally to the nucleus. As the stolon and its buds grow, the solitary animal also increases considerably in size. The buds are not formed by special outgrowths of the stolon, but by metamorphoses of the whole of it; the ectodermal tube of every young bud contains six separate structures; neurally is the ganglion, two endodermal sacs, two mesodermal bands, and hæmally the ovary and rudimentary oviduct; along the whole length of the germ-stock there extends two blood-passages common to all the buds, and these, enclosed by a flattened epithelium and a layer of cellulose, lead directly into the lacunar system of the embryo; they are separated by two horizontal layers of cells which are derived from the endodermal tube of the stolon. Owing to the presence of the endothelial wall the blood cannot pass directly into the young buds.

In the last period of development the primitive connection between the separate individuals is lost, and they are only connected by a fresh set of attaching processes. This separation becomes so complete that there is no structure which is common to all or even to several chain-salpæ; the young animals cut themselves off from the region of the two blood-passages, so that these come to lie quite outside the body of the *Salpæ*. The tube in which they are enclosed may be regarded as the remains of the stolon, and it gradually decreases in size. By the outgrowth of the attaching processes the chain-stage becomes possible, and the single structure becomes converted into a number of parts. The histological and structural changes which take place during this stage of development are fully described, and the whole may be thus summed up:—

The ectoblast of the embryo forms the ectodermal cell-tube of the stolon, the tegumentary epithelium, and the outer cellulose mantle of the chain-salpa; the mesenchym of the nucleus, which is perhaps partly derived from embryonic mesoblast, gives rise to the two paired lateral cords (which divide into the lateral end which belongs to that side of the stolon on which the chain-individuals will lie later, and the hæmal part of the opposite cord), the cord of the ovary, and the nerve-tube of the stolon; the lateral cord forms the inner cellulose mantle, the connective-tissue cells, the muscular bands and fibre-cells, the blood-cells, the dorsal wall of the gill-band, and the wall of the cloaca in the chain-salpa; the hæmal part forms the pericardium, heart,

and elæoblast; the ovarian cord, the male and female organs, and the nerve-tube, the ganglion, the sensory organ, and the ciliated pit. The endoblast of the embryo forms the endodermal tube of the stolo prolifer, and this the wall of the respiratory cavity, the ventral wall of the gill-band, the digestive tract with the gland that surrounds it, and the dorsal process. The pericardial cavity is at first a special portion of the primary cœlom, in which there are no isolated cells; one wall goes to form that of the heart, and the other that of the pericardium; it is stated that the finer histological characters of the muscles appear to deserve further investigation.

Individual Variations in the Structure of Simple Ascidians.*—Herdmann was the first to notice that the "vibratile organ" forming the opening of the duct of the hypoganglionic gland in Ascidians varies in form in different species. In general the aperture is single, but in *Phallusia mamillata* and in *Ascidia Marioni* the duct of the gland branches, and each branch opens into the branchial chamber by a separate pore. M. L. Roule now finds that a similar condition *occasionally* occurs in *Ascidia elongata* Roule, and *Cynthia papillosa* L.

In the former species each of the eight branches of the duct opens by a pore, and the eight pores are placed on a rounded prominence; but in *C. papillosa* the sixteen pores are each on a separate papilla; the group of papillæ forming the "vibratile organ." The difference between this organ in the first two species and in these latter forms, is that, in *A. Marionis* and *P. mamillata*, the branches arise from the main duct throughout its course; whereas in the other two the branches arise only from the peripheral part, near the apertures. While this arrangement of the duct is a constant character in the first two, it is only an occasional teratological phenomenon in the other two forms. As to the cause of its presence in the latter case, the presence of parasites or of debris, in the branchial cavity does not seem to offer a sufficient explanation, for there is a remarkable regularity in the arrangement of the pores. It is necessary to "look deeper into vital manifestations, and to recognize that certain organs, although placed in the interior and far removed from all direct external influence, can vary in their structure to a considerable extent; and this naturally, without the embryo having experienced any artificial teratogenic influences."

The Phallusiadæ of Provence.†—M. L. Roule describes five genera of the family Phallusiadæ. The family is divided into the sub-family Cionidæ, in which the visceral mass is placed behind the branchial sac; and into the sub-family Phallusiadæ, where the visceral mass is at the side of the branchial sac.

Of the Cionidæ, two forms, *Rhopalona neapolitana* Philippi, and *Pleurociona Edwardsii* n. sp., are described. *R. neapolitana* is pure white near its free end, and has a very characteristic shape, being divided into a branchial region and a visceral region, connected by a narrow, elongated œsophageal region. The two siphons are near one

* Comptes Rendus, cii. (1886) pp. 831–3.
† Recueil Zool. Suisse, iii. (1886) pp. 209–58 (4 pls.).

another at the free end, and the fixed extremity is mamillated and expanded. The arrangement of the bars in the pharynx or branchial sac is given in detail. The cœlom is fairly well developed. The ovary and testis are, as in *Ciona*, a good deal mixed up together, but each has its own duct. No renal organ was found, though numerous yellow cells are present in the visceral mass. The author places the genus near Herdmann's *Ecteinascidia*, in the family Clavelinidæ; it forms a connection between *Ecteinascidia* and *Ciona*; and thus also between the simple and the compound Ascidians.

A new species of the genus *Ciona*, viz. *Pleurociona Edwardsii*, is formed. The sub-genus includes those forms of which the whole of one side is fixed. This species is very nearly cylindrical, and yellowish green in colour. An important point of difference between this subgenus and *Ciona* is that the peritoneal fold which separates the general body-cavity from the peribranchial cavity is oblique to the long axis of the body, instead of being perpendicular to it.

Amongst the sub-family Phallusiadæ the species of the genera *Ascidia* and *Ascidiella* are described; of the latter, a new species, *A. lutearia*, is formed, in which the body is fixed by a posterior peduncle. Of the genus *Ascidia*, *sensu stricto*, the author gives a description of *A. involuta* Heller, in which the tunic is very thin and completely covered by débris of shells, Bryozoa, &c. The "vibratile organ" is very large, and its edges are much and irregularly folded. A new species is found for *A. elongata*, in which the anal siphon is about midway between the oral siphon and the fixed base; the siphons are rose-pink in colour, the whole tunic being reddish. The branchial sac resembles that of *A. mentula*. The "vibratile organ" is usually fairly simple, but in some individuals the aperture gets much subdivided by the unfolding and fusing of the edges.

A table is given, showing the geographical distribution of those Phallusiadæ which occur on the coast of Provence, and there are some excellent figures showing the natural colours and appearance of the forms described.

Arthropoda.

Claus's Classification of the Arthropoda.*—Prof. E. Ray Lankester has published a statement as to Prof. Claus's classification of the Arthropoda,† in which he shows that his own already-published conclusions have been largely borrowed, but without acknowledgment, by Prof. Claus.

a. Insecta.

Development of the Reproductive Organs in Insects.‡—Prof. A. Schneider continues his previous researches on the development of the reproductive organs in insects. In the first part of his memoir he gives an outlined attempt towards a connected view of the development and comparative anatomy of these organs; in the second part

* Ann. and Mag. Nat. Hist., xvii. (1886) pp. 364–72.
† See this Journal, *ante*, p. 240.
‡ Zool. Beitr. (Schneider), i. (1885) pp. 257–300 (4 pls.).

details as to peculiarities observed in some of the groups, and as to the opinions of some of the numerous other investigators of this subject are discussed.

(*a*) *Rudiment of the sexual organs.*—The first rudiment of the sexual organs appears as a muscle-fibre which branches off from an alary muscle. It is inserted posteriorly and anteriorly on the hypodermis. An accumulation of nuclei forms a median swelling, which is defined off from the anterior and posterior terminal threads, which he terms Müller's filament and the primary efferent duct respectively. Both of these exhibit nuclei, especially the latter, but both may be structureless.

(*b*) *Nuclei of the genital rudiment and efferent duct.*—The germinal epithelium is not definitely cellular, but consists of nucleated protoplasm. These nuclei are of two kinds, spherical and vesicular. The former are larger and probably originate from the latter, from which they differ in the disposition of their nuclear fluid. Both divide, and from such nucleated protoplasm not only the sexual rudiment, but the so-called duct of Herold are formed. By mutual pressure the large nuclei become polygonal, and form the well-known epithelium of the ovarian tubes, which is thus not strictly composed of cells. The smaller nuclei usually become squeezed in interspaces, and have been described as amœboid "wandering cells."

(*c*) *Direct development of the reproductive rudiment.*—(1) In the viviparous *Cecidomya* larvæ, in *Collembola*, *Campodea*, *Coccus*, *Lecanium*, *Aspidiotus*, and male *Diptera*, the reproductive rudiment forms the sexual organs *directly*. In the *Poduræ* the ova and "spermatoblasts" arise directly from the differentiation of cells from the large spherical nuclei of the protoplasmic mass. In other cases a simple terminal, or a manifold yolk-chamber is formed. In the female *Coccus*, *Lecanium*, and *Aspidiotus*, lateral germinal tubules are formed, while the median portion of the rudiment remains as the efferent duct. (2) In all other insects the sexual organs are formed from a *differentiation* of the rudiment, within which long round tubules, limited by a membrane, are formed. These usually lie, at first, at right angles to the longitudinal axis of the rudiment, but in most cases they afterwards radiate out in fan-like fashion from the secondary efferent duct. The envelope of the rudiment persists for a while as a structureless membrane with an apposed nucleated layer of protoplasm, but is in most cases absorbed before the imago is perfected, though remaining as the muscular egg-sac in *Diptera*, and as an interrupted, nucleated, net-like membrane in *Blattidæ* and *Saltatoria*. A peritoneal envelope is formed round the tubules, and another portion of the protoplasm forms special terminal filaments, connecting the ends of the tubules with Müller's filament. The secondary efferent duct appears and remains in *Orthoptera*, *Thysanura*, *Thyrepsida*, and *Hemiptera*; appears and disappears in *Diptera*; while in *Coleoptera*, *Hymenoptera*, *Neuroptera*, and *Lepidoptera*, it is not formed at all, the tubules coming into direct connection with the primary efferent duct. In the males the peritoneal sheath and the special terminal filaments are generally absorbed, and the tubules become spherical. The primary efferent ducts unite

terminally with the secondary ducts if such exist, and at the external end the ducts unite in a median portion.

(*d*) *Herold's duct* is formed independently of the generative organs, from the hypodermis; into it the primary efferent duct opens. At first simple, it soon forms diverticula, receptacula seminis or glands. In female insects the unpaired duct of Herold communicates with the median portion of the primary efferent ducts. In the males of *Collembola*, *Campodea*, *Thysanura*, and perhaps in *Orthoptera* and *Hemiptera* the communication is similar, but in the other insects the duct of Herold forms paired diverticula, into which the primary ducts open, though apparently in earlier stages the direct communication obtains.

(*e*) *Oogenesis.*—The two types (*a*) without and (*b*) with the participation of yolk-cells are described. In (*a*) the nuclei and protoplasm of the tubule are divided into two layers—the outer, with smaller nuclei forming the epithelium, the inner, with larger spherical nuclei, forming the ova, which are differentiated in order from the efferent duct towards the blind end, where a multiplication occurs in those which deposit their ova singly over a considerable period. In (*b*) the yolk-cells which become associated with the ova are found either in a single terminal chamber or in several successive chambers, in each of which an ovum is differentiated. The terminal chamber consists at first of the same blastem as the tubules; the internal nuclei become larger, the superficial remain small; the epithelial layer is separated from the yolk, which may remain undivided or form cells with one or more nuclei. From the protoplasm of the efferent portion, adjacent to the yolk-chamber, a nucleated portion is separated off to form an ovum. The surrounding nucleated protoplasm forms an epithelial envelope. As the portion between the ovum and the terminal chamber increases in length, the first ovum, moving towards the efferent duct, becomes connected with the yolk-chamber by a stalk, and between the two a second ovum is formed, and so on. In *Chironomus* a single yolk-cell, surrounded by an epithelial layer with small nuclei, occupies each chamber. One of the epithelial nuclei, with some protoplasm, separates itself to form the ovum. The process in *Forficula* and *Diptera* is essentially similar. In the others, with multiple yolk-glands, the process is somewhat different. *Labidura gigantea* is chosen as an instructive case. In the terminal portion only one kind of nuclei at first occurs; towards the efferent side some become larger—the future yolk-cells; no epithelial layer is yet present. A large cell with two nuclei—a yolk-cell nucleus and an egg-cell nucleus—is separated off. At the efferent side an epithelial layer arises, which surrounds the binucleate cell. In the multiple many-celled yolk-glands, e. g. of *Bombus*, packets of cells are separated off in the terminal portion, each consisting of an ovum and a number of surrounding yolk-cells. In these cases the ovum cannot be regarded as an epithelial cell, and this epithelial character is, in other cases, of subordinate import. The ovum originates neither from epithelial nor from yolk-cells, but from the original blastem of the reproductive rudiment.

(*f*) *Formation of Lecithin.*—In the protoplasm, at first homogeneous, dark granules appear near the nucleus. These are unchanged by acetic acid, and have been formerly termed protoplasmic granules. After these, *lecithin-granules* are formed, which are clarified by acetic acid. They are at first clear, like spaces filled with a drop of fluid, and gradually assume dark, fat-like contours.

The epithelial cells persist till the eggs are laid, and then disappear. There is nothing to show that the contents of the yolk-cells are taken into the egg.

(*g*) *Disappearance of germinal vesicle.*—In all cases the germinal vesicle becomes invisible. In *Chironomus* it breaks up into drop-like masses before the formation of the spindle. A similar metamorphosis has been described by Blochmann in various *Hymenoptera*, but interpreted in a different way.

(*h*) *Testes.*—The variations in the formation of the testes and in the spermatogenesis are not so striking as in the development of ovaries and ova. In all testes which arise from the differentiation of the reproductive rudiment, cells with large nuclei are developed internally, while round the wall of the tubule a sheath with small nuclei is formed. From the former the sperm-follicle arises; the nuclei divide, the outer form an epithelial layer, the inner grow and divide; the results form sperm-cells.

(*i*) *Comparison of Oogenesis and Spermatogenesis.*—The testicular tubules of insects with a terminal yolk-gland have, at the end of larval life, exactly the form of ovarian tubules. The cells, which represent yolk-cells in the ovarian tubules, become testicular follicles in the testes. When the ova develope directly without yolk-glands, the cells which, in the female, form ova, become sperm-follicles in the male. When the ova arise in the terminal yolk-gland, the yolk, or rather the male-cells in the female, remain undeveloped. The ova arise from cells of another region; the yolk-cells, i. e. the potential male-cells, come to nothing and disappear.

(*j*) *Application to Classification.*—Professor Schneider next considers the relation of the development of the reproductive organs to the general system of the Insecta. Neither this portion of his memoir, however, nor the second special division in which the families are discussed in detail, admit of short summary.

Histogenesis in the Ovigerous Sheaths of Insects.—M. J. Pérez* finds that the young ovary of insects has all its cells identical; that these are indifferent at first, but give rise later to the follicular epithelium on the one hand, and to the ovules and the vitellogenous cells on the other. When there are no vitellogenous cells the ovules result from the direct and successive transformation of some (the axial) of the primitive cells; those at the periphery and surrounding the ovule proliferate, more or less actively, and arrange themselves around the ovule, so as to form a follicular epithelium; these are always distinctly separated from the egg, and do not arise in its protoplasm, as has been asserted by M. Sabatier and M. Wilm.

* Comptes Rendus, cii. (1886) pp. 181–3.

Suitable objects for study are to be found in the Neuroptera, e. g. *Æschna* or *Agrion*, where the ovigerous sheaths are very long, and contain but a limited number of cells. The presence of vitellogenous cells makes no difference to the history of the epithelium, but the ovule is more complex; the indifferent cells of the ovariole, instead of being directly transformed into the ovule, proliferate, and give rise endogenously to a number of cells; this number is constant for the species, and even for a more or less large group. This may be easily seen in the Lepidoptera; but even here the mother-cell does not expel young cells, but they become free in the ordinary manner. In this group also M. Pérez denies the accuracy of Prof. Sabatier's observations.

M. A. Sabatier* answers the criticisms of M. Pérez. He urges that the latter's opinion that the follicular cells are primitively identical with those of the primitive ovules cannot be sustained, when it is known that the former are at first very much smaller than the latter; a study of the ovary of *Musca* or of *Acridium* is sufficient to demonstrate the exactness of this observation. Similarly as to the origin of the nutritive cells, M. Sabatier states that in *Dytiscus* a finely granular vesicle was seen to form in the yolk of the egg, which was identical with the nuclei of the nutritive cells: in spiders and some other forms similar intervitelline nuclei are developed, and they only differ in being absorbed by the egg before instead of after expulsion.

From his observations on the morphology of the ovary of insects, M. Sabatier concludes that the nutritive, like the follicular cells, are elements eliminated from the egg, that they only differ in size and in the time of their appearance, and that there is no reason for establishing an essential difference between insects which have only follicular cells, and those which have also nutritive cells.

In a further note on the elements contained in the ovigerous sheath of Insects† M. Pérez contends that the filament in which the ovigerous sheath frequently terminates, is only the atrophied portion of the sheath primitively filled with cells up to its blind extremity. The elements described by M. Sabatier in this region, are neither ova nor follicular cells. It is only in the ovariole itself, whether it reach the blind end of the sheath or be more or less removed from it, that ova, follicular cells, and so-called "nutritive cells" are found.

The author considers M. Sabatier's description of the formation of the two last sets of cells from the ovum, as perfectly erroneous. He considers it quite impossible to count the number of "nutritive cells" by means of sections. He treats them in the following way: the ovariole is spread out beneath a lens; it is then cut so as to separate an ovum with the surrounding cells from the ovariole; by pressing this portion the cells are set free; the preparation is stained and the cells counted. In this way the author finds three of these cells in *Panorpa*, seven in Lepidoptera, fifteen in Diptera, sixty-three in the bee. The "nutritive cells" described by Sabatier as being

* Comptes Rendus, cii. (1886) pp. 441–3.

† Ibid., pp. 557–9.

separated from the ova, as in Coleoptera, have none of the characters of vitellogenous cells.

Ovary of Insects.*—Ritter v. Wielowiejski finds, from his studies on the morphology of insects' ovaries, that, if the structural characters of the terminal chamber be taken as the basis, they may be divided into three groups.

In the first we have those in which the embryonic cells which, in young stages, are collected at the tip, are all converted into ovarian, vitelline, or epithelial cells; here we have the Diptera, Hymenoptera, Lepidoptera, Geodephaga and Hydradephaga, and the Orthoptera.

The second set contains ovaries the tip of which possesses throughout life a more or less large solid mass of cells (terminal chamber); here we have the Coleoptera (with the exception of the Geodephaga and Hydradephaga) and some of the Aphididæ.

In the third group, which is represented only by the Hemiptera, the tip of the ovaries has above the primitive ova a well-developed mass of cells which functions as the organ of yolk-formation: between its elements there project special root-like processes of the maturing egg-cells.

Heart of Insects.†—Miss Olga Poletajewa finds that the heart of *Bombus* is composed of five separate tubes, which form the chambers of the organ, and that the most anterior of these is continued into the aorta. Each tube narrows anteriorly so as to have the appearance of a truncated cone, while the walls become thinner; posteriorly it enlarges; the anterior end passes into the posterior in front, and each anterior end is so flattened laterally as to form a vertical cleft; the cardiac tubes are thus only united to one another at two points; the free portion forms a duct (ostium) by which the blood from the abdomen enters the heart; the internal surface of the anterior tube, and the external surface of the posterior form pouch-like safety-valves which regulate the movement of the blood. The heart of *Cimbex* is formed in essentially the same way as that of *Bombus*. The writer points out the differences between the accounts now given and those of such entomotomists as Strauss, Newport, and Graber, and describes the mode by which the heart appears to perform its function; contrary to the opinion of Strauss the first chamber does not function alone as the propelling agent, and the ostia are not perfectly closed, so that part of the blood does return to the abdominal cavity.

Further Observations on Optic Organs.‡—Herr J. Carrière gives preliminary notices of the results of his further observations on the structure of eyes.

1. *Double eyes of male insects.*—In two genera of the Ephemeridæ, *Potamanthus* and *Cloë*, the male has, in addition to the pair of eyes which resemble those of the female, a secondary pair of brightly coloured accessory and larger eyes; similar eyes have been examined in the Tipulid genus *Bibio*, and these have been found to differ, at

* Zool. Anzeig., ix. (1886) pp. 132–9. † Ibid., pp. 13–5.
‡ Ibid., pp. 141–7.

first sight, considerably from those of the female; they belong, however, to the same type of aconic eye, and only present a different stage in development.

2. *Aconic and pseudoconic eyes of insects.*—The author does not agree with Dr. Hickson in thinking that the difference between pseudoconic and euconic eyes is slight; on the other hand, he finds that the refractive parts of the aconic and pseudoconic eyes are only extreme forms of one type. The euconic eye is characterized by its vitrellæ passing at their free end into a common conical lens, while the other forms a part of the crystalline cone. In the aconic type the distal end of the vitrella becomes merely cuticularized, and the simplest form is that in which the cornea simply forms a watch-glass-like investment for the distal end of the vitrella; there may be further stages of complication, and the inner part of the corneal lens often breaks up into two dissimilar portions, the inner of which is the softer. A good example is afforded by *Bibio hortulanus*, for here the difference between the parts of the "female eye" are not so much marked as in the "male eye," which is of more complex constitution.

3. *Number and position of the retinula cells of Musca, Culex, and Bibio.* — The author supports Grenacher, as against Ciaccio and Hickson, in finding that the number of retinula-cells correspond to that of the rhabdomere. In *Musca vomitoria* the central retinula-cell has the form of a knife with the edge directed towards the centre of the retinula; the rhabdomere is placed on the edge, and this edge itself is at about its middle converted into a similar substance with it. As Hickson has stated, the nuclei of the other six retinula-cells lie at the distal end of the retinula; that of the seventh cell is not somewhat deeper, but in *M. vomitoria* is at the same level as the other cells. In *Culex* and *Bibio* the central rhabdomere is invested in a layer of pigment.

4. *Ocelli of Diptera and Orthoptera.*—Generic differences in the minute anatomy of the eyes have been detailed; the Orthoptera may have accessory eyes, or they may be rudimentary, or merely represented by simple white spots. Among the Acrididæ the young have bud-like organs which project a little way beyond the surface, and are comparable to the similarly named structures in vertebrates.

Gustatory Apparatus of Coleoptera.* — M. J. Gazagnaire has studied the gustatory apparatus of Coleoptera chiefly in the family Dyticidæ. He finds on the ventral surface of the labrum, and on either side, a conical swelling the apex of which carries a small chitinous "button" which projects into the buccal cavity; these buttons are hollow, their outer surface carries a number of modified hairs, hyaline in appearance, and provided with a central canal. At the base of the hair (at the periphery), there are about six chitinous canaliculi, which are the excretory ducts of unicellular hairs; the hair is distinctly lubricated. The branch of the labral nerve can be traced to the base of the button, into which five nerve-fibrils penetrate.

* Comptes Rendus, cii. (1886) pp. 629–32.

The author comes to the conclusion that, in the Dyticidæ, the swellings with modified hairs, carrying the chitinous buttons covered with special hairs chiefly on their inner contour, which are in relation with muscles that move them, with glands that lubricate them, and with numerous nerves, are the seat of the functions of testing, differentiating, and tasting. Put shortly, the gustatory sense of the Coleoptera may be located in the anterior region of the dorsal wall of the pharynx (labrum).

Salivary Glands of Coleoptera.*—In many Coleoptera the only representative of a salivary gland is the presence of a layer of gland-cells on the roof of the oral cavity; and M. J. Gazagnaire points out a series of forms illustrating the various stages in the development of salivary glands from such a group of gland-cells.

The family *Hydrophilidæ* furnish examples of these stages. The gland may be imagined as being at first represented by an unicellular gland, with a long neck opening into the oral cavity; groups of these cells, opening separately, are found in numerous examples in the order. The pores of these gland-cells may become limited to a certain area, which then becomes either papilliform, or depressed: the latter condition is found in *Hydrocharis flavipes*. This depression deepens and becomes cup-shaped, as in *Hydrocharis caraboides*. The bottom of the cup may have a ridge across it, as in *Hydrobius fuscipes*, which leads on to a bifurcation, and thence to a tri- or quadri-furcate condition; by each of these diverticula subdividing still further, a complicated gland, like that of *Hydrophilus piceus*, is produced. As the sieve-like depression deepens, the originally long necks of the cells become shorter, till in the more complicated glands, the cells, instead of each opening separately, come to be arranged round a lumen, which then serves as a common duct for their secretion.

Meloidæ.†—M. H. Beauregard continues ‡ his researches on Meloidæ. He has examined the buccal organs of about 200 species of vesicating insects, and advocates the corroboration of systematic conclusions, founded on superficial characters, by reference to the structural modifications of these organs, which exhibit great constancy in the various groups.

The various forms of *labrum* are (1) described, and four types are distinguished. He notes (2) the varied structure of the *mandible*, distinguishing maxilla, galea, sub-maxilla and inter-maxilla, and discusses especially the modifications of the last, with its tactile hairs, spinules, &c. Four principal types of mandibles are described and figured. (3) The genus *Pyrota* is selected as particularly well adapted for the illustration of the *maxillary* structures. The inter-maxilla and pre-maxilla, the sub-galea and galea, the sub-maxilla, maxilla, palpiger, and palp are described in order, and the various modifications due to coalescence, &c., are noted. As before, four chief types are distinguished. (4) M. Beauregard derives the tongue ("languette") of the

* Comptes Rendus, cii. (1886) pp. 772–4.
† Journ. de l'Anat. et Physiol. (Robin), xxii. (1886) pp. 85–108 (1 pl.).
‡ See this Journal, *ante*, p. 235.

labium from the fusion of galea and inter-maxilla, and notes the frequent presence in the palp of a fourth *basilar* joint, which is the evident equivalent of the palpiger in the first maxillæ.

Labrum of Hymenoptera.*—M. J. Chatin reports that, when simplest, as in *Larra*, the labrum has the form of a small horny plate, constricted in its middle, and bordered with closely-packed long hairs. After pointing out the various modifications which this part undergoes, the author remarks that the labrum always gives evidence of the presence of a median groove, and this, with the occasional possession of paired and symmetrical appendages, confirms the view that it is originally double, and that it has a close relationship to the other buccal parts. In the more complicated forms there is a basal piece due to the coalescence of the two sub-maxillæ which have fused along the middle line, while the central piece represents the two maxillæ. When present, the two lateral appendages are to be regarded as filamentar palps, which are not directly attached to the maxillary, but have an ovoid button at their base which may be regarded as a palpiger. The central tubercle, when analysed, is seen to be formed of several pieces which correspond to the galeæ and the intermaxillaries. The fundamental constitution of the labrum of two lateral pieces first enunciated by M. E. Blanchard, is confirmed by the study of the Hymenoptera.

Structure and Movements of Sting of Bee.†—M. G. Carlet reports that fine sections of the sting of the bee reveal the presence of a central longitudinal canal, the possession of which increases the solidity without adding to the weight of the organ; similarly there is an increase in size which allows of the teeth of the stylet being sufficiently divaricated (these teeth are useful as assuring the inoculation of the poison by retaining the sting in the wound); along the whole length of the stylet there extends an external groove, the section of which is narrower at its commencement than in the middle; the apparatus is so disposed that the stylet glides along easily without leaving its proper course, and the cleft which separates the two stylets is very narrow.

Morphology of Mouth-organs of Lepidoptera.‡—Herr A. Walter points out that the enormous number of species of Lepidoptera has been a great obstacle in the way of correctly understanding the morphology of their mouth-organs. If we consider the general type of insect mouth-organs we find it to consist of an unpaired labrum, lateral mandibles with horny teeth, and two pairs of maxillæ. The first of these pairs consists of two joints, cardo and stipes, with a many-jointed palpus maxillaris, and, sometimes, an additional squama palpigera; internally are the inner and outer mala. The second pair of maxillæ have their basal parts fused to form a labium, the cardines forming the submentum, and the stipites the mentum; from the latter arise the palpi labiales; the inner malæ form the ligula, the outer the "palps." The remaining parts are unpaired, and are the epipharynx formed by the upper, and the hypopharynx formed by the

* Comptes Rendus, cii. (1886) pp. 632–4. † Ibid., ci. (1885) pp. 89–90.
‡ Jenaisch. Zeitschr. f. Naturwiss., xix. (1885) Suppl. i., pp. 19–27.

lower pharyngeal wall; the former always fuses more or less with the labrum, and the latter becomes connected with the labium, and serves as an excretory apparatus for the secretion of the salivary glands which open at its base. The author next refers to Savigny's well-known account of the morphology of the parts in the Lepidoptera, and reminds us of the objections to it raised by Meinert and Tichomirow. Dr. Walter finds that *Micropteryx* has mandibles which are able to bite, and which have the form of well-developed horny pieces, with strong horny teeth on the cutting edge; somewhat similar mandibles reduced in form are to be found in some other genera of Microlepidoptera. The remaining mouth-parts of *Micropteryx* present us with very primitive characters; the cardo and stipes of the first pair of maxillæ are completely separated, as are also the palps; the outer one presents us with the most primitive condition of the lepidopterous proboscis; the inner one consists of a horny piece which supports the inner parts of the labium. The rudiments of the proboscis do not therefore lie against one another, but are widely separated at the sides of the mouth-opening, and only converge towards their tips. The three-jointed labial palps arising from the mentum have behind them two chitinous plates beset with strong setæ, the free malæ externæ, and between them there is a short, broad tubule. After comparing with these the mouth-organs of allied forms, the author passes to the question of the origin of the gnathites of the Lepidoptera.

Speyer has already endeavoured to ally them to the Phryganidæ, but the space which he recognizes as separating them is not bridged over by *Micropteryx;* Walter, therefore, turns to the Diptera, remembering the sword-shaped mandibles of *Tinea*, the elongated labium of the higher Micropteryginæ, and the presence of true lepidopterous scale in the flies with a long proboscis; the greatest resemblance is to be seen in the lowest Hymenoptera; it is among the Hymenoptera alone that we find imagines with a strongly incised labrum, and in them and butterflies an epipharynx, the base of which is fused with the labium, while the end is free.

To sum up, the Diptera, Hymenoptera, Lepidoptera, and Phryganidæ present a collection of agreeing characters, which are repeated in no other order; the agreement between the first three is most marked, while the last give a direct passage to the lower mandibulate insects. The first three—the representatives of the old group of Insecta sugentia, may be regarded as naturally allied to, and as arising from the Neuroptera through the Phryganidæ. Both the Lepidoptera and Hymenoptera, while widely diverging in their highest forms, present in their lowest a series of characters, which indicate a close connection with such Diptera as have not been specially modified by parasitic, blood-sucking, or other special habits. Further details are promised.

Vitality of Silkworm Ova.*—In answer to a criticism by Prof. Verson,† Prof. L. Luciani reasserts his conclusion ‡ that the hiber-

* Bull. Soc. Entom. Ital., xvii. (1885) pp. 185–91.
† Bull. Mens. d. Bachicoltura, 1885, No. 2.
‡ Bull. Soc. Entom. Ital., xvii. (1885) pp. 71–88.

nating silkworm ova may retain their vitality, that is, their power of further development, though kept for long (152 days) in conditions where respiration is impossible (in CO_2). The various objections of Prof. Verson are answered in detail, and the conclusiveness of the experiments is emphatically defended.

Colour-relation between larva of Smerinthus ocellatus and its Food-plants.*—Mr. E. B. Poulton gives an account of his investigations on this subject.

Numerous experiments were undertaken by him with larvæ captured and with larvæ hatched from five batches of eggs: these were placed, some on one food-plant, others on various other food-plants, and the colour of the larvæ was found to vary according to the colour of the leaves upon which the larvæ rested. The author concludes from these experiments that the colour of the larvæ of *Smerinthus ocellatus* is determined (1) by hereditary influence; (2) by the colour of the leaf upon which it lives, and not by the substance of the leaf when eaten; (3) by individual variation with similarity of parentage, &c., and conditions. In this way the author found that the larva maintains a colour-relation with the food-plant upon which it is hatched, adjustable within the limits of a single life. He points out that this differs from the usual resources in the scheme of larval protection, by resemblance to environment; for whereas, in most cases, natural selection has *finally* produced such a resemblance, which is common to all the food-plants of the larva; in this case the same process has given to the larva a power which enables it to answer, with corresponding colours, the difference which obtains between its food-plants. In the case of Amphibia, fish, &c., the change is due to the environment acting as a stimulus on the nervous system; whilst in the case under consideration the change is due to the absorption and product of pigments, rather than modification of them, when already formed.

Embryology of Muscidæ.†—Prof. A. Kowalevsky communicates the results of his investigations, begun many years ago (1873), of the development of *Muscidæ*.

(*a*) The *segmentation* begins about an hour after the egg is laid; the first two nuclei lie near the pointed anterior pole; the segmentation masses at first lie in the centre, but as they increase in number move outwards to the periphery. Posteriorly, the pole-cells penetrate outwards into the space between the ovum and the vitelline membrane. The others, which exhibit a club-like form, with the pointed end inwards, pass out, dividing as they go, to form the blastoderm-cells, incorporating in so doing part of the peripheral plasma. Some nuclei remain in the interior, forming the yolk-cells. (*b*) *The groove* appears at first ventrally, from the head-end backwards, extending thence over a third of the dorsal surface. The closure also occurs from before backwards. (*c*) *The embryonic membranes* are characteristic only in this (as Graber has noted) that they cover only a small portion of the embryonic tract, viz. the dorsal portion, and that they subsequently

* Proc. Roy. Soc., xl. (1886). See Nature, xxxiii. (1886) pp. 474–6.
† Biol. Centralbl., vi. (1886) pp. 49–54.

directly form the dorsal skin of the larva. Apart from these envelopes, the embryo exhibits in the fifth or sixth hour of its development two layers—the ectoderm and the meso-endoderm of the "ventral plate." With the endoderm the internal yolk-cells have nothing to do.

(*d*) *The splitting of the endo-mesoderm* occurs in the following way:—An anterior ectodermic invagination, forming the fore-gut, presses upon the anterior portion of the internal layer, pushing it into the yolk in the form of a watchglass-like protrusion. This becomes separated from the primitive endo-mesoderm, and forms the anterior half of the endoderm. An exactly similar process occurs posteriorly. The arched portions of the two elevations are turned to the respective ends of the embryo, the margins towards one another. These gradually grow to meet, surrounding the yolk completely. Two outgrowths from the margins of the watchglass-shaped rudiments grow faster and meet sooner than the rest of the endoderm. The yolk-cells still persist, probably loosening the yolk. It must be further noted, in this connection, that the invaginations do not occur directly at, but at a short distance from the poles, so that the inpushed portions of the primitive lower layer does not inclose the exactly anterior and the exactly posterior portions of the yolk, but sinking in, separate these last-named portions from the central mass. The extreme anterior and posterior portion of the yolk is thus not inclosed by the endoderm, but comes to lie between the gut and the body-wall, and is finally incorporated in the mesoderm. (*e*) *The mesoderm* is formed from the remaining portion of the primitive lower layer. It is divided (*a*) into two strands of cells, which lie along the growing processes of the endoderm, and form the musculature of the alimentary canal, and (*b*) of the much larger remaining portion, forming the usual structures.

(*f*) *General comparison.* Here, as in other cases, a kind of long drawn-out gastrula is formed, in which the invaginated portion forms endo- and mesoderm. As in such a case as *Sagitta*, a median invagination—present, however, only at each end—forms the endoderm, while the lateral portions furnish the mesoderm. It might even be suggested that in a gastrula so much drawn out as that of insects, the median (endoderm) sac is not unnaturally absent in the middle, and is present only at either end. Prof. Kowalevsky pursues the comparison further, both with *Sagitta* and with the higher Crustacea, showing how the formation of the endoderm may be indeed referred to the same process, viz. to a simple gastrulation.

Optic Ganglion of some Dipterous Larvæ.*—M. H. Viallanes, in his third memoir on the sensory organs of Articulates, discusses the optic ganglion of some dipterous larvæ. He finds that the very complicated visual apparatus of the adult insect is completely present and functionally active in the larva; it is not, however, quite so completely developed, and it is entirely hidden below the muscles and integuments. It consists of three chief parts—the imaginal disc of the compound eye, the nerve-trunk, and the optic ganglion.

The disc is formed like other discs; it has an investment which

* Ann. Sci. Nat.—Zool., xix. (1885) Art. No. 3, 32 pp. (2 pls.).

will disappear when metamorphosis takes place, an ectoderm, and an endoderm. The ectoderm is divisible into an optogenic and a non-optogenic region; the former contains large fusiform cells which are regularly arranged, and are destined to form the elementary eye—these are the optogenic cells; with each of them a nerve-cord is connected; the post-retinal fibres pierce the basal or internal limiting membrane of the optogenic region, and passing backwards form a thick layer; morphologically they are comparable to the mesoderm of the ordinary discs; they then become arranged in a cylindrical bundle (nerve-trunk) which passes to the optic ganglion. The optic ganglion lies between the nerve-branch and the optic nerve, and is formed of the same essential parts as in the imago, but these instead of being separated from one another, are so closely packed as to give the ganglion the appearance of a globular mass; the medullary masses and chiasmata are placed in the centre, while the ganglion masses are peripheral in position. The optic nerve arises from the two constituent capsules of the internal mass, is very short, and is entirely hidden; it is formed of two perfectly distinct bundles, one, superior, which passes to the anterior region of the brain; and one, inferior, which goes to the lateral parts. The optic ganglion is invested in a double neurilemma, which is continued on from the cerebral investment; between it and the nervous tissues there are to be found parts epithelial in character, which probably play an important part at the moment of metamorphosis; the perilaminar portion is in the form of an epithelial band which occupies a deep groove on the surface of the ganglion, while the intra-ganglionic portion is placed in the posterior part of the ganglion, and is superficial for a small portion only of its extent.

Anatomy of Psyllidæ.*—Dr. E. Witlaczil describes the external form of these insects, which calls to mind that of the Cicadellidæ. The head is well developed, the thorax, which contains the musculature for flying and springing, is strong, but the abdomen is comparatively weak and somewhat elongated; in the last there is the typical number of ten abdominal segments, one of which, as in many other insects, appears to strengthen the thorax; in the penultimate (male), or ante-penultimate (female), there are appendages which correspond in number and form to those of many other insects. There are greater differences in the form of the larvæ than of the imagines, and this is probably due to their parasitic mode of life; as a rule, the body is compressed dorsoventrally, broad, pretty thick, and well rounded off. There appear to be generally four larval stages which are separated from one another by ecdyses.

The skin, the fat-body, and the musculature agree generally with those of the Aphides; wax-glands of altogether similar function to those of the gall-dwelling Aphides are to be found around the anus of the larvæ, and of the adult imago, and as in them, they owe their origin to cells of the hypodermis. In a large number of larvæ peculiar hair-like structures of various forms, which the author calls wax-hairs, are to be found on projections of the integument; these

* Zeitschr. f. Wiss. Zool., xlii. (1885) pp. 568-638 (3 pls.).

are not secreted by processes but by gland-cells. Rather thick hairs, found on the peripheral portion of the dermal region, on the rudiments of the wings, and most numerously at the hinder end of the body, are seen in *Psyllopsis* to be of two kinds; some have a wide lumen and thin walls, the other a much narrower lumen and very thick walls; they differ in form in various genera. The tracheal system is difficult to make out in the imagines, but much easier in the larvæ; in the latter there are nine pairs of stigmata; these lead into short trunks which are not much thicker than the branches, into which they soon break up; their distribution is described in detail. As in the Aphides, the tubes consist of a layer of fused cells, which secrete the spirally thickened chitinous cuticle. The apparatus for closing the stigmata is described, and the account does not correspond with that given by Landois; the author thinks that we have to do with an arrangement which is involuntary.

The external structure of the nervous system of the Psyllidæ resembles that of the Aphides, and consists of the same parts as in other insects; internally are the fibrous masses which follow a very complicated course, but finally terminate at one end in a sensory organ or a peripheral nerve, and at the other in the cortical layer, in the cells of which they end. The author was unable to find the masses of cells in the interior of the brain, which have been described by Berger. He agrees with Michels in denying the existence of a dotted substance, the appearance of which is ascribed to the fibres which are cut through in sections. The digestive apparatus is somewhat more complicated than in the closely allied Aphides, forming loops as in the Coccidæ and some Cicadidæ; the suctorial apparatus, however, is exactly on the type of that of the Aphides. The dorsal vessel, and the pseudo-vitellus (secondary yolk of Metschnikoff) are as in Aphides; but the latter is of a brown colour. After describing the generative apparatus, to which in many points the same remark applies, the author concludes by discussing the genetic relationships of the Psyllidæ.

By their internal characters, as well as by the fact that the male and female differ little externally, the Psyllidæ stand nearest to the Cicadellidæ; the Aphides may perhaps be similarly referred; but certain forms have become markedly adapted to their parasitic mode of life, and especially the apterous generations which live in galls. The most primitive types must be those winged parthenogenetic females which most resemble the males, which most closely resemble one another in the different species, and which approach the males in the form of the body, wings, accessory eyes, antennæ, &c. The Chermetidæ present similar relations to the gall-dwelling Aphides; here we have winged parthenogenetic females which are like those of the Aphides, but no winged males; the last are either apparently wanting, as in *Chermes abietis*, or, as in *Phylloxera quercus*, and *P. vastatrix*, as also in many Pemphiginæ, they are, like their proper females, quite small and apterous. In some anatomical points the Chermetidæ appear to form a passage from the Aphides to the Coccidæ; the latter differ so much from the rest of the Phytophthires that we must perhaps suppose that they had a special origin from the

Aphides. In the complete adaptation of the females to the parasitic mode of life we may find a parallel in certain Crustacea.

Morphology and Anatomy of the Coccidæ.*— In a subsequent essay, Dr. E. Witlaczil treats of the morphology and anatomy of the Coccidæ. He commences with an account of their metamorphosis; the larva, when it escapes from the egg, is more delicate than in later stages, and males are scarcely to be distinguished from females; in later larval stages the female is, as a rule, broader and plumper; as in allied groups, the female undergoes only an incomplete metamorphosis, while that of the male is almost complete. Metamorphosis does not take place, as Bouché stated, in a special web, but in the ordinary shield; the traversed statement appears to owe its origin to a misunderstanding of the investment, which is formed by wax-hairs, having been taken for a web formed by a spinning gland. During development the digestive apparatus undergoes retrograde metamorphosis, and the intestine degenerates; in consequence of this the larvæ are, in their two later stages, quiescent. The rudimentary antennæ and legs are cast off, and quite new organs are gradually formed by the hypodermis; in place of the one pair of small, two pairs of larger but simpler eyes are developed, and with their appearance the brain becomes larger.

The unicellular dermal gland produces secretions of far more various kinds than in the Aphides, or even in the Psyllidæ; they most often cover the animal and its eggs, and so act as defensive organs. Wax is not secreted at first; when it begins to appear it does so at the anterior and hinder edge, but soon spreads over the whole periphery of the body; the filaments are generally quite thin, are wavy, looped, or zigzag in arrangement. These filaments make a common mesh, and so give rise to the shield, which is generally much larger than the body.

The tracheal system, which is carefully described, agrees generally with that of the Aphides, Psyllidæ, &c.; the inconsiderable lumen of the stigma is still further narrowed by chitinous processes; the tracheal system of the Chermetidæ is noticed, and is stated to be very like that of the Aphides, while it approaches that of the Coccidæ in the diminution of the number of stigmata.

The generative organs of both Coccidæ and Chermetidæ are described; in the latter the parthenogenetic females of *Chermes abietis* give rise to two colour varieties, one of which is bright yellow, the other almost black; their eggs are developed in the same way as in the Aphides, but take a rather longer time (about a month). The sucking-apparatus of the Coccidæ and of the Chermetidæ closely resemble that of the Aphides; the digestive organs of the former have been well described by Mark; the two groups approach one another by the possession of multilobate salivary glands and both differ from the Aphides in having a sack at the base of the labium, which is formed by the hypodermis, and has thin but somewhat strongly chitinized walls.

* Zeitschr. f. Wiss. Zool., xliii. (1885) pp. 149–74 (1 pl.).

β. Myriopoda.

Morphology of Chilopoda.*—Dr. E. Haase, after a short review of the work of his predecessors, reminds the reader that in 1880 he proposed to distinguish the Scutigeridæ and Lithobiidæ from all other Chilopods as C. *anamorpha*, in which there is post-embryonal development, whereas the rest, which leave the egg with all the segments and appendages of the adult, are *C. epimorpha*. He has carried this further by deriving the Scutigeridæ from a hypothetical *Protolithobius*-form, and, to use Meinert's term, by regarding them as peripheral forms. The study of Indo-Australian Chilopods in the Berlin Museum has led to the discovery of a new genus—*Cennatobius* (*C. martensii* sp. n.), which will form a new family of the *C. anamorpha*, and stand between *Henicops* and *Scutigera*. He points out the essential characters of the new genus, and urges that it represents the hypothetical Protoscutigerid which was necessary for the phylogenetic tree which he has propounded.

Respiratory Apparatus of Chilopoda.†—M. J. Chalande gives a short summary of the facts that are known concerning the respiratory system in the Myriopoda, and describes this system in the Chilopoda of France.

Whilst most of the forms possess tracheæ, opening to the exterior by means of stigmata placed on each side of the body, between tergite and sternite, some, on the other hand, have a series of dorsally placed masses of tubules, which he calls "lungs," opening by stigmata between the tergites in the middle line; the former he calls Tracheate Chilopods, the latter Pulmonate Chilopods, and includes only one genus described in this memoir—*Scutigera longipes*, which is regarded as uniting the Myriopoda with Arachnida. Of the tracheate forms he describes *Geophilus electricus*, *Himantarium gabrielis*, *Scolopendra hispanica*, *Cryptops hortensis*, and *Lithobius forficatus*. There may be a pair of stigmata in each segment, except in the cephalic and two anal segments, the tracheæ springing from which form two distinct networks, dorsal and ventral, as in *Himantarium* and *Geophilus*; and in these there is a "substigmatic pouch," without a spiral marking, into which each stigma opens. In the other three genera the stigmata occur on segments 3, 5, 8, 10, 12, and so on, up to six pairs in *Lithobius*, or nine pairs in the other two genera; in *Scolopendra* the tracheæ anastomose and form a single network amongst the viscera; whilst in the other two the tracheæ are independent: *Cryptops* has a substigmatic pouch.

Morphology of Scolopendrellæ.‡—A brief notice has been published of a memoir by Prof. B. Grassi on the morphology of *Scolopendrellæ* and their phylogenetic relations to insects and Myriopods. The specific characters of four species, one of them newly discovered by Grassi, are given, the geographical distribution is discussed, and

* Zool. Anzeig., viii. (1885) pp. 693-6.
† Bull. Soc. Nat. Hist. Toulouse, xix. (1885) pp. 39-65 (2 pls.).
‡ Atti R. Accad. Sci. Torino, xxi. (1885) pp. 48-50.

the anatomy of the various systems is described in detail. This interesting form, which Grassi regards as a primitive type, is compared with various Myriopods, with *Peripatus*, and with insects, but a report of his conclusions must be deferred till the publication of the original memoir.

γ. Prototracheata.

Peripatus.*—Dr. E. Gaffron follows up his previous research on the anatomy and histology of *Peripatus* by a description of the reproductive organs. The species studied was *P. Edwardsii*.

A. *The female reproductive organs* consist essentially of two cylindrical tubes, whose cæcal ends form the ovaries, and the remaining portions—the oviducts, seminal receptacles, uteri, and vagina. The two ducts are in communication close to the ovary, and at the vulva. The ovary is attached, in the dorsal median line, to the pericardial septum by a *ligament*, which consists of two flat muscular bands, enveloped by peritoneum, and is to be regarded as a drawn-out portion of the septum. The lumen of the ovarian tubes is lined by germinal epithelium, seated on a homogeneous tunica propria. The ova are surrounded by a distinct, but thin follicle, with few nuclei. Outside the tunica propria is a layer of longitudinal muscular fibres, and outside this a peritoneal sheath, from which the tracheæ penetrate inwards between the muscles. The *oviducts*, at first in communication in a transverse cavity at the end of ovary, at once assume a longitudinal course, and exhibit, at a short distance from their origin, a horseshoe-shaped diverticulum. The development of this structure—the *receptaculum seminis*—is described. It forms in the adult a compressed spherical vesicle, with two ciliated ducts; it is enveloped in a loose, chitinous, peritoneal sheath, inside which a muscular layer, a tunica propria, and a varied internal epithelium are observed. Spermatozoa were observed in the oviduct near the entrance of the two ciliated canals. The ovary is pushed forwards by the ducts, and exhibits notable changes of position. The ligament exhibits a corresponding increase in length, measuring in the adult as much as 1 cm. It is interesting to note how in insects, the ovarian tubes are similarly connected with the pericardial septum or with the heart by means of the terminal filament, which is thus homologous with the ligament in *Peripatus*. Dr. Gaffron points out the increased interest of this, in the light of Schneider's observation, that in insect larvæ the genital rudiment originates from a fibre of the so-called "alary musculature" of the heart.

B. *The male reproductive organs.*—While agreeing in general with Moseley's description of the male reproductive organs in *P. capensis*, Dr. Gaffron maintains that the proximal, tubular portion is not a "prostate" gland, but really part of the testis, and indeed the essential sperm-producing part. In the young *Peripatus*, the tubular portion in no way appears as a subordinate appendage of the vesicle, but the latter seems merely constricted off from the former.

* Zool. Beitr. (Schneider), i. (1885) pp. 145-63 (3 pls.).

Histology.—(*a*) The tubular portion of the testes is lined by a homogeneous, nucleated membrane, without distinguishable cell-boundaries, while the vesicular portion is lined by a characteristic pavement epithelium. The muscular layer is also much more distinct in the latter portion. (*b*) In the spermatogenesis the following stages are distinguishable: (1) large "spermatospores" or "Samenurmutterzellen"; (2) separate "spermatoblasts" or "Samenmutterzellen," resulting from the repeated division of the former; (3) immature sperms, with nucleus elongating to form the middle portion, and with protoplasm forming the long tail. A small protoplasmic remnant, of unknown import, persists for long near the anterior end. (*c*) The vasa efferentia arise, with a very narrow neck, from the vesicular testis, are closely coiled, and enveloped in a muscular peritoneal sheath. (*d*) The unpaired portion of the male ducts, the vas deferens, has the striking length of 7 cm., and exhibits three distinct portions—(1) a thin walled portion containing a mass of loose sperms; (2) a middle region in which the spermatophor is found; (3) a terminal, markedly muscular ductus ejaculatorius. All three portions exhibit a peritoneal sheath with tracheæ, a muscular layer, a tunica propria, and internal epithelium. The middle region, which is lined with well-developed cylindrical epithelium, and with distinct cilia, contains the long, cylindrical spermatophor. This consists of a central rod of agglutinated spermatozoa, surrounded by several protective sheaths, some of which, at least, owe their origin to the epithelium of the vas deferens. Near the proximal end, the originally simple sheath of the spermatophor tube splits into two, while the epithelial cells of the vas deferens becomes more markedly cylindrical, and exhibit cilia and granular contents. About 1 cm. from the end the spermatophor canal widens out, compressing the enveloping sheaths. Between the first and second of three to five similar swellings, some of the epithelial cells of the vas deferens are peculiarly modified; the nuclei increase, spherical secreted bodies ("Secretkugeln") are formed, the cells become distinctly glandular, and the ciliated cells are much compressed. The secreted balls enter the vas deferens and form a layer round the spermatophor. None are formed after the second expansion. The spermatophor seems to be shifted periodically forwards for a distance equal to that between two enlargements, and thus successive portions are enveloped by the products of the glandular cells.

C. *Crural Glands.*—While Moseley found crural glands on all legs of *P. capensis*, both in male and female, these structures were altogether absent in the female *P. Edwardsii*, and were present only in some segments of the male. Dr. Gaffron describes the appearance and distribution of these glands, which he regards as ectodermal invaginations.

D. *Anal Glands.*—The male is further characterized by the possession of a pair of glandular tubes in the anal region. They open ventrally on each side of the anus, and are doubtless identical with those noted by Moseley as "accessory generative glands." Each gland exhibits a distinct ectodermal and endodermal portion, separated

by a constriction, presumably regulating the flow of the secretion. The structure of the gland is described in detail.

E. *Bean-shaped Organ.*—On all the legs of both male and female, Dr. Gaffron has found a small, hitherto overlooked, bean-shaped organ. It is situated on the upper side of the legs near the apex, just before the stalk of the claw, sunk in a smooth fold of the epidermis. Muscle-fibres and nerves are fixed, like an umbilical cord, to the concave side. The organ is surrounded by a cuticle of modified epidermis cells, has no external opening, and though the cells have a glandular appearance, is more probably of a sensory nature.

δ. Arachnida.

Coxal Glands of Arachnida.*—Prof. P. Bertkau reports that in a specimen of *Atypus* he has been able to find a distinct efferent duct for the coxal gland; it is surrounded by the same fibrous plexus as the gland itself; in six other specimens the duct was not to be found, though the orifice was seen. This rare phenomenon may either be explained by supposing that there was an abnormal retention of an organ which is in other cases absorbed, or it may be suggested that in adult examples the efferent duct is regenerated from time to time; in which case the coxal gland would not be a rudimentary organ, but one that is intermittently functional; the constant presence of the orifice is an argument in favour of the latter hypothesis. It is important to note that the orifice appears on two segments, for this indicates a repetition of the glandular organ, and is *pro tanto* a support to the view of Ray Lankester that the coxal glands of Arachnids and of *Limulus* are the homologues of the segmental organs of *Peripatus*. The author suggests that the gland at the sides of the prothorax of *Anisomorphus buprestoides*, and those found by Scudder in the Phasmidæ, are possibly representatives of the same gland. In *Mantis religiosa* there is a coiled gland at the hinder side of the fore-leg.

Classification of Spiders.†—Prof. T. Thorell discusses the classification of the Araneæ proposed by Dr. Bertkau. While recognizing the value of his services to this perplexing subject, Thorell looks on the chief group Tetrasticta and Tristicta, and some of the subsidiary divisions as artificial rather than natural units, and he thinks that too much importance has been attributed to some of the internal parts of spiders, and especially to their tracheæ. Thorell regards the order Araneæ as divisible into the two sub-orders of Tetrapneumones and Dipneumones; the former contains the tribe Territelariæ; the latter the Tubitelariæ, divisible into Cribellatæ and Ecribellatæ; the Retitelariæ; the Orbitelariæ, divisible again into Cribellatæ and Ecribellatæ; the Laterigradæ; Citigradæ; and Saltigradæ.

Mites.‡—Dr. G. Haller has notes on *Cytoleichus sarcoptoides* in which he has particularly been able to study the gnathites; on

* SB. Niederrhein. Gesellsch., 1885, pp. 13–6.
† Ann. and Mag. Nat. Hist., xvii. (1886) pp. 301–26.
‡ Zool. Anzeig., ix. (1886) pp. 52–5.

Tetranychus molestissimus of the Argentine Republic, a species allied to, if not similar with which appears to be the cause of the Port-natal-sicht, and possibly of the erythema autumnale which obtains in South France; on *Halarachne halichœri* which has, notwithstanding Kramer's failure to detect it, an eight-footed nymph-stage; and on *Halacarus gossei*, a new species which is parasitic on worms and Synascidians; it is a true Hydrachnid, though it has ordinarily been regarded as an Oribatid; it resembles the Hydrachnidæ in the form of its gnathites; what earlier authors, e. g. Grube, took for the stigma is really the eye. Dr. Haller remarks that he has recently had an opportunity of examining *Pontarachna punctum*, and that it is very closely allied to *Hygrobates longipalpis*.

Acari of the Genus Glyciphagus.*—Mr. A. D. Michael, during some investigations on mole's nests, discovered two new species of *Glyciphagus* among the dried grass, &c., forming the nest; they were not found on the animal itself, nor in disused nests. The genus was founded for certain Acari which feed on fruits, and the author refers to the work by Famouse and Robin,† wherein the genus is defined; and he draws attention to the various points of difference exhibited by the males and females of the two new species, *G. platygaster* and *G. dispar*. In the former the difference between the two sexes is not more marked than is usual in the genus; but in *G. dispar* the difference is almost specific in degree, and had it not been that the author was able to find them in the act of copulation, he would have considered the two sexes as specifically distinct; the male is deprived of the long hairs and spines characteristic of the genus, and is proportionately much broader than the female. The author obtained proof, from the same observations, that the supra-anal papilla in the female, is, as he had surmised, the *bursa copulatrix*. The characters of the male, female, and nymph of the two species are then given in detail.

ε. Crustacea.

Abyssal Decapod Crustacea of the North Atlantic.‡—Mr. S. I. Smith reports on the deep-sea Decapoda collected by the 'Albatross.'

Altogether 130 species were taken, but only 44 were found at depths below 1000 fathoms. The first question which arises is, which of them actually inhabited the bottom; fifteen of them—that is the two Brachyura, the seven Anomura, the Eryontids, Crangonids, and Glyphocrangonidæ among the Macrura are unquestionably inhabitants of the bottom; it is doubtful whether those that are here grouped together as Miersiidæ are deep-dwellers, they are among the most common characteristic forms taken in trawling at great depths, while the structure, e. g. the highly developed black eyes, the comparatively *small* eggs, and the firm integument of *Acanthephyra agassizii* and *A. eximia*, are some evidence that they do not normally inhabit the

* Journ. Linn. Soc. Lond., xix. (1886) pp. 262–82.

† Journ. Anat. et Physiol. (Robin), iv. (1867) p. 568 (2 pls.).

‡ Ann. and Mag. Nat. Hist., xvii. (1886) pp. 187–99; abstracted from 'Report on the Decapod Crustacea of the Albatross,' and published in advance.

bottom. *Pasiphaë* and *Parapasiphaë* seem to be abyssal species, but to be free-swimming; the eight species of Penæidæ which are in the list are undoubtedly free-swimming forms not confined to the immediate region of the bottom, but their relatively small eyes and well-developed ocular papillæ indicate that they are deep-water, if not abyssal species.

The author provisionally groups the species into four classes: 1. Species inhabiting the bottom or its immediate neighbourhood. 2. Species probably not confined to the immediate neighbourhood of the bottom, but showing structural evidence of inhabiting abyssal depths. 3. Doubtful, but probably inhabiting abyssal depths. 4. Species probably not inhabiting abyssal depths.

Many of the species are remarkable for their large size, and there are none that are very small; many are large members of, or even giants in the families to which they belong. The colour of the abyssal Decapoda is very characteristic; a few species are nearly colourless, but most are of some shade of red or orange; bright markings were not seen in any species from below 1000 fathoms. The structure of the eyes is of the highest interest, and worthy of the most minute and careful investigation, but Mr. Smith has not yet been able to make it. He gives, however, the results of a "superficial examination of the external characters of the eyes." The simplest and most direct form of the tendency to modification is seen in the gradual reduction in the number of the visual elements. Sometimes the eyes are highly modified (as in *Pentacheles*), and here all the species have probably been long inhabitants of deep water; when the eyes are less modified, or obsolescent, the species are much more closely allied to shallow-water forms. Many Decapods have the eggs large in size and small in number, but this is not true of all; when the eggs are large development is, as in *Bythocaris leucopis*, abbreviated.

Revision of the Astacidæ.*—Mr. W. Faxon, working on this group as represented in the Museum at Harvard, adopts the division of the family *Astacidæ* with the sub-families *Potamobiinæ* and *Parastacinæ*. The first sub-family comprises forms occurring in Europe, Asia, and North America; and include the two genera *Astacus* and *Cambarus*. Of the genus *Astacus*, fourteen species are described; these are widely distributed over Western North America, over the western portion of the Europeo-Asiatic continent, and over Eastern Asia. The genus is not known in Siberian rivers flowing into the Arctic Ocean, nor between Lake Baikal and the Ural Mountains. Of the genus *Cambarus*, fifty-two species are described, all of which are confined to America, with the exception of one blind species occurring in the caves of Carniola. The description of the *Parastacinæ* will appear in a second part.

'Challenger' Schizopoda.†—Professor G. O. Sars reports that the collection of Schizopoda made by H.M.S. 'Challenger' was both

* Mem. Mus. Comp. Zool. Cambridge, x. (1885).

† Report of the voyage of H.M.S. 'Challenger,' xiii. (1885) 228 pp. (38 pls.).

large and instructive, several remarkable new types having been discovered, and light thrown on our comprehension of the morphology of the group, and its relations to other Crustacea. The author regards the group as forming a sub-order of the Decapoda, and as being the most primitive of known Podophthalmata; the most highly organized members form the family of the Lophogastridæ, and the Mysidæ are the lowest; the Eucopiidæ are most remarkably distinguished from the Lophogastridæ by the structure of their legs; contrary to the opinion of Boas, Sars includes the Euphausiidæ among the Schizopods. Then follow useful definitions of the families, among which are 31 genera; 57 species are reported on. At the conclusion of the report on the Euphausiidæ the author enters with some detail into the history of the development of that family, giving careful descriptions of the various stages or forms which have come under observation.

Crustacea Parasitic on Arctic Tunicata.*—Dr. C. W. S. Aurivillius finds that the Ascidians collected during the voyage of the 'Vega' had amphipodan and copepodan parasites. Of the former, *Andania pectinata* and *Aristias tumidus* were found only at Spitzbergen and Greenland; of the nine Copepoda, six are new to science; of those already known *Idya furcata* was as commonly found living freely as parasitically; for four of the new parasites two new families have been formed; one, that of the Enteropsidæ, contains two new genera, *Enteropsis* and *Haligryps;* they are most nearly allied to the Ergasilidæ, and the former has the feet simple, and the body vermiform, while the latter has biramose feet deprived of natatory hairs. The second family have manducatory mandibles, and are allied to the Notodelphyidæ; it has been called that of the Schizoproctidæ, and is distinguished by two sacciform folds, which are perfectly separated at the bases, the thorax is very high and compressed, while the abdomen is cylindrical: the only species was found in a *Phallusia* from Spitzbergen.

Anatomy of the Cytheridæ.†—Herr A. Kaufmann gives a detailed account of the work of previous authors; the means of determining species, &c.; and describes minutely the shell and other external features in three species of *Cythere*, more especially *C. jonesii* Baird.

The shell of the latter is very thick, and ornamented with various knobs and processes; it is of the usual bivalve character, the two valves together having a diamond shape; the two valves are opened by means of a ligament along the dorsal line, and are closed by a muscle passing through the body and inserted in each valve at about its centre. The body, attached along the line of the ligament, is divided into thorax and abdomen by a transverse chitinous fold on the ventral surface. The mouth is provided with prominent upper and lower lips. It is pointed out that one of the characteristics of the Ostracoda is the correspondence in the number and simplicity of the appendages with those of the Metanauplius.

* Bull. Soc. Zool. France, x. (1883) pp. 281–2.
† Recueil Zool. Suisse, iii. (1886) pp. 131–205 (6 pls.).

From the structure and mode of articulation of the first antennæ, the author considers that they are not functionally locomotor, but rather tactile organs; although in the allied genera *Cypris*, *Cypridina*, and *Halocypris*, these appendages are used for swimming. The second antenna consists of four joints, and is bent upon itself; this is the chief swimming appendage, since the legs are used chiefly, if not entirely, for walking on the mud at the bottom of the water; on the third joint is a small papilla, probably an olfactory organ. Rising from the base of the second joint is the flagellum or "sting," of some authors, which is characteristic of the family; it is usually said to be in connection with a poison-gland, but although in an allied genus *Sclerochilus*, the author was able to find a gland with a duct opening at the distal extremity of the flagellum, he was unable to find either gland or duct in any of the eight species of *Cythere* examined for the purpose. The use of the flagellum is obscure. As an organ of defence it appears useless, since the shell, thick-coated in *C. jonesii* with carbonate of lime raised in knobs, closes upon the slightest touch, and is itself a sufficient protection from preying animals. It may have something to do with obtaining food; in those Ostrocoda which live on the remains of other water-animals, this flagellum is stunted and therefore is of no use as a means of catching or killing prey, even if the food had to be obtained by such means. The author is at present unable to offer a solution on this point. The mandible consists of a biting portion, and a tactile portion or palp carrying on its outer side a small branchial portion. The maxilla is chiefly a branchial lamella, with a small portion in relation to the mouth.

The copulatory apparatus of the male is of extraordinary size and of great complexity. Essentially it consists of a "basal plate," or rather a triangular and quadrangular plate fused, resting on each side of the abdomen. The posterior, upper angle is drawn out into a sharp spine. Articulating with the anterior lower part of this basal plate, is the organ which serves to clasp the abdomen of the female. This "clasping plate" is roughly an elongated triangular plate, the posterior lower angle of which is produced so as to form a sharp, slightly hooked process, characteristic of *C. jonesii*. At the articulation of this clasping plate with the basal plate is a medley of chitinous bands and knobs, serving for copulation; at the apex of one of the spines is the opening for the *vas deferens*, and it is this spine which is inserted into the vagina of the female. In the female there are two pairs of openings in the posterior of the abdomen; of these the hinder pair are the apertures of the two oviducts, whilst the other two pores are the "vaginæ," and lead into a canal in communication with the seminal vesicle.

After describing *C. jonesii*, the author gives a shorter description of *C. antiquata* and *C. quadridentata*.

In *Sclerochilus contortus* a gland and duct are found at the base of the second antenna. The copulatory organ is uncoloured, and the "clasping plate" is relatively much smaller than the "basal plate."

In the female the openings of oviduct and vagina on each side are quite close together, and surrounded by a common chitinous ring.

At the end of the memoir a classificatory table is given of the family *Cytheridæ* for the determination of the genera.

Vermes.

Vascular System of Annelids.*—M. M. Jaquet commences by giving an account of the vascular system of various Hirudinea:—*Hirudo medicinalis, Aulostoma, Nephelis, Pontobdella verrucosa,* and *Clepsine; Lumbricus terrestris* is the selected type of Oligochætes; and the Polychæta are represented by *Arenicola piscatorum, Terebella meckelii, Spirographis pallanzanii, Protula intestinum, Nephthys scolopendroides, Nereis, Siphonostoma diplochaïtos,* and *Hermione hystrix.*

This comprehensive survey reveals profound modifications in the vascular system of animals which, according to the author, some zoologists have grouped as Annelids, and is sufficient to justify an expression of opinion as to the relationships of these forms with one another. As is well known, the position of the Hirudinea has been the subject of many controversies; M. Jaquet concludes that they form a very distinct sub-class of the Chætopoda; the lowest grade of the circulatory system is seen in the Rhynchobdellidæ; if perfection were the result of quantity *Hirudo,* which has four large canals well developed, would be the highest, but *Pontobdella* by the possession of verrucæ on its skin, the processes of which play an important part in the act of respiration, and *Branchellion* with its functional if not morphological gill-processes, urge their claims to this place. It is not the size but the differentiation of a system which marks the systematic position of its possessor; when there are sinuses the division of labour is least marked, and *Clepsine* is therefore the lowest of the Hirudinea. In passing his final judgment on the relative positions of *Pontobdella* and *Hirudo* the author awards the palm to the latter on the ground that the former appears to have a small sinus at its anterior end.

The differences between the Polychæta and the Hirudinea are very marked, the former being without the lateral canals which are found in leeches, and the leeches have no lateral canals of the ganglionic chain such as are found in marine worms. It is easier to institute a comparison between Polychæta and Oligochæta; if we take *Arenicola piscatorum* and the earthworm we find that both have a dorsal canal attached to the dorsal surface of the digestive tract and passing anteriorly into the region of the cerebral ganglion; they both want lateral, but both have neural canals; *Arenicola* wants the "hearts" which are found in the earthworm, but has instead a contractile dilatation in the anterior portion of the dorsal vessel. In the earthworm the intestino-tegumentary vessel arises from the dorsal, gives off a number of branches to the œsophagus and pharynx, and irrigates the stomach and the glands of Morren. In *Arenicola* the expansion which is regarded as the heart, and which

* MT. Zool. Stat. Neapel, vi. (1885) pp. 297–398 (3 pls.).

is largely formed from the dorsal vessel, gives off a branch which extends along the œsophagus to the pharynx, irrigates the organs of unknown function which are placed at the base of the gullet, and passes into the ventral vessel; the subneural vessel into which it passes in *Lumbricus* being wanting in the marine worm.

The author suggests that the two separate subintestinal vessels which are found in *Arenicola* may represent the primitive condition of the single ventral vessel of the earthworm, in which case the ventral of the former becomes the homologue of the subneural of *Lumbricus*, and the homology between the "hearts" becomes more complete. Other differences are due to the presence of gills in the marine forms, the essential points in the disposition of the vessels appear to be the same for both.

Germ-layers of Clepsine.*—Dr. C. O. Whitman, after noticing briefly the various contributions to the embryology of the Hirudinea which have appeared since his first paper (1878) on the embryology of *Clepsine*, gives an account of some organs on which he has been able to make more satisfactory observations.

He finds now that of the eight rows of "neuroblasts" only the two median give rise to the nerve-chain; the outer row of either side probably give rise to muscular elements, while the two intermediate form the nephridia. The ganglionic-chain developes from before backwards; the nerve-collar and the supra-œsophageal ganglia are certainly formed from cells that lie beneath the epidermis, and not from a thickening of the epidermis itself.

The epithelium of the archenteron arises from free nuclei belonging to the three large blastomeres, and those which line the œsophagus are the first to appear; some of their products give rise to the salivary glands. The sense-organ of the lip appears as bulb-like thickenings of the epidermis. Larval gland-cells formed from epidermal thickenings (and apparently confused by Nusbaum with the originating nervous system) have the function of fixing the young to their mother, before either sucker is sufficiently well developed to do this.

Genital System of Pontobdella.†—M. G. Dutilleul gives a description of the genital apparatus of *Pontobdella muricata*. The male pore is placed on the ventral mid-line between the second and third rings of the clitellum: the female pore between the fourth and fifth rings. On each side are six testes connected with a longitudinal vas deferens, which anteriorly opens into a seminal vesicle: this is twisted like a corkscrew, and has muscular walls. From this vesicle a curved duct, with thick muscular walls and glandular epithelium, leads into an ovoid "spermatophoral pouch," which is lined by unicellular glands placed radially to the lumen. From this pouch a short duct passes medially to meet its fellow of the opposite side, and the common duct thus formed opens to the exterior. The female system consists on each side of a "tubular ovary with a delicate muscular wall"; the lining of which gives rise to ova and to nutritive cells. The ovary

* Zool. Anzeig., ix. (1886) pp. 171–6.
† Comptes Rendus, cii. (1886) pp. 559–62.

becomes narrowed anteriorly to form the oviduct: the two oviducts soon unite to form a short canal to the exterior. Opening into this common canal is an accessory gland on each side, formed of numerous unicellular glands imbedded in connective tissue. The author regards the structure of the genital system as proving the affinity between *Pontobdella* and *Branchellion*.

Classification and Morphology of the Oligochæta.*—Prof. F. Vejdovsky has published in a connected and handsome form an account of the Oligochæta.

After a full bibliographical list, the author describes in order the families, genera, and species. Ten families — Aphanoneura, Naidomorpha, Chætogastridæ, Discodrilidæ, Enchytræidæ, Tubificidæ, Phreoryctidæ, Lumbriculidæ, Criodrilidæ, and Lumbricidæ— are recognized.

In the second part of the work, the dermomuscular tube with the hypodermis and hypodermal glands of the cilia; the phosphorescence of earthworms; the structure of the cuticle, and the arrangement of the muscular layers, are discussed; this is followed by an account of the setæ, cœlom, mesenteries, and orifices of the body-cavity; the chapter on the nervous system not only gives an account of the topography and external form of the central nervous system, but describes the peripheral system, the histology of the fibres and cells, and the lateral cords of ganglionic cells and the visceral nervous system. Then follows an account of the ciliated pits and of the various organs of sense. The digestive, vascular, and excretory organs are fully described and great attention is given to a history of the generative apparatus, its degeneration and its morphology, and to the process of fission as seen in *Æolosoma tenebrarum*.

The author fails to recognize the necessity of making any group of "Archiannelides," for the moment we distinguish Oligochæta from Polychæta we find that the archiannelid *Æolosoma* belongs to the former, and *Ctenodrilus*, *Parthenope*, *Monostylos*, *Polygordius*, &c., belong to the latter group. This monograph is one which will be consulted by every student of Annelids.

Studies on Earthworms.†—Mr. W. B. Benham, after an historical introduction and an account of previously described genera, gives a table of the characters of the genera of earthworms, in which notice is taken of the group (ante-, intra-, or post-clitelline) to which they belong, of the somite at which the clitellum commences, of the number of somites through which it extends, of the position of the male pore, of the characters of the copulatory appendage, the position and number of the spermathecæ, of the number of setæ per somite and of the mode in which they are arranged, of the position of the nephridiopore, length, and habitat; a list of all known earthworms whose distribution is known is next given. In the third part the variations in the structure of earthworms treated according to the different systems of organs are described;

* 'System u. Morphologie der Oligochæten.' fol., Prag, 1884, 172 pp. and 16 pls.

† Quart. Journ. Micr. Sci., xxvi. (1886) pp. 213–301 (3 pls.).

the nephridia become modified to form a genital duct, by a fusion of a series of nephridia, by a disappearance of a part of the nephridium, or by a shifting of the position of the pore. The large *Microchæta rappi* (*Lumbricus microchetus*) is described in detail; and the more noticeable points are the small size of the prostomium and setæ, the large size of the nephridiopores, the very large size and complicated structure of the nephridia, the excessively strong septa of the anterior somites, the numerous small spermathecæ, of which there is more than one pair in a somite, the bifurcation of the dorsal trunk in five of the anterior somites and the great enlargement of its wall in somite VIII.

Slavina and Ophidonais.*—Mr. E. C. Bousfield disputes Vejdovsky's opinion that *Nais appendiculata* d'Udekem is identical with *N. lurida* Timms, both of which belong to Vejdovsky's new genus *Slavina*. The author has examined numerous specimens of the latter species which he describes and figures; he gives a figure from Vejdovsky of *S. appendiculata*, and points out the differences between the two species. After remarking on the differences in the arrangement of the capillary setæ, he points out that, whereas *S. lurida* has only six or eight "touch-organs" in a ring round each somite, and that they are absent on the ventral surface, in *S. appendiculata*, on the other hand, as many as twenty of these occur in a ring, which passes across the ventral surface. In the former the eyes are purple, in the latter brownish-black. A description follows of *Ophidonais serpentina* Gervais, which the author considers as belonging to Vejdovsky's genus *Slavina*, as it has the characteristic "touch-organs" and in other respects agrees with the other two forms. The capillary setæ are frequently absent in many of the anterior and posterior segments, and even when present the number is reduced to one in a bundle; the "touch-organs" are irregularly placed, more or less in rings, and are especially numerous on the head. In conclusion the characters of these three species of *Slavina* are summarized.

Musculature of Chætopoda.†—Dr. E. Rohde reviews the more important investigations of Chætopod musculature, and reports the results of his own widely based studies. In *Branchiobdella*, which he discusses first as a good illustrative type, the longitudinal musculature of the body consists of very large, partly cœlomyary, partly completely closed muscle-cells, in which the contractile rind is clearly separated from the nucleated medullary substance. He traces the development of these muscle-cells from very granular, large cells with central nucleus and distinct membrane, which differentiate into fibrils on one side, and thus become platymyary. The fibrillar layer becomes strongly developed, and bends round, forming the cœlomyary, and lastly the completely inclosed tubular form. The muscle-fibres of the Chætopoda exactly resemble those of *Branchiobdella*, and each is the equivalent of a cell, whose outer membrane forms the sarcolemma. The fibres are completely inclosed, but in *Phreoryctes* and

* Journ. Linn. Soc. Lond., xix. (1886) pp. 264–8 (1 pl.).
† Zool. Beitr. (Schneider), i. (1885) pp. 164–205 (4 pls.).

Lumbricus olidus Dr. Rohde observed the occurrence also of cœlomyary forms.

Phreoryctes most closely resembles *Branchiobdella*. All the other Chætopods exhibit a decidedly weaker development of muscle-cells, and much less medullary substance. In *Limicolæ* the usually flat muscle-cells form a single row; in the Lumbrici this is folded so that bundles are formed; in *Criodrilus* these groups of cells are replaced by an entirely irregular disposition. In *Serpula* and *Protula* among Chætopods, highly complicated forms of bundles occur; in *Spirographis* hints of bundles occur only here and there; in the other Polychætes the cells are disposed either in strands (*Arenicola*, *Terebella*), or in small groups (*Polynoe*, *Eunice*, *Chætopterus*), or quite irregularly (*Ammochares*, *Nephthys*). The cells themselves are on an average much smaller than those of Oligochætes, but the longitudinal layer, as a whole, is more strongly developed.

Between the muscle-cells, and frequently between them and the body-cavity, a nucleated mass occurs, often closely apposed to the surface of the cells. This Dr. Rohde regards as the formative substance of the musculature. Round the cells there is always a fibrous intermediate tissue, not, however, a proper connective tissue, but rather a secondary separated product of the muscle-cells.

The contractile cortical substance of the cells is resolved into primitive fibrils arranged radially in fibrillar plates which pursue a spiral course round the fibres. In this radial disposition of the primitive fibrils the Chætopods resemble the Næmatodes, Hirudinea, and partly the Gephyrea. A transverse striation is often recognizable, due to the interrupted swelling of the muscle-cells. A great tendency to longitudinal splitting is very evident.

The memoir closes with an interesting comparison of the Chætopod musculature with that of the Platyhelminthes and Gephyrea. In a postscript Dr. Rohde sums up by emphasizing that while in the Nematodes the musculature exhibits the simplest form of platymyary cells, from which the cœlomyary state is developed by a bending round of the fibrillar plates, in the Chætopods the simplest form is that of cœlomyary or the completely inclosed muscle-cells, lying in a row, from which, by a secondary folding, bundles are formed, repeating in their structure the form of the cœlomyary cell.

Development of Dasychone lucullana.*—M. L. Roule has some notes on the development of this Sabellid, which is very common at Marseilles; its history recalls that of *Psygmobranchus protensus*, which has been studied by Salensky, and is more direct than that of *Eupomatus uncinatus*, on which Hatschek has written. *Dasychone lucullana* begins to deposit ova early in April; the eggs escape by the orifice of its tube, connected together and protected by the voluminous mass of mucus which is formed around them; in this covering the embryos pass through the early stages of their development, whence they escape as trochospheres. Segmentation is not uniform, but there is distinction between the more rapidly and the more slowly dividing

* Rev. Sci. Nat., iv. (1885) pp. 463-70.

yolk; both contain true protoplasm (hyaloplasm) and nutrient granules; when segmentation is completed the egg has a layer of outer cells, which become the ectoderm of the larva, and an internal mass of granulations, in the midst of which it is difficult to distinguish the cell-walls; the origin of the mesoderm has not yet been discovered.

The larva, which is at first globular, elongates and becomes ovoid in form; towards one extremity the ectodermic cells segment more rapidly, and give rise to a cylindrical epithelium provided with long vibratile cilia; these form a collar, which surrounds the larva transversely, and divides it into a short swollen portion, which will be the head, and an elongated more delicate posterior part, which gives rise to the thorax and abdomen. The cilia of the collar elongate, and become very large; the head becomes provided with some rigid points which recall by their appearance the cnidocils of the Cœlenterata; two eyes, formed by pigment-spots of irregular contour, appear at its base, and the branchial tentacles arise as lateral lobes, which bifurcate or trifurcate. The first segments to appear are those which belong to the thorax of the adult; they are provided laterally with short parapodia, which carry one or two fine setæ. The anterior part of the digestive tube is large, and the posterior delicate and elongated: all the cells of the intestine, from mouth to anus, are covered by active vibratile cilia. In this condition the larva secretes a delicate transparent tube, which envelopes it entirely, but which it can easily leave. Development henceforward proceeds very rapidly, and all the regions of the body proceed to take on the form which they have in the adult; a larva which was inclosed in mucus on the 29th of April possessed on the 13th of May eight well-marked segments and a good supply of cephalic tentacles; a week later two rings had been added. This species possesses the great advantage to the embryologist of being one whose larvæ can be continuously studied.

'Challenger' Gephyrea.*—The Gephyrea collected by the 'Challenger' are reported on by Prof. E. Selenka; the forms are defined as Annelids with degenerated segmentation, without external jointing, parapodia, or gills. There is a closed vascular system, and one to three (rarely six) pairs of segmental organs. There are seldom numerous setæ, and in most species none. The collection is rather small, and the condition of some of the specimens has prevented their being studied anatomically; a more complete figure of the male *Bonellia viridis* than any yet produced is given.

As an appendix to the report, Prof. Selenka has a few notes on *Chætoderma* (*C. militare* sp. n.), the systematic position of which is not, in his opinion, yet determined; the new species differs only from the North Sea species (*C. nitidulum*) in the form of its spicules.

Strongylus Axei.†—Dr. T. S. Cobbold refers to the discovery by Prof. Axe, in the stomach of a donkey, of this Nematode, which is remarkable for its small size, being only about 1/5 in. in length. The body is filiform; the mouth simple; the œsophagus short. The

* Reports of the voyage of H.M.S. 'Challenger,' xiii. (1885) 25 pp. and 4 pls.
† Journ. Linn. Soc. Lond., xix. (1886) pp. 259–63 (1 pl.).

"hood" at the posterior of the male is bilobed, with six finger-like "rays" on each side, and a median forked "ray"; in general similar to the hood of *S. Douglassi* Cobb. There are three spicules. The vulva is in the posterior sixth of the body. The body is very transparent, allowing the viscera to be seen; measurements are given of the various organs. This Nematode is allied to that of the grouse, *S. pergracilis*, and to the stomach-worm of lambs, *S. contortus*. The author mentions Schneider's opinion that the larva of *Simondsia paradoxa* exhibits a rhizocephalous condition, similar to that of *Sacculina* amongst the Crustacea.

Embryonic Development of Bothriocephalidæ.*—Dr. H. Schauinsland has studied the embryonic development of *Bothriocephalus rugosus*, *B. latus*, *B. sp.*, *Trienophorus nodulosus*, *Ligula simplicissima*, and *Schistocephalus dimorphus*; they agree with one another in all essential points. The germinal cell alone takes a direct part in forming the embryo; it exhibits a regular segmentation, and some of the cells thus formed give rise to an embryonic envelope, which becomes particularly well developed in the non-ciliated embryos (*B. rugosus*), but is very delicate in the eggs that are very rich in yolk and have ciliated embryos. The embryonic cells within the yolk are generally spherical and again form an epibolic covering, which does not, however, extend over the whole of the yolk; the embryo now consists of a thin outer cell-layer and a compact inner mass; the former gives rise to an investment which contains a quantity of protoplasm; this later becomes vacuolated and in some forms reduced to fine protoplasmic filaments. This second investment is, or is not, ciliated; it serves as a protective or locomotor organ; the connection between the larva and its covering is always slight; the larval body is formed of two kinds of cells which differ in size, the larger being more central, but the smaller peripheral cells do not form an epithelium. Although the entrance of the larva of a bothriocephalid into its host has never been actually observed, it is quite certain that when it does so the ciliated mantle or homologous investment is cast off; all that remains of the larva, and therefore of the adult worm, is of an endodermal nature. This view is shown to be correct by the study of development, in which gastrulation occurs as in other Metazoa; there is no cleavage cavity, but this is not remarkable, though the double epiboly is. Leuckart has already expressed a belief that the adult worm has no ectoderm, and this is supported by the structure of the adult, in which we can distinguish no epidermis, but only cortical and medullary substance.

The author points out that the Bothriocephalidæ agree essentially with the Tæniidæ in the history of their development, and they still more strikingly resemble the Trematoda; their resemblances to the Turbellaria and the Nemertinea have not yet been completely worked out, but there is reason to suppose that so far as regards the ectoblast, they will be found to exhibit really similar phenomena. If the adult Cestodes have no true ectoderm, it follows that the adult Trematoda

* Jenaisch. Zeitschr. f. Naturwiss., xix. (1885) pp. 523–73 (3 pls.).

are also without this layer; however, the question cannot yet be regarded as settled with regard to the monogenetic forms of the latter order.

New Sense-organ in Mesostoma.* — The structure which M. P. Hallez regards as an olfactory organ in *Mesostoma lingua*, consists of a small invagination on the ventral mid-line, between the mouth and anterior extremity of the body. This small pit passes obliquely forward, and ends in two lateral blind diverticula. The wall of the pit is formed of cells similar to the epithelium of the ventral surface of the body; these are ciliated at the commencement of the pit, but the author is uncertain how far inwards this condition is continued; here and there is a gland-cell. The sub-epidermic pigment surrounds the pit, and streaks of it pass from this organ to the eye-spots. Nerve-fibres from the ventral surface of the cerebral ganglia pass to the ends of the diverticula.

The author considers this structure sensory rather than glandular, owing to the few gland-cells present; moreover, as Dugés pointed out, the quick perception of the presence of food by the Planarians seems to indicate that some sense, other than sight due to their ill-developed eyes, must be present.

Mesostoma personatum.†—Dr. A. Jaworowski has a preliminary notice of his studies on this Turbellarian.

The cells of the epidermis are devoid of pigment, and in and between them the rods are visible; in some that have just escaped from the egg the pharynx is not in the anterior or middle part of the body, but behind, so that they appear to be species of *Opistomum*. The orifice between the eyes and the pharynx is near the former in young, while it is exactly between them in older forms. There is a longitudinal and a circular layer of muscles, and the fibres anastomose to form a plexus. The anterior part of the enteric cavity is proportionately longer and larger in young than in adult forms; the ventral portion of the parenchyma is much better developed than the dorsal. The pharynx is a plexiform organ, which is made up of three layers; the outer and inner consist of longitudinal and circular muscles, which anastomose with one another; the median layer is the best developed and consists of branching and plexiform fibres, in the wide meshes of which the large cellular pharyngeal glands are to be found; there is a fourth, epithelial, layer. The water-vascular system consists of two chief trunks, each of which divides into two branches; the anterior of these open in the epidermal invagination between the eyes and the pharynx. The walls of the generative organs consist of a close plexus, some of the fibres of which are so disposed as to have the appearance of being simple elements of muscular fibres.

Fresh-water Monotidæ.‡—The discovery by Dr. Zacharias at Hirschberg of a fresh-water Planarian belonging to Graaf's family

* Comptes Rendus, cii. (1886) pp. 684–6.
† Zool. Anzeig., ix. (1886) pp. 83–5.
‡ Bull. Soc. Vaud. Sci. Nat., xxi. (1886) pp. 265–73 (1 pl.).

Monotidæ, led Dr. G. Plessis to complete his description of the fresh-water species of the genus *Monotus*.

Dr. Plessis regards Zacharias' *M. relictus* as specifically identical with his own *M. morgiensis* (= *Otomesostoma morgiense* v. Graaf). The genus *Monotus* has a single otocyst, inclosing a single otolith, in the anterior region of the body: and out of the whole genus only two species are found in fresh water—*M. morgiensis* and *M. mesopharynx* Diesing. These are monogonoporous, whilst the marine forms are digonoporous. The author gives a description of the anatomy and histology, together with the localities of his species. He regards the otocyst as being a visual organ as well as an auditory organ, since it is in very close connection with a pair of pigment-spots. The otolith is fixed to the wall of the otocyst, and neither cilia nor auditory hairs are present. He regards the fresh-water species as relicts of a marine fauna once extending over the localities in which the above species are found.

Rotifers.*—Mr. J. E. Lord draws attention to the genus *Euchlanis*, in which the lorica is more or less depressed, and consists of an upper and lower plate, connected by a flexible membrane: the dorsal plate is larger and more convex than the ventral plate. The author figures four forms which he has been unable to identify. One of these he believes to be *E. Hornemanni*, in which the lorica is ovate and has four ridges along the back: the foot is furcate. A second, which may be *E. hipposideros*, has a short foot, not projecting from the lorica, while the two forks are long, but have not the bristles mentioned by Pritchard. The mastax in these is brachionæan, but the trochal disc is not lobed. The last species resembles *E. macrura*, with lobed trochal disc.

Keeping Melicerta ringens alive.†—M. F. found in a dirty pond a fine colony of *Melicerta ringens*, which for about a week appeared to thrive, but as time went on they disappeared altogether.

He accounts for this from the fact of having taken them from a pond where the water was thick, and where they could find plenty of food and material for building their cases, and placed them in water, which, after a time, became so clear that they could obtain nothing from it for their brick-making, and he is "led to think that the search for *Melicerta ringens* is often unsuccessful from the fact of seeking it in clear ponds instead of muddy."

Echinodermata.

Nervous System of Echinus acutus.‡—M. H. Prouho states that if one suitably treats a portion of the integument which covers the test of *Echinus acutus* with chloride of gold or citric acid, numerous bluish lines connected by frequent anastomoses will become apparent; the appearance forcibly recalls that figured by Prof. Lovén of the peripheral nervous system of *Brissopsis lyrifera*. Examined under a

* Sci.-Gossip, 1886, pp. 83–6 (7 figs.). † Scientif. Enquirer, i. (1886) p. 46.
‡ Comptes Rendus, cii. (1886) pp. 444–6.

power of 500, the plexus will be found to consist of a large number of fibrils, and some of the principal bundles will be seen passing towards the spines and adjacent pedicellariæ. The fibrils of which this plexus is formed are identical with those of the tentacular and ambulacral nerves, and each is continuous with the fibre from the ambulacral nerve which emerges from one of the tentacular pores; the plexus lies between the external epithelium and a layer of connective tissue which sends off a number of connective bands through the meshes of the nervous plexus to support the epithelium. At the base of each spine there is a relatively well developed nervous ring. The cellular elements of the plexus are very difficult to detect in the plexus, but they are very numerous and easy to see in the nerve-ring; the author does not, however, agree with Mr. Romanes in his description of these elements. M. Prouho has also been able to make out a nervous genital ring, which connects the five genital glands with one another, and, by means of the five ambulacral trunks, with the peribuccal nervous pentagon.

New Echinothurid and its Poison-apparatus.*—Herren C. F. and P. B. Sarasin have found in the Bay of Trincomalee a new Echinothurid, for which they propose the name of *Cyanosoma urens*.

While presenting many resemblances in coloration to *Asthenosoma varium*, it presents generic differences in the structure of its skeleton, but they have not been able to study the descriptions given by A. Agassiz of the 'Challenger' Echinoids. If one seizes a specimen one immediately feels a number of extremely painful stings, like those of a bee, but the sense of pain is soon relieved. The organs which effect this are spines in the dermal covering; when best developed they have the appearance of small blue stalked capitula, which are traversed by a fine spine, the tip of which projects a little or not at all beyond the soft parts; the upper end of the spine is continued into a pretty wide and strong sack of connective tissue, which is continued as a solid lamella through the spine; the end of the spine inclosed in the sack is thus completely shut off from the more basal portion. The head itself which surrounds the poison-bag consists essentially of muscular fibres together with connective-tissue and pigment-cells; the fibres are generally so arranged as to run parallel to the surface of the head, and are attached at one end to the poison-bag, and at the other to the spine below.

The mechanism appears to be of the following nature: when an object presses on the top of the spine, the musculature of the head contracts; this breaks the poison-bag inferiorly; and the greater part of the tip of the spine becomes free; at the same time the secretion contained in the bag is pressed into the spine through the large orifices at its base, and so make their way into the wound which the spine has made.

The other spines in the tegumentary coverings are formed in the same way, but the mechanism is so far modified that the poison-bag is not compressed by muscular force, but by the pressure of the

* Zool. Anzeig., ix. (1886) pp. 80-2.

objects that touch it. In addition to their offensive functions, the spines are also of importance as sensory organs.

In conclusion, the authors have a few remarks on the anatomy of this Echinothurid; they draw attention to the five pairs of well-developed longitudinal muscles which serve to depress the test; these are inserted by pairs into the auricles; morphologically, they are of importance as bearing on the comparison of the Echinothurids with Holothurians.

A small fish, whose ground colour is that of *A. urens*, and a small macrurous Decapod of similar colour, live commensally with the urchin; on *Diadema setosum* there is a closely allied fish; both, when frightened, hide among the spines, as if fully conscious that they would be there quite safe.

New Organs of the Echinida.* — Dr. O. Hamann, under the title of globiferi, describes some organs in *Sphærechinus granularis*, which have an extraordinary resemblance to one form of pedicellaria, as described by Mr. W. Percy Sladen, in the same Echinid; no reference to the earlier writer is, however, made by Dr. Hamann, who describes the bodies as glandular organs which emit a secretion through apertures; he is reminded by them of the mucigenous cells of Vertebrates.

Transversely striated Muscles in Echinida.†—Dr. O. Hamann, who has vainly sought for transversely striated muscles in Holothurians and Asterids, has now detected them in the pedicellariæ of Echinids. The fibrils if examined in the living state distinctly show the transverse striation; the individual fibrils when, as they may easily be, separated from one another, are seen to have attached externally a large elongated oval nucleus.

Cœlenterata.

Cyclic Development of Siphonophora.‡—Prof. C. Chun continues his researches on Siphonophora, especially on Monophyidæ, supporting and extending what he has previously maintained in regard to the cyclic development of the latter.

I. *The cyclic development of Monophyidæ.*—All the Monophyidæ, viz. *Muggiæa Kochii*, *Monophyes irregularis*, and *Monophyes gracilis*, are independent species, whose primary swimming-bells are thrown off, and replaced by final heteromorphous bells, of which only one is present Prof. Chun maintains, against Claus, that *Muggiæa* is a Monophyid and not a Diphyid. The primary bells may be regarded either as "nurses" from which the stem and the reserve bell are budded off, or as larval forms, according as most importance is attached to the preponderant development of a distinct bell of considerable size, or to the analogy with the alternation of heteromorphous protective organs and tentacles in other *Siphonophora*.

* Ann. and Mag. Nat. Hist., xvii. (1886) pp. 386-7.
† Tom. cit., p. 338, from SB. Jenaisch. Gesell., 1886.
‡ SB. K. Preuss. Akad. Wiss., 1885, pp. 511-29 (1 pl.).

II. *The relation of Monophyidæ to Diphyidæ and Polyphyidæ.*—In Monophyids, after the formation of the single final bell, there is no further alternation of bells; the final heteromorphous bell is homologous with the first-formed, heteromorphous, superior bell of the Diphyids. The single, secondary, heteromorphous bell of the Monophyids is final; in the Diphyids there lies below the two, secondary, heteromorphous bells, a constant reserve supply of similar bells. And if we suppose that the secondary bells of the Diphyids be not thrown off, but, with the growth of young bells, become groups in two similar rows along the stem, then we get the Polyphyid type, as in *Hippopodius* and *Vogtia*.

III. *The Eudoxia groups of the Diphyids and their sexual relations.*—Under the genus *Praya* two categories of Diphyids have been included. One, represented by *P. maxima*, exhibits *Eudoxia*-groups with the four characteristic constituents, viz. nutritive polyp, tentacle, hydrophyllium, and gonophore. The others, namely, *P. diphyes* (Vogt and Kölliker), *P. medusa* (Metschnikoff), and a new form described by Chun, exhibit not only a remarkable multiplication of gonophores with rudimentary umbrellas, but "special swimming bells," with medusiform characters, but without any hint of a manubrium. Prof. Chun proposes to reserve for *P. maxima* or *cymbiformis* the generic title *Praya*, and to erect the genus *Lilyopsis* for the three others, viz. *L. diphyes*, *L. medusa*, and *L. rosea*.

Medusæ.*—Prof. E. Metschnikoff communicates the systematic results of his developmental study of a number of medusa forms. He describes a *Velella* medusa, a new species of *Tiaropsis*, and a number of others, but the bulk of the paper is occupied with purely systematic notes, which do not admit of summary, in regard to a large number of medusoid forms. The communication includes some critical remarks on Häckel's system.

New Hydroids.†—Prof. G. J. Allman describes a number of new species of Hydroids, chiefly from Australia and the Cape. *Thecocladium* is a new genus allied to *Thuiaria*, but differing in the facts that the branches invariably spring from within the hydrothecæ and extend through their orifice; the habitat of the single species is unknown. *Gattya* is another new genus, which is intermediate between the typical Eleutheroplean and Statoplean forms of the Plumulariidæ; it has the movable lateral nematophores, and the mesial nematophore completely separated from the wall of the hydrotheca as in the former, and the fixed mesial nematophore and dentate margin to the hydrothecæ of the latter; it is allied to the genus *Heteroplon* found by the 'Challenger'; the habitat of the single species is unknown. *Aglaophenia late-carinata* sp. n. appears to be a characteristic form of the floating Sargasso-field of the North Atlantic. *Thuiaria heteromorpha* sp. n. from Tasmania is significant in its bearing on the question of the definiteness of systematic characters, for the form and disposition of the hydrothecæ vary in

* Arbeit. Zool. Inst. Univ. Wien, vi. (1886) pp. 237–66 (2 pls.).
† Journ. Linn. Soc. Lond., xix. (1885) pp. 132–61 (20 pls.).

different parts of one and the same colony to an extent which, if noticed in separate colonies, would be regarded as affording grounds for generic distinction.

New fresh-water Cœlenterate—Microhydra Ryderi.*—An interesting fresh-water polyp-form has been discovered near Philadelphia by Mr. E. Potts, and described by Mr. J. A. Ryder. Simpler and much smaller than *Hydra*, this *Microhydra Ryderi* exactly resembles a fixed planula, without cilia and provided with a mouth. The latter is small and exhibits an irregular opening; there is no disc-like expansion, nor hint of tentacles. The nematocysts of the thin ectoderm are mostly near the mouth. An indistinct layer beneath the ectoderm probably represents contractile processes of the outer cells. Round the mouth the endoderm consists of solid cells; below this narrow zone, for the upper third of the polyp, the endoderm consists of large cells, with distinct vacuoles and small excentric nuclei.

Sexual reproduction has not been observed; but asexual budding has been repeatedly studied through several generations. The *Microhydra*-bud, however, unlike that of *Hydra*, is formed longitudinally; the parent and the bud lie side by side. When separation occurs the bud falls to the foot, remains for a while motionless, then fixes itself at the aboral pole, and begins an independent life. Artificial division has not yet been tried. If the above account be correct the simplest Cœlenterate is certainly *Microhydra*.

New Zoantheæ.†—Dr. A. Erdmann commences with some observations on the characters of the septa, which he distinguishes as dorsal and ventral; in some the dorsal septa which are directed towards the ventral zone consists only of macrosepts, and this type may be distinguished as the macrotype from the more common microtype. In all other Actiniæ (excepting the Cerianthidæ) every pair of septa is capable of producing new pairs of septa, but in the Zoantheæ only two interseptal processes are capable of producing new septa; they are the two which lie nearest the ventral directive septa. Zoantheæ are either free-living or colonial, and colonies are either formed by delicate branching stolons given off from the base, or they are placed on a more or less extended cœnenchym, or, lastly, the polyps are sunk into a common cœnenchym. This last is always traversed by connecting tubes lined by endoderm, and continued directly into the interior of the polyps; the mesoderm has a number of special cavities filled with cells, and the canals and cavities appear to be always of ectodermal origin; numerous rounded or stellate connective-tissue bodies are also to be found in the mesoderm; the mesodermal filaments have their lower halves formed by an unpaired glandular streak; in the middle there is a paired ciliated streak; a table of the five known genera is given with the distinctive marks, drawn from the characters of the septa, the circular muscle, the cœnenchym, integument, and disposition of gonads. Of the thirteen forms whose descriptions follow, *Polythoa axinellæ* is alone referred to its species, the

* Amer. Natural., xix. (1885) pp. 1232–6.

† Jenaisch. Zeitschr. f. Naturwiss., xix. (1885) pp. 430–88 (2 pls.).

others having only their genera indicated. In concluding the description of the thirteenth, which appears to be a representative of a new form, Dr. Erdmann remarks that the developmental process of the septa of Actiniæ may be divided into two periods; the first ends when the first six or primary pairs of septa have been developed; in the second period the septa of the second, third, and other orders are laid down; in the Zoantheæ the law of development in the second period is different, owing to the fact that only two processes can give rise to new pairs of septa. It seems to be clear that in them the number of septa is in direct relation to the size of the animal, which, as a general rule, corresponds to its age.

The author gives definitions of all the genera, and woodcuts illustrating the arrangement of the septa.

North Atlantic Pennatulida.*—Drs. D. C. Danielssen and J. Koren have produced another of their beautifully illustrated memoirs on the animals collected by the Norwegian North Sea Expedition; the most interesting part of this memoir deals with *Umbellula encrinus*, the specific name of which we owe to Linnæus, though our knowledge of the species has been as yet so slight. Twelve specimens, forming a very complete series of stages and sizes, were obtained, the largest of which is, to judge from the illustrations, a magnificent example. The polyps of this species appear to be viviparous.

Eleven of the thirteen species found are new, and of the eight genera represented, two are new; these are called *Svava* and *Gunneria;* the former is small, has rudimentary fins, and is without spicules in the sarcosome, cells, or polyps; the gonads are developed on the lateral zooids, while the fully developed polyps are barren; the larvæ are set free by the mouth, as in *Corallium*. Only a fragment attests the generic characters of *Gunneria*, but the generic characters may be seen in the large number of spicules on the bodies of the polyps, tentacles, and sarcosoma, so that the new genus appears to approach the Gorgonidæ.

Porifera.

Relationship between Sponges and Choanoflagellata.†—Prof. F. E. Schulze has criticized in detail the theory, lately revived by Saville Kent, that the sponges were flagellate colonies. Allowing, of course, the suggestive resemblance of the collared cells of sponges with the collared flagellates described by Saville Kent as Choanoflagellata, and by Bütschli as Calico-mastiges, Prof. Schulze points out that the similarity does not amount to identity, and even if it did, would not necessitate the conclusion that sponges were colonies of Flagellata. In regard to Saville Kent's description of numerous sponge larvæ, according to which the swarm-gemmules consist of ciliated individuals which soon all acquire *collars*, the absence of corroboratory researches, and the opinion of all other investigators are noted, while

* Den Norske Nordhavs-Expedition. Zoologie—Pennatulida, 84 pp. and 12 pls., fol., 1884.

† SB. K. Preuss. Akad. Wiss., 1885, pp. 179–91.

it is suggested that the collared larvæ in question were only separated portions of a collared chamber layer. The development of these larvæ, if such they are, is not, according to Saville Kent, the result of segmentation, but is parallel to the colony formation observed in various Flagellata, and especially in the newly discovered Choanoflagellate *Salpingœca fusiformis*, in which a typical individual retracts its collar and flagellum, becomes amœboid, passes into a spherical quiescent stage, and undergoes regular division ending in ciliated swarm-spores which leave the capsule and develope into Salpingœcas. In the sponge a parallel process results in ciliated and then collared individuals which remain, however, united by a common gelatinous supporting substance, which indeed occurs in the new Choanoflagellate *Protospongia hæckelii:* a slight modification in the disposition of the zooids in the latter would produce a very simple sponge. Prof. Schulze emphasizes in answer, *inter alia*, the now well-established character of the ground-tissue in sponges, which, thanks to Schulze's researches, has been shown to be a connective tissue with distinct cellular elements, fixed, wandering, contractile, glandular, &c. The presence of the internal endothelium, absent in Protospongia; and the fact that in the latter the ciliated cells are almost wholly immersed in the connective substance, are also noted. The impossibility of now denying either the true sexual reproduction as evidenced by the repeated presence of spermatozoa, or the presence of two embryonic layers in the larval forms is enforced.

The metazoan nature of sponges is not however inconsistent with their relation by direct descent from Choanflagellates, as Bütschli has recently maintained, though such a history of the origin of sponges would conflict with the other theory of their close relationship with Cnidaria. Prof. Schulze reviews the opinions of Leuckart, Balfour, Marshall and others in regard to the relation between sponges and Cœlenterates. Against Bütschli's hypothesis, he advances the apparent absence of collared cells in the blastula stage, where they would, on his supposition, be naturally looked for. He inclines towards the supposition of an independent origin of the collars, hints of which are found in some Protozoa, as in *Placopus ruber*. From the close resemblance between sponge and Cœlenterate larvæ, Prof. Schulze maintains that the divergence of the two lines did not begin before that stage in the phylogenetic development, which corresponds to the metamorphosis of the mature ciliated larvæ. He thinks Marshall's hypothesis that the common ancestors had radially disposed mesenterial pouches, tentacles with stinging capsules, and lateral pores, to be without sufficient basis, and regards the most primitive type as a simple sack-like form such as persists in *Olynthus*.

Origin of new species owing to the loss of older characters.* —The late Prof. O. Schmidt relates how in 1864 he was induced to place *Ancorina aaptos* among the Tetractinellidæ, owing to its resemblance to the family of Corticatæ; this family he has since had to regard as untenable, and with it *A. aaptos* had to be given

* Zeitschr. f. Wiss. Zool., xlii. (1885) pp. 639–47 (1 pl.).

up. In 1862 he formed the genus *Caminus*, which appeared to be one of the Tetractinellidæ, although it had not the characteristic tetraradiate spicules. He is now able to show that this is not a hypothesis merely. Specimens lately received from Dr. Köhler, who collected them at Sark and sent them to the author with the inquiry whether they belonged to the species *C. osculosus*, were remarkable in that a few of them had four-rayed spicules, the characters of which are described in detail, and their significance discussed. The result seems to be that *Caminus* affords the proof that by the disappearance of what was previously regarded as an important ordinal character, a new form, which is to be distinguished as a genus, becomes developed. It is possible, therefore, that *Ancorina* is similarly a good genus, and, at any rate, the author is justified in his belief that work with such ideas as he has had is good work.

Nervous and Muscular Systems of Horny Sponges.*—Dr. R. v. Lendenfeld gives an account of *Euspongia anfractuosa*, which differs in some particulars from the ordinary bath-sponge (*E. officinalis*); the fine membrane which extends from the tips of the horny fibres consists of parallel spindle-shaped cells, which are set perpendicularly to the outer surface of the sponge; they end in extraordinarily fine tips; the protoplasm contains small but highly and doubly refractive granules, imbedded in a singly refractive substance; the granules are so arranged as to give the appearance of a kind of transverse striation. The author believes that these are muscle-cells, intermediate in structure between smooth and transversely striated fibres; at the margins of the grooves the membrane suddenly becomes twice or thrice as thick, and does not here consist of spindle-shaped cells, cell-boundaries are no longer distinct and the substance is granular. Fibres are given off laterally from this thickening, and superiorly there are spindle-shaped sensory cells, which call to mind those found by Jickeli in the Hydroida. The thickening may be described as consisting of ganglion-cells, the contours of which are not distinct, while the fibres are nerves. The author homologizes these with the circular nerves of the cycloneurous Medusæ (Hydromedusæ), and thinks that their affinity with the Cnidaria is closer than is now generally admitted.

Oscarella lobularis (O. Schmidt) var. cærulea.†—Herr F. E. Schulze, in exhibiting some living specimens with gemmules both in process of formation and just cast off, remarks that this askeletal sponge produces at times, and especially when the water is infected by noxious matter, as decomposition gases and the like, free-swimming spheroidal bladders, the external membrane of which, though commonly possessing a similar structure to that of the parent body, differs therefrom considerably, since the exhalent oscula of the ciliated chambers in the gastric cavity, sometimes spheroidal and provided with special apertures of exit, terminate by a wide opening, whereby the form appears no longer spheroidal, but hemispherical.

* SB. K. Preuss. Akad. Wiss., 1885, pp. 1015–20. See also Ann. and Mag. Nat. Hist., xvii. (1886) pp. 372–7.

† SB. Gesell. Naturf. Freunde Berlin, 1885, pp. 183–4.

The change is easy to be understood if we regard the process of formation of the gemmules. By the bladder-like expansion of the fold of the discoidal sponge-body, the body-wall becomes so greatly extended that the spheroidal chambers opening originally into the inner gastric cavity by a small canal, now by the obliteration of this canal and universal expansion of its aperture assumes the hemispherical form, and through the wide opening which has arisen must open directly into the gastric cavity.

Such spheroidal gemmules, which have a diameter of 2–5 mm. after their separation, by means of currents never altogether absent in the sea, are easily transported to another place; and should the conditions be favourable, even may adhere together and develope a large crust.

Sponge destructive of Oysters.*—Dr. R. v. Lendenfeld describes a sponge, to which he gives the name *Chalinula Coxii*, which grows on shells of living oysters, and disappears when these die. It is found that in an oyster-bed in the Clarence river, where this sponge made its appearance, the oysters were killed off. The sponge seems to intercept some of the food-particles, which would otherwise be all available for the oyster, which thus sooner or later gets starved; there is no direct connection between the sponge and the body of the oyster. The author suggests, as a remedy, that fresh water should be led through pipes to the infected locality: the oyster would not thereby suffer any harm, but the sponge would be unable to live in the fresh water.

Australian Sponges.†—The fifth part of Dr. R. v. Lendenfeld's monograph commences with the order Ceraospongiæ, which he defines as "Spongiæ with a skeleton composed of horny fibre. Siliceous spicules produced by the sponge itself may occur in the ground-substance—flesh-spicules—but never within the fibres." This order is divided into two suborders, (1) Microcameræ, with small, spherical, ciliated chambers, and (2) Macrocameræ, with large, oval, ciliated chambers. Under the first suborder come the families Spongidæ, Aplysinidæ, and Hircinidæ; in the second, are the Spongelidæ and Aplysillidæ.

A new subfamily of the Spongidæ is formed, for forms having lacunæ, into which both the inhalent and exhalent apertures open. In this subfamily of the Auleninæ, are placed four new genera: (1) *Halme*, four species of which are very fully described and figured, *H. simplex*, *globosa*, *micropora*, and *nidus-vesparum;* the last he regards as identical with *Holopsamma laminæ favosa* Carter. (2) *Aphrodite* has one species, *A. nardorus.* (3) *Aulena* includes *A. villosa*, *A. nigra*, and *A. flabellum;* in the first species a nervous system is described and figured: it consists of numerous spindle-shaped cells carrying palpocils externally, whilst their deep ends branch, and below them are multipolar ganglion-cells. (4) *Halmopsis* is formed from *H. australis.* In the subfamily Sponginæ no new

* Proc. Linn. Soc. N. S. Wales, x. (1886) pp. 326–9.

† Ibid., pp. 282–321 and 481–550 (13 pls.).

genera are formed: it contains the genera *Euspongia*, *Hippospongia*, and *Cacospongia*, whilst the genera *Phyllospongia*, *Carteriospongia*, and *Stelospongia* form his subfamily Chalinopsinæ.

The author divides the genus *Euspongia* into seven subgenera, *Irregularis*, *Triplicis*, *Laxifibris*, *Ditela*, *Regularis*, *Densalis*, *Silicifibris*. Various species of the genus are described, in some of which a nervous system, derived from mesoderm, is described; he mentions Marshall's opinion that all organs in sponges are mesodermal; a list is given of the various kinds of cells found in the mesoderm, and the development of these is suggested to have had the following course:—amœboid wandering cells are present, and retain the appearance of the original mesoderm-cells of the blastula: from these ova, spermatoblasts, and indifferent tissue-cells have been derived, as well as "spongoblasts" and gland-cells of the skin. Neuromuscular elements were developed from the indifferent tissue-cells, which were further differentiated into ganglia and sensitive cells or true muscular cells. A table is given showing the way in which the "vestibule spaces" may be derived from the ancestral gastræa by a series of foldings of the wall of the sac.

In an "addendum" * the author suggests that *Halisarca Bassangustiorum* Carter should have its generic name altered to *Oscarella*, and he throws some doubt on Carter's description of a single large inhalent pore at the opposite pole to the osculum in *Teichonella labyrinthica*.

Protozoa.

Bursaria truncatella.†—Herr A. Brauer describes the structure and mode of encystation of this infusorian. Specimens are best preserved in a 1–2 per cent. solution of osmic acid, treated with picrocarmine, Beale's carmine, and 2 per cent bichromate of potash, and made transparent by being left for a long time in filtered water.

The author disagrees with Stein as to the position of the anus, which he always saw on the ventral side, and not in the middle of the hinder edge; no other infusorian is known to have so large or so completely formed a peristome as this species; it is only connected at its wide orifice with the body-wall, and has walls of its own; its cavity is apparently, but not really, divided into two halves; in the left lies the peristomial groove, and in the right the greater part of the ciliated zone with the subjacent bands or muscular fibres, and the spoon-shaped depression.

The contractility of the body of the fresh-water Vorticellinæ appears to have its seat in the highly refractive, sharply limited fibres which either arise from the base of the body, or in those with non-contractile stalks, or are direct continuations of the stalk-muscle; these fibres pass at a more or less obtuse angle to the cuticle, and are inserted at the level of the ciliated ring, whence anastomoses pass to the peristome; the fibres are separated from one another by granular

* Proc. Linn. Soc. N. S. Wales, x. (1886) p. 475.

† Jenaisch. Zeitschr. f. Naturwiss., xix. (1885) pp. 489–519 (1 pl.).

stripes; so far as the body-muscles are concerned the Vorticellinæ agree essentially with the Stentores and the Spirostomeæ.

The only observer who has given an account of the encystation of *Bursaria truncatella* is Cienkowski (1854); when encystation commences the parenchyma becomes vacuolated, and the peristome with all its parts becomes completely aborted; when this organ is lost, we have apparently quite another infusorian; this is partly due to the great increase in size of the layer of trichocysts, which becomes double its former breadth. Encystation is completed by the gradual diminution of this layer, the conversion of the vacuolated parenchyma into a granular mass, in the loss of the cilia, and the rounding off of the form of the body. Two membranes become developed, the outer of which—the so-called stellate membrane—may be best likened to a number of parallelograms of unequal size distributed irregularly over the body of a sphere; where the diagonals cut there are depressions; the inner membrane is homogeneous, thick and strong, and slightly refractive. The contents are in the form of a dark brown mass composed of coarse large granules. Encystation appears to take place in December, and the first *Bursaria* observed to become free was seen at the end of February. Few changes go on within the cyst; the rotating spores described by Cienkowski were Flagellata, which made their way into some of the cysts. The author remaks that this is the only infusorian known to him in which there is a retrograde metamorphosis, but he thinks that similar phenomena may be seen in some of the Stentors.

Spirochona.*—M. E. Canu, after referring to the work of Stein and Hertwig on *S. gemmipara*, which is found on *Gammarus pulex*, and on *S. tintinnabulum*, found on the skin of the tadpole of *Triton*, gives an account of his discovery of *S. crystallina* n. sp., together with *Freya limnoriæ* and numerous other peritrichous infusorians, on a marine isopod *Limnoria*. The author does not agree with Entz's opinions on the affinities between the Ciliata; he regards *Spirochona* as separated from all other infusorians by the arrangement of its peristome; and considers it as a peritrichous stage, with homogeneous cilia, amongst the Hypotricha. He further regards the Oxytrichinidæ, Halteridæ, and Tintinnidæ as highly developed hypotrichous forms with a ciliated peristomial area.

Characters of the Cilio-flagellata.†—Prof. O. Bütschli has been able to study *Glenodinium cinctum* in the living condition, when he finds that forms differ not inconsiderably from one another; smaller examples appear to be almost round when looked at ventrally or dorsally, but the large are ordinarily oval; the colour varies between yellowish and greenish brown, and is generally pretty deep. All those examined had a thin envelope which lies directly on the body, but it is only distinctly visible when the body is contracted under the influence of killing reagents, or when the flagellum has been lost and the specimen has passed into a resting condition. Resting forms do

* Bull. Sci. Dép. Nord, ix. (1886) pp. 21–31.
† Morphol. Jahrb., x. (1885) pp. 529–77 (3 pls.).

not appear to have a special encysting envelope, but the cellulose reaction of the ordinary covering is very easy to detect. The coloration of the body is due to a closely packed unilaminate layer of chromatophores, which are found in the periphery of the protoplasm; these have a rod-like form, are arranged perpendicularly to the surface of the body, and are set radially. The stigma is a structure of some size, and is always found in the longitudinal groove, which is its characteristic position in the Cilioflagellata; it occupies the whole breadth of the groove, is concave at its anterior margin and convex posteriorly, so that it is, on the whole, like a horse-shoe in shape. An irregular brownish body of a fatty nature is not rarely seen in the central protoplasm, and is especially large in the resting-stage. The relatively large spherical nucleus lies near the centre of the body, and, during life, has the appearance of a bright speck; its structure is finely plexiform, the nodal points being darker and somewhat thicker. A true contractile vacuole was not to be detected, but one or more ordinary vacuoles were often seen on the ventral surface.

Prof. E. Askenasy has supplied an account of his observations on copulation and ecdysis. He states that he several times observed copulating pairs of *Glenodinium cinctum;* though not often found, he has sometimes, with very rich material, found one or two pairs in every drop examined; they so attach themselves to a point that the hinder pole of one is attached to the anterior of the other; they then move about together in the water, several times they separate and again attach themselves, and the attachment becomes closer and firmer; the movement of a pair may last over an hour. This suddenly ceases, but for a short time longer the long flagella may be seen moving; the zygote (if we may so call the product of copulation) remains quite still. The appearance of the zygote varies with circumstances, but the form is always biscuit-like, and two eye-spots and two nuclei are always to be seen; at the point of junction there is a distinct continuity of the protoplasm. In quiescent zygotes there is a distinct doubly contoured membrane; the further development of the zygotes was not observed. As to the process of ecdysis, the same observer notes that if swarming individuals be observed for an hour or two, they will be seen after some time (at the most an hour or two) to become quiescent and throw off their cilia; specimens observed for several days were not seen to exhibit any further change; but at the end of a week several individuals were seen to have cast their cuticles, which were found lying scattered about. One was observed in the act; there was a cleft at the side of the equatorial groove; when escaped it had the appearance of a naked alga just escaped from its mother-cell, and it may, therefore, be concluded that at this time there is no firm membrane. Freshly escaped or thin-cuticled *Glenodinia* appear to copulate.

After some observations on the marine species of *Ceratium, Peridinium, Gonyaulax, Dinophysis,* and *Prorocentrum,* Prof. Bütschli passes to the consideration of the genetic relations of the Cilioflagellata; he concludes that they are derived from the Flagellata, but he is not certain whether there are differences sufficient to justify the establish-

ment of an independent group of the Mastigophora; we must always bear in mind their peculiar and characteristic mode of development; as to the name which is ordinarily applied to the group, it is no doubt misleading. As he cannot with Klebs extend the term Peridineæ beyond *Peridinium* and its allies, and as he cannot recommend the use of Stein's term of arthrodele Flagellata, he proposes to make use of the term Dinoflagellata, which will call to mind the characteristic peculiarity of the group—the development of a transverse groove and the appended flagellum.

As to the relationship of *Noctiluca* with the Cilioflagellata, he allows that there are certain points of resemblance, such as the longitudinal groove, the cilium with its rod-like organ, and the two flagella. The so-called swarm-spores of *Noctiluca* recall a number of the characters of the Cilioflagellata, such as the backward direction of the flagellum; other points of resemblance are discussed. The difficulty in the way is that no direct observations have yet been made on the further development of these swarmers. Bütschli suggests that as they grow the transverse groove is lost, a portion perhaps becoming the anterior margin of the atrium. This last is found as a depression; changes occur in the size and relations of the flagella, and so on. But the question can only be set at rest by an exact study of all the changes which occur in the course of development.

Cenchridium.*—Dr. E. v. Daday remarks that the groove in the test of this Cilioflagellate is not, as Stein thought, homologous with the ventral suture of the Prorocentrina, but is merely due to ridges of the test, such as extend from one end to the other, and divide it into two equal halves. The protoplasm never completely fills the internal cavity of the test; it is rare for it to be yellow in colour. An oval nucleus and smaller scattered masses of various sizes are distinctly to be observed, as well as small, brownish-yellow, rounded algæ, which are, of course, foreign bodies. It is very important to note that the protoplasm changes continually its form and place. The author repeatedly saw the protoplasm streaming out through the siphon, and then branching into very fine pseudopodia; with the change in form and shortening of these pseudopodia we may correlate the locomotive movements of the animalcule. Dr. v. Daday comes to the conclusion that the *Cenchridium* of Ehrenberg and Stein (with which is synonymous the *Entosolenia* of Williamson) is not a Cilioflagellate, but a Rhizopod, and that the species are really members of the genus *Lagena*. The contained algæ are representatives of Brandt's *Zooxanthellæ*, and are not to be regarded as having been swallowed as nutriment; food is obtained by means of the pseudopodia. Prof. A. Gruber † points out that he has already (1884) shown that *Cenchridium* is a Rhizopod, allied to *Lagena*.

Phosphorescent Flagellate Infusorian.‡—Dr. A. A. Julien describes a minute organism, which he regards as the cause of the phosphorescence of the sea. He obtained it from the sea off the coast of

* Zool. Anzeig., ix. (1886) pp. 15–9.
† Tom. cit., p. 200.
‡ Trans. New York Acad. Sci., v. (1885) pp. 15–6.

New Jersey, in which were also *Salpæ* and *Medusæ*, the phosphorescence of which would not account for the milky glow on the water. He was unable to observe any phosphorescence in the organism itself when examined microscopically, but when alcohol was poured into the water points of light were produced; damp sand from the shore exhibited the same phenomenon. At first the author thought the organism was a small species of *Noctiluca*, but that idea has been given up. In the discussion which followed the reading of the paper, Mr. C. F. Cox suggested that the organism was a bacterium, and connected with decay of the *Medusæ*. Dr. N. L. Britten considered that they were zoospores of *Medusæ*, while Prof. D. S. Martin thought it probable that they were a very young stage in the development of *Salpa*.

Pulsating Vacuoles of Infusoria.*—M. Z. Fiszer describes his observations on the structure of the vacuoles in *Aspidisca lynceus* and *Paramecium aurelia*, especially with reference to the statement of older observers that the vacuole is separated from the surrounding protoplasm by a special membrane; he adopts, on the contrary, the more recent view that it is a simple cavity in the interior of the protoplasm-body. In *P. aurelia* he was able to see directly how the canals which radiate from the vacuoles swell up, after the disappearance of the vacuole, till their converging ends meet, and then these swellings coalesce into a new vacuole.

The author confirms Oscar Schmidt's statement that the pulsating vacuoles communicate with the surrounding water by a special exit, and expel their contents when they contract. This view was confirmed by the observation that in *Aspidisca*, at the moment of contraction, the vacuole is distinctly renewed outwards.

As to the physiological function of the vacuoles, the author came to the conclusion that their main purpose is to serve as a means of carrying away the water which has been deprived of atmospheric oxygen, although possibly products of metastasis may at the same time be excreted through them. In all the species examined, as *Stylonychia mytilus*, *S. pustulata*, *Chilodon cucullus*, *Pleuronema chrysalis*, *Paramecium aurelia*, &c., when placed in water that had been boiled and then rapidly cooled, the vacuoles, instead of pulsating more slowly, behaved in exactly the opposite way, contracting and again expanding three or four times more quickly than in ordinary conditions. An exception was afforded by *Acineta mystax*, in which water destitute of oxygen did not quicken the pulsations; but the vacuoles swelled up to three times their original size; the increased amount of water expelled at each pulsation replacing the increased rapidity of the pulsations. The same results were obtained by gradually replacing the water beneath the cover-glass by boiled water. The phenomenon lasted, however, only for a short time, the Infusoria soon perishing under such conditions.

The physiological function of the pulsating vacuoles is, from

* Wszechswiat Warsaw, iv. (1885) (in Polish). See Bot. Centralbl., xxv. (1886) p. 34.

these observations, thus described:—The water which enters through the mouth is distributed between the particles of protoplasm, invests them, and gives off its oxygen to them; it then becomes unserviceable to the organism, and must be expelled to make room for currents of water from without containing oxygen. The water thus used up collects at first in the canals, through which it flows to the vacuole, which then, after it is filled, expels its contents by the contraction of the surrounding protoplasm.

Protoplasmic Layers in Rhizopoda.*—Prof. A. Gruber reviews some of the opinions held in regard to the often-disputed question as to the existence of distinct zones in the protoplasm of Rhizopods.

While many have distinguished ectoplasm and endoplasm, Maggi defines three layers, ecto-, meso- and endo-plasm, and Brass four. Agreeing with Bütschli in his criticism of Brass, Prof. Gruber explains the supposed presence of distinct layers as due either to the artificial results of staining, or to temporary aggregation of granules and vacuoles, and emphasizes the homogeneity especially manifest before division. He calls attention to the fact, observed independently by Wallich and by himself, that contact with the water seems to produce round the Rhizopod body a certain stiffening of the plasma, to which Wallich has also referred the definiteness exhibited by the food-vacuoles.

Recent Irish Foraminifera.†—Messrs. F. P. Balkwill and J. Wright report on recent foraminifera collected off the coast of Dublin and in the Irish Sea; in the systematic table 148 species are enumerated, of which 14 are new to the British fauna. Of the latter, *Ophthalmidium carinatum*, *Lagena curvilineata*, *Discorbina tuberculata*, *Nonionina pauperata*, are new species.

Parasitic Protozoa in Asthmatic Sputa.‡—Dr. Deichler reports the presence in asthmatic sputa of organisms of constant form which have a superficial resemblance to leucocytes, but are seen to differ from them in their structure and vital phenomena. They tend to be curved on themselves, and to have a central space which is occupied by a smaller mass of protoplasm. Though convinced that he has here to do with a protozoon, the author is undecided as to whether it is a rhizopod, infusorian, or one of the Flagellata.

Protozoan Parasites in Termites.§—Prof. B. Grassi describes and figures a new Protozoan parasite found in great abundance in the intestine of *Calotermes flavicollis*. It resembles the *Lophomonas* found in the intestine of *Blatta*, having a variable form, without mouth or contractile vacuoles, and bearing at the anterior extremity a large tuft of numerous vibratile flagella, at the base of which the nucleus is seen. It differs from *Lophomonas* in the possession of a complex internal skeleton, occupying the longitudinal axis, and com-

* Biol. Centralbl., vi. (1886) pp. 5–8.
† Trans. R. Irish Acad., xxviii. (1885) pp. 317–63 (3 pls.).
‡ Zeitschr. f. Wiss. Zool., xliii. (1885) pp. 144–8.
§ Acad. Gioenia, Sci. Nat., xviii. (1885) 6 pp.

posed of a vertical rib, like that of the Trichomonads, and of curved and claviform little rods, disposed in a bundle round the anterior end of the rib. Unlike *Lophomonas*, this parasite (*Jœnia annectens*) exhibits no denser and darker tract in the anterior portion of the body. Posteriorly the body is furnished with cilia-like processes, which were never seen in motion, and which seemed to be direct processes of the ectoplasm. The protozoon was fed with wood-crumbs, and anterior pseudopodia-like processes (possibly abnormal) were observed. Prof. Grassi discusses similar parasites described by Leidy, and would unite one of these, *Trichonympha agilis*, with his *Lophomonadidea*, under the name *L. trichonympha*. He places the *Lophomonadidea* among the flagellates, beside the Trichomonads, Magosphæras, Sinuræ, and perhaps Mallomonads.

Amyloid Granules of Gregarinida.*—M. E. Maupas has found amyloid granules in the cytosome of all Gregarinids he has examined; they vary considerably in size, from 1 μ to 20 μ; they are oval, spherical, discoid, or irregular in form, and yet in every species of Gregarine (and of Infusorian) there is a characteristic and specific form; indeed, in the case of difficult species, they will furnish an excellent criterion. Among the large granules some are often found in which the mass is differentiated into concentric layers, similar to those of vegetable starch; and like them, they present, with polarized light, a polarization-cross; this, with direct solar rays on the mirror of the Microscope, can be seen even in granules 2 μ long. The author gives an account of the chemical tests which he has applied, and comes to the conclusion that the granules are composed of a body which resembles starch rather than glycogen; and he proposes to replace the term of paraglycogen proposed by Bütschli for that of zoo-amylum; from the chemical point of view the body is interesting as affording us an amyloid substance which reduces mixtures of copper and potash without there being any suspicion of an admixture of glucose; from the view of general cellular physiology their mode of formation is no less interesting, for they arise in the midst of a protoplasmic mass without the intermediation of any special organs, comparable to the amyloplasts of plants.

* Comptes Rendus, cii. (1886) pp. 120–3.

BOTANY.

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

a. Anatomy.*

Continuity of Protoplasm.†—Mr. S. Le M. Moore has studied the phenomena connected with the continuity of protoplasm in several species of *Strychnos*, and describes the difference presented in the different cases, as also in *Diospyros embryopteris* and *melanoxylon*. As a staining material he finds Judson's Oxford-blue and Sands' blue to answer as well as Hofmann's blue recommended by Gardiner. For permanent preparation the best mounting medium is water or calcium chloride. Mr. Moore dissents from Tangl's statement that the employment of ordinary reagents causes in all cases total plasmolysis. The best way of observing plasmolytic threads is to place sections in a drop of solution of iodine in alcohol on a slide, a minute or so afterwards placing a cover-slip upon them, and examining either in this state, or after addition of a small quantity of water. Although easily overlooked, the threads can then readily be made out with care; in many cases they may be seen to run into the intramural threads.

The author then proceeds to describe the phenomena of continuity in a considerable number of Florideæ. He adopts the view that the continuity is always direct in the early history of the cells, and in some cases (*Chondrus*, *Polyides*, *Furcellaria*) persistently so; while in others direct continuity may persist in one part of the thallus, and be supplanted by the indirect form in another (*Ceramium rubrum*, &c.). The young cells are placed in communication by means of a fine filament, upon which is in most cases placed a small nodule, just as a bead is strung upon a thread. The ground for this statement is that in surface-views of the nodule only a single small central pore can be seen, and that the thread itself, as slender as the single threads piercing the membrane of rings, cannot be seen to undergo division in passing the nodule. Attention is called to the rapid growth of the thread, accompanied by concurrent growth of the nodule to form a ring.

Currents of Protoplasm.‡—Herr A. Wigand distinguishes seven kinds of protoplasmic currents in the vegetable cell, viz.—(1) Circulation, when the currents cross one another in different directions in the cell-cavity, and unite in rays round the nucleus which is suspended in the cavity. (2) Rotation, when the protoplasm moves in simple or branched paths, and the nucleus is applied to the cell-well. (3) The currents observed in the young endosperm-cells of *Ceratophyllum*,

* This subdivision contains (1) Cell-structure and Protoplasm (including the Nucleus and Cell-division; (2) Other Cell-contents (including the Cell-sap and Chlorophyll); (3) Secretions; (4) Structure of Tissues; and (5) Structure of Organs.

† Journ. Linn. Soc Lond. (Bot.), xxi. (1886) pp. 595–620 (3 pls.).

‡ Forsch. a. d. Bot. Garten Marburg, i. (1885) pp. 169–224. See Bot. Centralbl., xxv. (1886) p. 4.

where a thick string of protoplasm occurs in the centre of the cells, dividing at the end into fine branches. (4) In the hairs of *Petunia hybrida* and cells of the rhizome of *Adoxa*, broad currents radiate from the nucleus, composed of a number of fine independent streamlets quite distinct from one another. (5) The revolution of the entire contents of a cell round its centre, as in *Æthalium septicum* and *Euglena viridis*. (6) The movement of protoplasm dependent on light, which causes the change of position of the chlorophyll-grains. (7) The movement of minute strongly refractive granules irregularly and independently in the protoplasm in various directions.

The author states that these currents commence on the formation of the vacuoles, and that the protoplasm and cell-sap are not separated by a membrane of any kind. He attributes them to a periodical change in the capacity of protoplasm for absorption.

Origin of Chlorophyll-grains.* — Herr K. Mikosch has investigated the mode of origin of chlorophyll-grains, and has come to a different conclusion from Schimper and Meyer,† that they always arise from the division of grains already in existence. For his preparing fluid he employed a dilute 5–10 per cent. solution of cane-sugar, which causes no contraction during the first twenty minutes, and does not in the least disturb the protoplasmic currents in uninjured cells. A very instructive object for observation is the cotyledons of *Helianthus annuus*.

If sections are first freed of oil by ether, and then placed in glacial acetic acid, the aleurone-bodies are dissolved, and there remains an undifferentiated reticulation of protoplasm. At a somewhat later stage of development numerous granules are seen in the parietal layer which approach one another in places, and later still the homogeneous network becomes also granular, and in the meshes are seen larger or smaller very ill-defined protoplasmic bodies of various forms, which are the young chlorophyll-grains, and become green in the light.

In the very young leaves of *Allium Cepa* there are also no differentiated protoplasmic structures to be seen; what were described as such by Meyer were drops of oil. The protoplasm of the young meristem-cells at the base of the leaf has a framework structure, and particular parts of the framework develope into chlorophyll-grains. The growing-points of *Elodea* and the young leaves of *Zea* were also found free of starch-generators. In the latter the starch which is conveyed from the endosperm to the young leaves can become organized at any spot, and especially where the protoplasm is densest, into starch-grains and chlorophyll-grains. Under other circumstances also he found that starch-grains are produced without the previous presence of starch-generators.

Amount of Chlorophyll in Leaves.‡—Dr. A. Hansen has carried out a series of experiments for the purpose of determining this point,

* SB. K. Akad. Wiss. Wien, i. (1885) 30 pp. (2 pls.).
† See this Journal, iii. (1883) pp. 238, 525; iv. (1884) p. 81.
‡ SB. Phys.-med. Gesell. Würzburg, 1885, pp. 140–4.

the plants employed being the sunflower, pumpkin, turnip, and tobacco. To isolate the chlorophyll (not separating the yellow and green pigments), he first boiled for a short time in water, and then extracted the chlorophyll by hot 96 per cent. alcohol. After saponifying the alcoholic solution, the pigment was extracted by alcohol-ether, evaporated, dried, and weighed. The results varied considerably with the species, but gave an average of 5·142 gr. to 1 sq. metre of surface. Comparing this with Sachs's statement that in favourable weather 1·6 gr. of starch are formed per hour per sq. m. (in the sunflower and pumpkin), it follows that 0·2 gr. of the chlorophyll-pigment are employed in the production of 1·0 gr. of starch. Dr. Hansen believes that the chlorophyll-pigment acts as the carrier of carbon dioxide to the assimilating protoplasm in the chlorophyll-grains.

Chlorophyll and the reduction of Carbonic Acid.*—By treating an alcoholic solution of chlorophyll with nascent hydrogen, M. C. Timiriazeff obtained a substance, which was yellow in dilute, and red in concentrated solutions. The spectrum of this substance showed a marked difference from that of chlorophyll; the line I in the red was absent, and a large band was present, extending some distance on each side of the position of line II of the chlorophyll spectrum. This substance rapidly becomes oxidized in contact with air, and turns green. The band I reappears in the spectrum when the slightest trace of oxygen is present.

The author gives the name "protochlorophylline" or "protophylline" to this substance, which he regards as a product of reduction of the green principle of chlorophyll, which he has already named "chlorophylline." Solutions of this substance, in sealed tubes with carbonic acid, retain their characteristics in the dark, but in sunlight rapidly become green, being converted into chlorophyll. The author is inclined to consider that the reduction of chlorophyll in living plants takes place apart from the plant itself, and that chlorophyll is formed by oxidation at the expense of carbonic acid. He considers that this "protophylline" exists in the living plant, and that the difference between the spectrum of freshly extracted chlorophyll, and that which has undergone oxidation is due to the presence of this "protophylline." Moreover, protophylline is only a stage in the reduction; for if a mineral acid or an excess of carbonic acid be present under the described conditions, a complete destruction of colouring matter takes place. He expects that the study of these substances in the normal and etiolated state of living plants will throw a light on the chemical side of the action of chlorophyll, which has lately been studied only physically.

Action of Chlorophyll in the Ultra-Violet Obscurity.†—MM. G. Bonnier and L. Mangin show that, in opposition to the ordinarily received doctrine that the action of chlorophyll (the absorption of

* Comptes Rendus, cii. (1886) pp. 686–9. Cf. this Journal, v. (1885) p. 837, *ante*, p. 281.

† Comptes Rendus, cii. (1886) pp. 123–6.

carbonic acid and the elimination of oxygen) only takes place under the influence of light, its action goes on also under the influence of the dark or ultra-violet rays. They remark that the definition of luminous radiations is subjective, and varies with individuals; that one of the principal absorption-bands of chlorophyll is cut by the limits of the visible spectrum at the violet end, and that the rays which correspond to the second part of the band are invisible to our eyes. As a proof of their position they give the following table :—

Species studied.	Date.	Relation of the volume of carbonic acid given off to that of oxygen absorbed.	
		In ordinary darkness.	In ultra-violet obscurity.
Pinus excelsa	March 2	0·73	1·05
Sarothamnus scoparius	„ 3	0·66	0·84
Pinus sylvestris	„ 21	0·85	0·99
Erica cinerea	„ 14	0·81	0·99
Ilex Aquifolium ..	„ 10	0·76	0·96

Elements of Lactose in Plants.*—M. A. Müntz, after describing the methods by means of which mucilage, gums, pectous and mucous bodies can be obtained from plants, gives the percentage of these substances found in various plants used as food by man and domestic animals.

Amongst grains, for instance, wheat contains 0·5 per cent. of pectose, which is situated chiefly in the bran; and 0·5 to 1·0 of gum, chiefly in the flour; barley contains 0·9 of pectose, 2·8 of gum. Amongst the Leguminosæ, white beans, broad beans, &c., have 2·0 to 4·0 per cent. of pectous material, chiefly as pectate of lime, in the testa. In the oleaginous forms, such as clover and lucerne, a large quantity of gum, as much as 45·0 per cent., is found. Amongst fruits, apples contain 0·8 pectose, 0·5 gum; plums, 0·6 pectose, 1·2 gum. Roots and tubers are generally rich in pectose and gums, e. g. carrot contains 1·0 to 2·0 per cent. of pectose, and 0·5 gum; potato, 0·6 and 0·8. Greens contain pectate of lime; cabbage, 0·6 to 1·2 per cent.; endive, from 0·5 to 1·0 per cent. of pectic acid. Amongst forage plants usually eaten by farm animals, grasses contain 1·1 to 4·5 of pectose and 1·0 to 3·0 of gum, and so on. In fermented liquors, gums are always present, e. g. beer contains 10 grams per litre; cider, 5 grams. In all these cases the pectic acid obtained from the plant is identical, but the gums are either lævorotatory as in fruits, or dextrorotatory, as in the Leguminosæ. By considering the above results it is possible to calculate what proportion of the principles able to form galactose, may be consumed by a milch-cow yielding a known quantity of milk per day. And the author finds (1) that the gums, mucilage, and pectous bodies of plants contain, in the products of their decomposition, galactose identical with that of milk sugar. (2) That these mucous substances exist in vegetable foods in such quantity that they can furnish galactose, which enters into the

* Comptes Rendus, cii. (1886) pp. 681–4.

constitution of the milk secreted by the mammary glands of the herbivora. The sequel to these researches will show if galactose, existing in plants in a state of varied combination, is the only source of the galactose of milk sugar; or if the animals during lactation can produce this sugar by the help of substances, the fundamental molecule of which is different, thus carrying on synthesis and transformations which we are more accustomed to meet with in the vegetable world.

Rosanoff's Crystals in Endosperm-cells of Manihot Glaziovii.*—Mr. S. Le M. Moore describes the occurrence of the above as the first recorded instance of the existence of crystals in a resting-tissue. They consist of calcium oxalate, and occur in four different forms—clinorhombic, sphere-crystals, five- or six-sided short prisms with plane faces, and twin-crystals. They are in various ways surrounded and attached to the wall of the inclosing cell by cellulose.

Allantoin, Asparagin, Hypoxanthin, and Guanin in Plants.†—Pursuing their previous researches on this subject,‡ Herren E. Schulze and E. Bosshard gives details of the occurrence and the proportion of these substances found in various plants. They find the quantity of amides formed to be larger when the plants are grown in the dark.

Excretion of Salts from Leaves.§ — Herr A. Andrée claims to have established, as the result of experiment, that leaves transpire not only water, but soluble salts which have become superfluous for their vital processes; and that this takes place especially through the water-pores. Chlorides of magnesium and sodium were found to be excreted in this way.

Growing-point of Phanerogams.‖—Mr. P. Groom has come, on this subject, to quite a different conclusion from Dingler and Korschelt, who maintain the existence of a single apical cell in the growing-points of the stem of some Gymnosperms and Angiosperms. He considers their statement to result from errors of observation, resulting from the mode of preparation with potash, or from unequal focusing of the Microscope. Mr. Groom's observations were made exclusively on the apex of old stems, or of the lateral branches of old trees. The medium found to be most efficient was Noll's eau de Javelle; optical longitudinal sections and surface-views were taken of nearly all the objects. The subjects were:—among Gymnosperms: *Abies pectinata*, *Pinus canadensis* and *sylvestris*, *Taxodium distichum*, *Juniperus communis*, and *Ephedra altissima;* among Angiosperms: *Elodea canadensis*, *Panicum plicatum*, *Festuca*, *Myriophyllum spicatum*, *Ceratophyllum demersum*, *Hippuris vulgaris*, and *Utricularia minor*. In none of these was an apical cell found, although a longitudinal section often gave a deceptive appearance of one.

* Journ. Linn. Soc. Lond. (Bot.), xxi. (1886) pp. 621–4 (8 figs.).

† Zeitschr. Phys. Chem., ix. pp. 420–44. See Journ. Chem. Soc. (Abstr.), 1885, p. 1007.

‡ See this Journal, v. (1885) p. 97.

§ Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 313–6. ‖ Ibid., pp. 303–12 (1 pl.).

Lining of Intercellular Passages.*—Herr H. Schenck has repeated the observations of Russow† and others on the alleged layer of protoplasm in the intercellular passages. He finds the layer described by Russow very generally present; but agrees with Gardiner‡ that it is not protoplasmic in its character, but is rather the lignified or mucilaginous outermost layer of the cell-wall bounding the intercellular space. As Russow pointed out, this layer is especially noticeable in bog- and water-plants, as *Nuphar lutea*, *Potamogeton natans*, *Limnanthemum nymphæoides*, *Hottonia*, *Utricularia*, *Myriophyllum*, &c. It is readily recognized by a potassium iodide solution of iodine (0·2 per cent. I, 1·64 per cent. KI) and sulphuric acid (when alcohol material is used 5–6 parts H_2SO_4 to 1 part H_2O). If to a section saturated with the iodine solution beneath a cover-glass, the acid is introduced drop by drop, the wall of the parenchymatous cells surrounding the air-passages begins to swell, and to take an intense blue colour, while the passages are bounded by a delicate lighter or darker yellow, or reddish-brown pellicles of a cuticular character, as is clearly shown by treatment by Schultze's maceration-process, viz. boiling in potassium chlorate and nitric acid, when the lining in question is completely dissolved.

Capacity of Bark for Swelling.§—According to Herr R. Mann, the capacity for swelling of a zone of bark differs in intensity, as a rule, in the three dimensions; that in the radial direction being almost always greater than in the other two. Each zone of the bark appears to acquire a specific capacity for swelling.

"Ant-plants" of the Indo-Malayan Archipelago and New Guinea.‖—Dr. O. Beccari gives a summary of what is at present known respecting this remarkable group of plants, in which ants take up their residence in special chambers in the tissue, and plant and animal seem each necessary to the life of the other. A good example is furnished by *Acacia cornigera*, and its connection with a particular species of ant, *Pseudomyrma bicolor*, which makes its nest in the strong bifurcate spines of the stem and branches, after perforating them near their apex. They devour the pulpy interior of the spine, and then find nutriment in the saccharine and nutritive substances in the glandular structures of the young leaves. Here they remain always on the alert, forming an army of defence against herbivorous animals and other species of ants which would destroy the leaves. If cultivated where these friendly ants cannot gain access to it, the plant appears to perish.

Another exceeding good illustration of these formigerous plants is *Myrmecodia*, an epiphytic genus of Rubiaceæ, and others are found scattered through the orders Myristicaceæ, Euphorbiaceæ, Verbenaceæ, Melastomaceæ, and Palmæ.

* Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 217–25 (1 pl.).

† See this Journal, iv. (1884) p. 404. ‡ Ibid., p. 585.

§ Zeitschr. f. Naturwiss., iv. (1885) pp. 348–73. See Bot. Centralbl., xxv. (1886) p. 6.

‖ Malesia, ii. (1884) 128 pp. and 25 pls. See Arch. Ital. de Biol., vi. (1885) pp. 305–41.

Dr. Beccari explains the phenomenon on the basis of variability and heredity. When a seed of *Myrmecodia* falls on the branch of a tree and germinates, a small swelling makes its appearance on the tigellum, serving the purpose of a reservoir of water for the plant during the dry season, but never attaining any great development without the intervention of ants. When these visit it for the sake of food, they cause a hypertrophy of the cellular tissue similar to that of galls; and this individual peculiarity is transmitted to the descendants until it becomes fixed by heredity. These phenomena occur in many species of *Myrmecodia* and *Hydnophytum*.

Dimorphism of Jasminum.*—Sig. R. Pirotta describes a species of Jasminum, *J. revolutum* Sims, with short-styled and long-styled flowers, accompanied by the ordinary differences in the position of the stamens and the size of the pollen-grains. Both forms are proterandrous.

Causes of the Zygomorphy of Flowers.†—Dr. H. Vöchting distinguishes between two kinds of zygomorphy, constitutional, when the flower itself developes a monosymmetrical form, e. g. *Aconitum;* and accidental, when the original polysymmetrical form of the flower becomes monosymmetrical by the movements of particular parts. This last kind of zygomorphy, of which *Epilobium angustifolium* is a good example, is entirely the result of geotropism, which causes the sepals and petals to bend upwards, the stamens and styles to bend downwards.

Bud-Scales of Conifers.‡—As the result of an examination of sixty-three species, Herr J. Grüss states that in by far the greater number of conifers the young shoots are covered by bud-scales furnished with a very resistent epidermis on their under side, usually composed of elongated sclerenchymatous cells, the outermost wall of which is much thicker than the rest, and distinctly laminated; they usually possess pores and a delicate cuticle; the cell-cavity is small, and sometimes entirely closed. This typical form occurs in *Picea*, *Abies*, *Tsuga*, *Pinus*, *Cedrus*, *Larix*, and *Torreya*.

A considerable number of conifers (*Cephalotaxus*, *Podocarpus*, &c.), have buds with a simple epidermis. In *Araucaria Bidwillii* and *Cunninghamia sinensis* there are no buds, the period of growth beginning with the development of scale-like leaves, which exhibit the structure of ordinary leaves only to a rudimentary extent. These species present a transition to those like the Cupressineæ, which produce no bud-scales.

In many cases the development of bud-scales is clearly related to the habit and climate of the species.

Mechanism for the Opening of Pore-capsules.§—According to Dr. G. Beck the bursting of pore-capsules is always due to the drying

* Rend. R. Istit. Lombardo, xviii. (1885) 5 pp. See Bot. Centralbl., xxv. (1886) p. 201.

† Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 341–5.

‡ Grüss, J., 'Die Knospenschuppen der Coniferen,' 43 pp. and 1 pl., Berlin, 1885. See Bot. Centralbl., xxv. (1886) p. 38.

§ Verhandl. K. K. Zool.-Bot. Gesell. Wien, xxxv. (1886) pp. 23–4.

of the pericarp. The various modes may be arranged under four different types, viz.:—

1. In the genera of Campanulaceæ, *Campanula*, *Adenophora*, *Trachelium*, *Phyteuma*, and *Specularia*, the pores are formed between the veins of the pericarp, and are due to the bending outwards of wedge-shaped masses of sclerenchyma in particular parts of the dissepiments.

2. In the genus *Masschia* the opening of the pericarp is the result of several superposed transverse fissures, in consequence of a rupture of the thin portions of the pericarp-wall between the masses of vascular bundles.

3. In *Antirrhinum* and *Linaria* the pores arise in previously formed projections at the apex of the capsule, and the bursting takes place suddenly and irregularly.

4. In *Papaver* the pores are the result of the contraction and bending upwards of the rays of the stigma; a loculicidal pore being formed corresponding to each partial loculus of the capsule.

Dorsiventral Structure of the Roots of Orchideæ.*—M. E. de Janczewski has examined the structure of the aerial roots of a number of Orchideæ, and finds that, while many have a radiar structure like that of the earth-roots, others, as those of *Aëranthus fasciola*, *Phalænopsis amabilis*, *Sarcanthus rostratus*, and *Epidendron nocturnum*, have a remarkable dorsiventral structure which is much the most strongly developed in the first-named.

In the aerial roots of this epiphytic orchid—which are of great length compared to the very abbreviated leafless stem, and are the only assimilating organs—the velamen consists, on the upper surface and the margin, of only a single layer, which perishes very early, giving a dark-green colour to these parts; while the under side, where the velamen is well developed, is white. The root-hairs and air-chambers are confined to the under side; the latter are in connection with the intercellular system. The central vascular cylinder has the ordinary radiar structure.

Externally these roots are flat on the upper side, with deep longitudinal furrows, the under side forming a projecting angle; and the history of development shows that this structure is congenital and is not the result of external conditions, such as light.

Roots acting as Leaves.†—Dr. Fritz Müller reports a unique instance of an epiphytic orchid, *Aëranthus*, which, though only consisting of roots and heads of small flowers, nourishes itself independently, since the long, much coiled roots contain chlorophyll, and thus act as leaves.

Vernation and Methods of Development of Foliage as protective against Radiation.‡—Rev. G. Henslow describes the vernation and mode of opening of the leaves of a number of woody and herbaceous

* CR. Acad. Sci. Cracovie, xii. (1884). See Ann. Sci. Nat. (Bot.), ii. (1885) pp. 55–81 (3 pls.).

† Kosmos, ii. (1885) p. 443. See Biol. Centralbl., v. (1886) p. 765.

‡ Journ. Linn. Soc. Lond. (Bot.), xxi. (1886) pp. 624–33 (15 figs.).

plants, and deduces the conclusion that vernation, conduplication, the various positions taken up by developing leaves, &c., all conspire to protect them from the evil effects of radiation.

Anatomy and Morphology of submerged Monocotyledons.*—M. T. Holm gives a detailed description of the structure of two submerged species of Monocotyledons, *Halophila Baillonii*, a marine plant, and *Elodea densa*, from Brazil.

Leaves of Sagittaria.†—According to M. J. Costantin, the two forms of leaf of *Sagittaria sagittæfolia* are not the result of external conditions, and do not pass the one into the other, but are distinct from the bud-condition. The ribbon-shaped leaves undergo great change when they come into contact with the air, only then developing stomata and palisade-tissue. When the plant grows at a great depth in the water, it has not sufficient vitality to produce the arrow-shaped leaves, and does not flower.

Anatomy of the Leaves of Aroideæ.‡—The examination of a large number of species of Aroideæ leads Dr. M. Dalitzsch to the conclusion that the anatomical structure of the leaves affords characters for their systematic classification, derived from the presence or absence of intercellular sclerenchymatous fibres, the presence or absence of laticiferous tubes, and from the form in which the oxalate of lime is deposited in the cells. The leaves of *Spathiphyllum*, *Rhaphidophora*, *Monstera*, and *Scindapsus* have intercellular sclerenchyma-fibres, but no latex-tubes; the remaining genera have latex-tubes, but not the intercellular fibres. Raphides-cells are especially abundant in *Colocasia*. *Amorphophallus* and *Acorus* have no crystals; the latter abounds in resin-cells. Large intercellular spaces are wanting only in *Anthurium*, *Monstera*, *Spathiphyllum*, and *Scindapsus*, which grow on rocks, or epiphytically on trees; they occur in the epiphytic *Philodendra*, but are filled, not with air, but with a very thin mucilage, often containing tannin. The red and yellow dots which occur especially on the under side of the leaf of many species of *Anthurium* are glands, the secretion being formed between the cuticle and the epidermal membrane.

Closing of the Scar after the Fall of the Leaf.§—According to Herr L. Staby, the healing of the wound after the fall of the leaf takes place in four different ways, viz.:—1. By drying up of the surface of the wound (tree-ferns); 2. By the formation of reticulated cells (Orchideæ); 3. By the formation of periderm; this is much the most common mode; 4. By temporary closing by gum; this is also very common.

* Bih. K. Svenska Vetens.-Akad. Handl., ix. (1885) (4 pls.). See Bot. Centralbl., xxv. (1886) p. 6.

† Bull. Soc. Bot. France, xxxii. (1885) pp. 218–23.

‡ Bot. Centralbl., xxv. (1886) pp. 153–6, 184–7, 217–9, 249–53, 280–5, 312–8, 343–9 (1 pl.).

§ Staby, L., 'Ueb. d. Verschluss der Blattnarben nach Abfall d. Blätter,' 39 pp., Berlin, 1885. See Bot. Centralbl., xxv. (1886) p. 38.

β. Physiology.*

Fertilization of Greenland Ericaceæ.†—Prof. E. Warming speaks of the biology of the species of Ericaceæ gathered in Greenland, sixteen in all, especially with reference to the arrangements for pollination. All have coloured flowers; many are scented, and all except *Pyrola* produce honey. The position of the corolla, and the very common presence of hairs inside, all point to cross-fertilization, although in most cases self-fertilization is quite possible. The pollen-grains are in all cases smooth and dry, and united into tetrads. All the Greenland Ericaceæ are more or less shrubby; and in all, except *Vaccinium uliginosum*, the leaves are deciduous.

Influence of Oxygen at high Pressure on the Disengagement of Carbonic Anhydride by Germinating Plants.‡—The general result of the experiments made by Dr. W. Johannsen with air and oxygen at the ordinary pressure, and at 2, 4, and 5 atmospheres, is that the disengagement of carbonic anhydride increases at first as the pressure of oxygen increases, but that this increase is only temporary; the respiration gradually diminishes (more quickly as the pressure is greater), and the plants rapidly die. The most interesting result of the experiments is the discovery of an inductive effect exercised by the presence of oxygen at a high pressure for a short time; as soon as the ordinary pressure is restored a great increase in the respiration is obtained, amounting to as much as 50 per cent. in the case of maize. The cause of this inductive action is unknown.

Assimilation and Respiration.§—Prof. U. Kreusler has carried out a series of experiments with the view of determining the proportion of carbon dioxide in the atmosphere most favourable to the assimilation of plants, and finds that it lies between 1 and 10 per cent. In dry air plants assimilate much less strongly than in air that is moderately moist; hence the comparative suspension of the growth of vegetation during very dry weather. Complete saturation of the atmosphere appears to have in itself no unfavourable influence on transpiration. The effect of the electric light, as compared with daylight, whether diffused or direct sunshine, was very greatly to reduce the amount of assimilation in proportion to the respiration.

Apical growth and Phyllotaxis.‖—Prof. S. Schwendener brings further arguments in favour of his view that there is no coincidence in the mode of apical growth in all the higher plants. It is well established that in the roots of Marattiaceæ there are four apical cells.

* This subdivision contains (1) Reproduction (including the formation of the Embryo and accompanying processes); (2) Germination; (3) Nutrition; (4) Growth; (5) Respiration; (6) Movement; and (7) Chemical processes (including Fermentation).

† SB. Botan. Sällsk. Stockholm, April 22, 1885. See Bot. Centralbl., xxv. (1886) p. 30.

‡ Untersuch. Bot. Instit. Tübingen, 1885, pp. 686–717. Cf. Journ. Chem. Soc. Lond., l. (1886) p. 274.

§ Verhandl. Naturh. Ver. Preuss. Rheinlande, xlii. (1885) pp. 330–7.

‖ SB. K. Preuss. Akad. Wiss., xl. (1885) pp. 921–37 (1 pl.).

In the Gymnosperms the three-sided apical cell is sometimes replaced by a four-sided one, sometimes by several. In the case of *Araucaria excelsa* different shoots from the same individual gave different results.

Notwithstanding the contrary assertion of Dingler, the researches of Pringsheim, Hanstein, Strasburger, and Pfeffer on *Salvinia*, *Azolla*, *Marsilea*, and *Selaginella*, show that there is no necessary connection between phyllotaxis and the septation of the segments. The author was unable to confirm the observations of Reess on *Equisetum scirpoides*, that there was any definite connection between the formation of whorls and the segmentation of the apical cell. In Ferns with a three-sided apical cell the leaf-spiral is sometimes homodromous, sometimes antidromous to the spiral of the segments: in *Struthiopteris* the apical cell is two-edged, but the phyllotaxis spiral. In Mosses the relationship is simple because only one leaf proceeds from each segment.

Influence of Light on the Formative Processes in Plants.*—For the purpose of experiments on this subject, Dr. E. Wollny, employed cubical zinc vessels filled with moist quartz-sand. One of these was completely darkened by being covered up by another similar vessel. The loss of water was replaced every day. The plants employed, maize, peas, and beans, were observed for 35 days after appearing above the soil.

The conclusion arrived at was, that with decrease of the intensity of the light the growth in length of the stem (in dicotyledons), or of the leaves (in certain monocotyledons), was promoted, while, on the other hand, the development of the assimilating and of the nutritive organs and those for the absorption of water, was affected injuriously. The amounts of carbohydrates and of organic nitrogenous substances in the plant were in proportion to the intensity of the light, while the amount of water contained in the plant was in inverse proportion to the intensity of the light.

Growth of Shoots of Potato when the roots are removed.†—Herr C. Kraus describes experiments on the effects of the removal of the roots from potato-tubers in relation to the retarding influence of light on the shoots. No very definite results are arrived at.

Sensitive Movements of Plants.‡—The late Prof. E. Morren gives a *résumé* of the present state of our knowledge respecting the various kinds of movements in plants, and contends in favour of his view previously published of the essential identity of the process of digestion in plants and in animals.

Effect of different parts of the Solar Spectrum on Transpiration.§—Rev. G. Henslow gives a *résumé* of results obtained by various observers on this point, and discusses the various methods employed, pointing out in particular the uncertainty of experiments on detached parts of plants. He describes then a series of experiments of his own

* Wollny's Forsch. a. d. Geb. der Agriculturphysik, vii. (1885) pp. 351–75. See Bot. Centralbl., xxv. (1886) p. 141.

† Ber. Deutsch. Bot. Gesell., iii. (1886) pp. 388–90.

‡ Bull. Acad. Roy. Sci. Belgique, x. (1885) pp. 851–900.

§ Journ. Linn. Soc. Lond. (Bot.), xxii. (1885) pp. 81–98.

on plants grown in pots, the pot itself being carefully inclosed in gutta-percha, so that no evaporation of water could take place except through the plant itself. Mr. Henslow's general conclusions are in accordance with those of Wiesner. While obscure heat-rays cause a certain proportion of the loss of water by evaporation, transpiration *per se* is especially, if not entirely, due to those particular bands of light which are absorbed by chlorophyll; such light, when arrested, is converted into heat, which then raises the temperature within the tissues and causes the loss of water.

Influence of high Temperatures on the Transpiration-current in Wood.*—The result of experiments on this subject by Herr C. A. Weber, for the purpose of testing the correctness of the imbibition theory, led to the conclusions that an entire chemical and physical change in the transverse section is without any essential influence on the ascent of the transpiration-current in branches of *Ribes;* and that in branches of *Corylus* and *Sambucus*, a disturbance was caused by the withering of the leaves, which could be removed by placing in water of 40°–45° C.

Conducting-capacity of Duramen.†—Herr C. Rohrbach has experimented on the capacity for conducting water of the duramen of a number of trees and shrubs. His conclusion is that it has no power of doing this in sufficient quantity. The chief seat of the conduction of water is the alburnum, although the duramen, when present, may be able to assist to a limited extent.

Imbibition of Wood.‡—Prof. E. Godlewski derives the following conclusions on this subject from the results of a series of experiments:—

1. When wood dries, a decrease of volume takes place from the moment when all the water has disappeared from the cell-cavities; under perfect desiccation this may amount to 20 per cent. of the original volume.

2. As wood contracts, the absolute capacity of the cells increases, a fact which points to a stronger contraction of the cell-walls in the radial than in the tangential direction.

3. When the desiccation of the wood has not advanced so far, the cell-walls absorb, in air saturated with aqueous vapour, as much water as they had previously lost by evaporation, the capacity of the cells diminishes, and the wood again assumes the condition in which it existed before the contraction.

4. When the desiccation has advanced further, it absorbs less water when brought into air saturated with vapour than it contained before the contraction, but it again assumes its original volume, so that the capacity of the cells has again increased, a proof that the imbibed water is deposited more in the tangential than in the radial direction between the molecules of the cell-wall.

* Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 345–71.

† Zeitschr. f. Naturwiss., iv. (1885) pp. 319–47. See Bot. Centralbl., xxv. (1886) p. 105.

‡ Verhandl. Polon. Gesell. Naturf. "Copernicus." See Bot. Centralbl., xxv. (1886) p. 236.

5. When completely dried and then swollen again in a moist atmosphere and again dried, wood contracts less than when quite fresh, but shows a greater volume than fresh wood similarly dried.

6. From these facts it is shown that when wood is but slightly dried the molecular structure of the walls undergoes no change, but that changes take place as soon as the desiccation is more complete. It is not therefore possible to infer the quantity of water imbibed by the cell-walls of wood in the fresh condition, from the imbibition of wood dried at 100° C.

Carbonates in Living Plants.*—MM. Berthelot and G. André have estimated the amount of soluble and insoluble carbonates in the root, stem, leaves, and flowers of different plants, at different stages of their growth; the analyses are given in detail. Fresh plants contain a certain amount of free carbon dioxide produced by internal oxidation. In the root, leaves, and flowers, the carbon dioxide is mainly in the free state, while in the stem it seems to exist entirely in the form of carbonates.

Relation of the Vegetable Acids to Assimilation.†—Using De Vries's curcuma-test for the presence of vegetable acids in parts of plants, Herr O. Warburg has determined that in succulent plants the two processes of the formation and disappearance of the acids are going on at the same time, the increase or decrease of these substances depending on their relative energy. Thin-leaved plants show, as a rule, no difference in the amount of acid by day and by night. Plants with dry leathery leaves show, on the contrary, a small diminution by day; this being much more considerable in most succulent plants, as Crassulaceæ, Aloineæ, Euphorbiaceæ, and Stapelieæ (some Asclepiadeæ and Compositæ form an exception), and still greater in the epiphytic Orchideæ and Bromeliaceæ. Experiments on etiolated plants and on normal plants under coloured media, show that assimilation and the disappearance of acids are dependent on the same conditions, the latter being much the strongest with the least refrangible rays of the spectrum. The author infers that the acids are used up in a kind of intramolecular assimilation. The abundance of acids in succulent plants is due to imperfect oxidation. The acid present in largest quantities appears to be malic acid.

Assumed Bacterian Origin of Diastase.‡—M. E. Laurent has put to an experimental test the theory of Béchamp and others § that the formation of diastase in the higher plants, whether in germination or in other metastatic processes, is due to the presence of bacteria in the interior of the tissues. Besides the ordinary appliances for sterilizing the vessels and instruments employed, M. Laurent placed living parts of plants in a suitable nutrient substratum, after freeing them entirely from bacteria, and preventing, as far as possible, infection through the air. The substrata employed were Koch's nutrient

* Comptes Rendus, ci. (1885) pp. 24–30. Cf. this Journal, *ante*, p. 105.
† Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 280–9.
‡ Bull. Acad. R. Sci. Belgique, x. (1885) pp. 38–57.
§ See this Journal, v. (1885) p. 693.

gelatin and plum-juice. Entire seeds of *Zea*, *Hordeum*, *Helianthus*, &c., were carefully washed with a 0·2 per cent. solution of sublimate, and then grown in the prepared substratum. The greater number of cultures remained entirely free from bacteria. The same was the case when pieces of tissue of growing seeds were placed in the same solutions with the same precautions. The general result obtained was that no bacteria are present in living vegetable tissues, and that the fermentative processes in them are due to the vital activity of the cells.

In the same way M. Laurent demonstrated that the power possessed by germinating seeds of reducing nitrates to nitrites is independent of the presence of bacteria.

Selective Alcoholic Fermentation.*—According to M. E. Bourquelot, there is no such thing as real selective fermentation; in a mixture of sugars each constituent ferments according to its own peculiar laws independently of the other constituents. When yeast is introduced into a mixture of maltose and levulose, or of glucose and levulose, both sugars ferment simultaneously, but at unequal rates. In the first mixture the levulose ferments more rapidly than the maltose, while in the second the glucose ferments more rapidly than the levulose. In both cases, however, at a certain stage in the fermentative process, the order of selection or the relative rate of fermentation becomes reversed. This arises simply from differences in the rate of dialysis through the cell-wall.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Mode of Dissemination of the Spores in Vascular Cryptogams.†—M. Leclerc du Sablon states that the mode in which this function is effected is the same in all vascular cryptogams except the aquatic Rhizocarpeæ, viz. by the action of desiccation.

Taking *Polystichum Filix-mas* as a type of ferns, the dehiscence of the sporange commences at the spot where the annulus ceases; this latter gradually straightens, and then curves in the opposite direction. The spores remain attached to the annulus, and are detached and thrown to a distance by its sudden return to its original position. This is the mode of dehiscence of the sporange in all the Polypodiaceæ, and the process is the same in all essential points in *Trichomanes*, in *Schizæa*, in *Todea* and other Osmundaceæ, and in the Marattiaceæ. In the Ophioglossaceæ the dehiscence is effected by the unequal tension of the epidermal and subepidermal layers of cells of the epidermis of the sporange.

In the Equisetaceæ the cells of the wall of the sporange have annular or spiral thickenings, and the dehiscence is caused by inequality of contraction resulting from this circumstance. The

* Comptes Rendus, c. (1885) pp. 1404–6, 1466–9.
† Ann. Sci. Nat. (Bot.), ii. (1885) pp. 5–27 (1 pl.).

active movements of the spores themselves depend upon unequal lignification of the elaters.

The structure of the sporange of Lycopodiaceæ and the macrosporange of Selaginellaceæ is nearly uniform, and was studied in *Selaginella*, *Psilotum*, *Tmesipteris*, and *Isoetes*. The outer walls of the epidermal cells are composed of pure cellulose, while the inner and side walls are lignified, and dehiscence is caused by the outer face of the cells contracting more than the inner face in dry air.

Vascular System in Davallia.*—M. A. Trécul classifies the species of this genus of ferns under four sections—*Eudavallia*, *Leucostegia*, *Microlepia*, and *Odontoloma*—and describes the structure of the fibrovascular system in each.

In Eudavallia (*D. pentaphylla*, *stenocarpa*, *canariensis*, and *elegans*) there are in the central region of the stem two principal bundles, placed at some distance one above the other and parallel, the lower one being usually the larger. A transverse section shows other slenderer bundles, arranged in a curve on each side, and forming a network between the insertion of the superposed fronds. In each petiole are two anterior, and one, two, or three dorsal bundles, which may be wanting in the smaller fronds.

In Microlepia (*D. trichosticha* and *strigosa*) and Leucostegia (*D. immersa* and *Novæ Zelandiæ*) the cellulo-vascular system of the stem takes the form of a continuous tube, open only at the insertion of the fronds. Odontoloma (*D. repens*) also has a tubular vascular system in the rhizome, but is not regularly thickened, as in the two preceding sections, and presents also other points of difference in its structure, which are described in detail.

Stolons of Nephrolepis.†—M. A. Trécul replies to M. Lachmann's contention ‡ that these organs are cauline in their origin. He denies M. Lachmann's statement that it is always the case in fern-stems that the vascular bundles are arranged radially, and that the small primordial vessels are always on the external face of the bundles, as in the roots. On the contrary, in the stem of many species, the bundles are disposed parallel to the circumference, and there are no small primordial vessels—annular, spiro-annular, reticulated, or spiral—except at the margin of the network, and only below the insertion of the petiolar bundles. M. Trécul gives a number of examples of this structure. He does not consider the absence of a root-cap as by any means conclusive evidence that the structures in question are not of radicular origin.

Muscineæ.

Peristome of Mosses.§—Pursuing his researches on this subject, M. Philibert now describes the peristome of several species of *Bryum*, including one new one, *B. Kindbergii*. He regards the series of forms

* Comptes Rendus, ci. (1885) pp. 1453–9.

† Ibid., pp. 915–20.

‡ See this Journal. v. (1885) p. 1033.

§ Rev. Bryologique, xii. (1885) pp. 81–5, Cf. this Journal, v. (1885) pp. 100, 1035.

allied to *B. pendulum* as indicating best how the external and internal peristome of the Bryaceæ represent, the one by its ventral, the other by its dorsal plates, the divisions of one and the same layer of cells analogous to that which composes the teeth of *Splachnum*.

Abnormal developments in the Capsule of Mosses.*—Dr. K. M. Gottsche describes the following examples of abnormal development, viz.—(1) Two stems of *Polytrichum gracile*, with the setæ perfectly distinct, and the capsules covered by a common bilocular calyptra; (2) *P. juniperinum* in which the seta perforates the calyptra, and bears at its summit the fully developed capsule; (3) several examples of *Bryum pseudotriquetrum* with two or three capsules developed on one seta. The first abnormality results from two perfectly distinct archegonia, the hairy coverings of which (found in *Polytrichum* and *Orthotrichum* only) have become united in their growth.

Fructification of Didymodon ruber.†—M. Philibert has for the first time met with this alpine moss in fruit. It is strictly dicœcious, the male and female plants forming separate tufts. M. Philibert recognizes in the Barbulaceæ a progressive evolution of the peristome, the extremes of which are represented on one side by *Barbula*, on the other side by *Pottia*, and of which the genera *Didymodon*, *Desmatodon*, and *Trichostomum* are intermediate terms. *Didymodon rubellus* and *ruber* represent two degrees of this evolution, which, starting from the structure common to the Aplolepideæ, reaches a very special type; the peristome of *D. rubellus* approaching more nearly the type of *Pottia*, that of *D. ruber* the type of *Trichostomum*.

Scandinavian species of Orthotrichum and Ulota. ‡—In a monograph of the Scandinavian species of these genera based on the work of Venturi, Herr A. L. Grönvall describes seven new species.

Regeneration of the Marchantieæ. § —Dr. H. Vöchting has made a series of observations of the vegetative power of reproduction displayed by the thallus of the Marchantieæ, using as his subject chiefly *Lunularia vulgaris*.

The author distinguishes, in the first place, between organs with unlimited and those with limited power of growth, among the former being the thallus. By making sections of this in various directions he concludes that the new formations always arise on what is morphologically the under side, usually from the tissue of the mid-rib, and grow in the direction of the apex. This differentiation of upper and under side is not, however, dependent on the position of the shoot, nor on the relative illumination, but, according to the experiments of the author, on internal causes dependent on the organization of the thallus. Isolated masses of cells possess this faculty of new

* SB. Gesell. Bot. Hamburg, Jan. 29, 1885. See Bot. Centralbl., xxv. (1886) p. 224.

† Rev. Bryologique, xii. (1885) pp. 89–94.

‡ Arsberätt. Malmö allm. läroverk, 1885, pp. 1–25 (1 pl.). See Bot. Centralbl., xxiv. (1885) p. 3.

§ Pringsheim's Jahrb. f. Wiss. Bot., xvi. (1885) pp. 367–414 (4 pls.).

formation, without reference to the part of the thallus to which they belonged.

Of purely vegetative organs with limited growth, the wall of the cupule was the only one examined, and in this the new formations always originated at the base. The same was also the case with *Marchantia polymorpha*. The receptacle and its pedicel exhibited the same phenomena. If the latter is separated from the thallus, whether with or without the receptacle attached to it, vegetative shoots arise from its base, but at different heights, according to the vital conditions. When female receptacles are detached, the adventitious shoots spring either from near the cut surfaces or from the furrows on the under side of the rays of the receptacle. Separate rays, or even their outer ends, gave birth to such shoots from their base.

With regard to the cause of the phenomenon, the author agrees on the whole with Pflüger's view. He believes that the locality and the nature of the newly formed organs do not depend on the accumulation of specific nutrient substances, but on the structure of the protoplasmic framework and the mode of combination of its molecules. They are connected also with the properties of the gemmæ or bulbils.

Experiments on the development of the gemmæ in *Marchantia* and *Lunularia* showed that the direction of the first division-wall, and the consequent eventual form of the organ, do not depend on gravitation; every separate portion of the bulbil exhibits a polarity which the author again refers to the arrangement of the molecules in the protoplasmic framework.

Attention was paid also to the histological structure of the adventitious shoots from the thallus, the pedicel of the receptacle, and the receptacle itself. In sections of the thallus these shoots always spring from the undermost cells of the cortex, or, when this is wanting, from the undermost layer of the parenchymatous tissue; the ventral cortical layer of the mid-rib displays especial capacity for cell-division. When the shoot is being formed, the growing point appears behind its centre, and only subsequently occupies its normal lateral position as the result of displacement. Several shoots are usually formed side by side in the ventral furrow of the pedicel and in the furrows which pass along the rays of the receptacle. In both cases they originate by division of the outermost cortical cells which line the furrows.

Abnormal Development of the Sporogonium of Lejeunia.*—Dr. K. M. Gottsche describes a peculiarity in the structure of the sporogonium in many species of *Lejeunia* from widely separated localities, consisting in the excessive development of the parts designed for the protection of the fructification. The entire envelope appears to be composed of two superposed parts; the upper part retains its normal structure adapted to assist the development of the capsule and the spores, while the lower portion exhibits an unusual

* SB. Gesell. Bot. Hamburg, Feb. 26, 1885. See Bot. Centralbl., xxv. (1886) p. 255.

development of the part which usually constitutes the foot. The peculiarity does not appear to be the result of the attacks of insects or other parasites.

Hepaticæ inclosed in Amber.*—Dr. K. M. Gottsche sums up what is at present known with regard to the remains of Hepaticæ which have been found inclosed in amber. He refers them to the five following genera, viz.—*Frullania*, *Lejeunia*, *Radula*, *Scapania*, and *Jungermannia*.

Algæ.

Evolution of Algæ.†—MM. E. Heckel and J. Chareyre trace the probable evolution of the various groups of algæ from the simplest forms (chlorophyllaceous Protophyta), such as *Protococcus*, from which spring at once three parallel series distinguished by the colour of their endochrome, green, blue-green, and brown. Although this difference has, in itself, but little physiological value, being dependent on adaptation to external conditions as respects light, it nevertheless serves as the point of departure of three distinct lines of descent. Of these the blue-green series never advances more than a few steps in development, the brown series attains a considerably higher degree of differentiation, while the green series developes into a far larger number of very distinct forms, finally giving birth to the Florideæ and Muscineæ.

The green series of algæ derived from *Protococcus* divides at once into four parallel groups, the Siphoneæ, Cœnobieæ, Confervaceæ, and Conjugatæ. In the Siphoneæ the single cell branches, and the different portions assume different functions; in the Cœnobieæ a number of intercellular organisms collect into a colony; in the Conjugatæ and lower Confervaceæ the primitive cell divides into a multicellular filament; in the higher Confervaceæ into a plate or mass of cells.

The group of Siphoneæ starts from the Sciadieæ, in which the conjugation of zoospores presents the first manifestation of sexuality. In the Bryopsideæ (*Bryopsis*, *Caulerpa*, *Acetabularia*, &c.), the thallus displays great ramification, and this family then gives birth to two branches, the Codieæ with isogamous reproduction, and the Vaucherieæ in which the sexual elements are differentiated into oospheres and antherozoids.

The Cœnobieæ start from the isogamous Hydrodictyeæ, the next stage being the Volvocineæ, at the base of which are isogamous types like *Pandorina*, advancing to others like *Chlamydomonas* in which the sexual elements differ only in size, closing with the higher Volvocineæ, like *Volvox* and *Eudorina*, in which heterogamy is displayed in the differentiation of antherozoids and oospheres.

The Conjugatæ are all filamentous algæ, commencing with the isogamous Desmidieæ in which septation is only rudimentary,

* SB. Gesell. Bot. Hamburg, Oct. 30, 1884. See Bot. Centralbl., xxv. (1886) p. 95.

† Journ. de Micrographie, ix. (1885) pp. 452–8, 508–10.

advancing to the truly septated forms, such as the Mesocarpeæ and *Zygogonium* which are truly isogamous, and finally, through *Zygnema* and *Spirogyra*, in which heterogamy is indicated by the immobility of one of the reproductive bodies, to *Spirogonium* with morphological differentiation of the sexual organs.

The lowest member of the filamentous Confervaceæ is the Ulotrichaceæ, starting at once from the Sciadieæ, and still displaying isogamy. From the Ulotrichaceæ spring the branches with a varying degree of differentiation, viz.—(1) The Cladophoreæ and Chætophoreæ, isogamous, with a filamentous thallus; (2) the Ulvaceæ, isogamous, with a membranous thallus; (3) the Mycoideæ, parasitic and heterogamous, with oospheres and pollinodia; (4) the Sphæropleeæ, which give origin directly to the Œdogonieæ, and these again to two branches, the Coleochæteæ, Characeæ, and Muscineæ. Possibly a fifth branch, unknown in its early stages, gives birth to the Florideæ.

The blue-green algæ attain but a very limited development, the principal branches being the Oscillarieæ, filamentous and reproduced only by cysts, the Merismopedieæ with a membranous, and the Chroococcaceæ with a massive thallus, the Nostocaceæ, characterized by the production of heterocysts, the Rivularieæ, and the Scytonemeæ.

The brown algæ commence with the Diatomaceæ, which are connected with the higher forms through *Hydrurus* and *Chromophyton*, the latter, with mobile zoospores, establishing a passage to the Phæosporeæ. At the base of the Phæosporeæ are the Ectocarpaceæ, reproduced by non-sexual zoospores and by undifferentiated gametes, advancing then to the Sphacelarieæ, Laminarieæ, and Punctarieæ. Starting from these lower forms are three distinct more highly differentiated branches, the Dictyoteæ, Cutleriaceæ, and Fucaceæ, the last representing the highest type in the complete suppression of non-sexual reproduction.

The evolution of the Florideæ is traced by the authors from its youngest group the Bangiaceæ, which are closely allied to the Confervaceæ and Ulvaceæ, through the Nemalieæ (Batrachospermeæ and Helminthocladeæ), whence are developed two parallel series of families. In the first of these, consisting of Gelidieæ, Cryptonemieæ and Squamarieæ, the oosphere developes directly into a sporogonium; in the second series, which includes the Ceramiaceæ, Rhodomeleæ, Rhodymeniaceæ, and Corallinaceæ, it is not the oosphere, but an auxiliary cell in its neighbourhood, which, after receiving the contents of the latter, divides, like the oosphere itself in the first series, and gives birth to the sporogonium.

Agardh's Florideæ.*—The most recent volume of Prof. J. G. Agardh's 'Contributions to the Systematic Classification of Algæ' is devoted to the Florideæ, and contains descriptions of three new genera and between fifty and sixty new species. The new genera are:—*Titanophora*, belonging to the Nemastomeæ, with two species,

* Agardh, J. G., 'Till Algernes Systematik,' VII., Florideæ, 117 pp. and 1 pl., 4to, Lund, 1886. See Nature, xxxiii. (1886) p. 458.

T. incrustans (*Halymenia incrustans* J. Ag.) and *T. Pikeana* (*Galaxaura Pikeana* Dickie); *Glaphyrymenia*, belonging to the Rhodymeniaceæ, with one species; and *Merrifieldia*, also placed under Rhodymeniaceæ, with one species, *M. ramentacea* (*Chondria ramentacea* C. Ag., *Hypnea ramentacea* J. Ag.). The little-known genus *Marchesettia* Hauck is placed near *Thamnoclonium*; and *Melanoseris* Zan. is closely allied to *Pollexfenia*. *Halymenia saccata* Harv. is placed under *Bindera*, and *Amansia marchantioides* under *Placophora*.

New Fresh-water Algæ.*—Mr. F. Wolle describes a number of fresh-water algæ from Florida, including the following new species:—*Ectocarpus rivularis*, *Œdogonium cataractum*, *Dictyosphærium Hitchcockii*, *Zygnema purpurea*, *Mesocarpus crassus*, *Staurastrum Tokopekaligense*.

Burmese Desmidieæ.†—Mr. W. Joshua describes a collection of Desmidieæ taken from the leaves of *Pistia Stratiotes* from a pond in the neighbourhood of Rangoon. Thirty-three new species are described.

Animal character of Diatoms.‡—Dr. G. W. Royston-Pigott writes, "For my own part, considering their peculiar power of movement and sustentation, and also of conjugation, as well as their unaccountable strength of movement, I do not doubt that diatoms are living animals."

Lichenes.

Glœolichenes.§—Herr K. B. J. Forssell contributes a monograph of this group of Lichens, also known as Homolichenes, homoemerous lichens, Collemacei, Phycolichenes, and gelatinous lichens. Their gonidia are always Phycochromaceæ, belonging to Nostocaceæ, Rivularieæ, Scytonemeæ, Stigonemaceæ, or Chroococcaceæ. Their membranes always deliquesce on moistening to a homogeneous pulp; the thallus displays no differentiation of cortical, medullary, and gonidial layers. The gonidia are blue-green, surrounded by a thick gelatinous membrane, and always multiply by dichotomous division. The author points out that in the construction of lichens similar fungi may be associated with very different algæ, or very similar algæ with different fungi.

In classifying lichens the author assigns the first importance to the mode of fungal reproduction, next to the nature of the gonidia. On this plan the Glœolichenes must be placed under Ascolichenes. The chroococcaceous gonidia form an "indifferent symbiosis, i. e. the algal cells undergo no change in becoming gonidia, but the gonidia may undergo various modifications. The sole common character of the hyphæ is their immersion in the mucilaginous mass formed by the deliquescence of the membrane of the gonidia. They are sometimes

* Bull. Torrey Bot. Club, xii. (1885) pp. 125–9 (1 pl.).
† Journ. Linn. Soc. Lond. (Bot.), xxi. (1886) pp. 634–54 (4 pls.).
‡ Engl. Mech., xliii. (1886) p. 115.
§ Forssell, K. B. J., 'Beitr. zur Kennt. der Anat. u. System. der Glœolichenen,' 118 pp., Stockholm, 1885.

remarkably developed, as in *Cryptothele* and *Pyrenopsis*. Their mode of union with the gonidia is very various; in some cases it is effected by means of a special hyphal branch, or even by a kind of "haustorium" or absorptive organ.

The fungal element always produces reproductive organs, while the alga rarely produces spores. The spores of the fungus are always endogenous; the apothecia are sometimes open, sometimes closed; spermogonia with spermatia are often met with. The fungal characters are, however, so variable, that the classification of the Glœolichens must depend on the characters of the gonidia. Three types of chroococcaceous algæ have been distinguished in the gonidia, according to which the Glœolichens are divided into the following families: — (1) Pyrenopsidei, including the genera *Cryptothele*, *Pyrenopsis*, *Synalissa*, and *Phylliscidium* (n. gen.) in which the gonidia are formed by *Glœocapsa*; (2) Phylliscei, comprising *Pyrenopsidium* and *Phylliscum*, with the gonidia composed of *Chroococcus turgidus*; and (3) Omphalariei, including *Collemopsidium*, *Euchylium*, *Psorotichia*, *Peccania*, *Anema*, and *Omphalaria*, with the gonidia consisting of *Xanthocapsa*. The following diagnosis is given of the new genus *Phylliscidium*:—Thallus monophyllus, umbilicatus, gonidiis *Glœocapsæ* in tela hypharum pseudoparenchymatica insertis ornatus. Apothecia lecanorina margine crasso; sporæ 8-næ, simplices, hyalinæ, ellipsoideæ. Spermogonia spermatiis oblongis.

Fungi.

Toxicological Ingredients of certain Fungi.*—Herr R. Böhm finds in *Boletus luridus* large quantities of choline together with a substance similar to cholesterin, small quantities of muscorin, and an acid, luridic acid, crystallizing in brilliant red needles, and yielding succinic acid on distillation. *Amanita pantherina* contains essentially the same substances, but its acid crystallizes in yellow crusts.

Organ for excretion of resin in Fungi.†—According to Dr. R. v. Wettstein, the glutinous coating on the pileus of many species of *Polyporus*, such as *P. australis* and *laccatus*, is due to an excretion of resin. This takes place from hyphæ of peculiar form, thickened above into a globular or club-shape, and containing when young an oily yellow fluid. Eventually from three to six protuberances appear at the ends of these hyphæ, which gradually increase and exude a cap of resin, and these gradually flow together into a continuous layer. This process may be repeated and the coating of resin thus comes to consist of several layers.

Trichophyton tonsurans.‡ — Dr. G. Thin finds from new researches on this fungus, that, contrary to his previous observations,§ the hyphæ continue to grow even when excluded from the atmosphere.

* Chem. Centralbl., xvi. pp. 249–51. See Journ. Chem. Soc. (Abstr.), 1885, p. 1008.

† Verhandl. K. K. Zool.-Bot. Gesell. Wien, xxxv. (1886) p. 29.

‡ Proc. Roy. Soc. Lond., xxxix. (1885) pp. 415–6.

§ Ibid., xxxiii. (1881) p. 234.

By the use of gelatinized meat-juice he was able to watch this growth, and to separate *Trichophyton* from *Penicillium*, &c., which may have got mixed with it. The author finds no fructification; and in other respects it differs so much from the ordinary moulds, that it deserves to be separated from them, and in this view Dr. Koch agrees.

Anthopeziza, a new genus of Discomycetes.*—Dr. R. v. Wettstein gives the following diagnosis of the new genus *Anthopeziza*:—Thalamia cæspitosa, magna, longe stipitata, cum stipite flexuoso cornu speciem referentia, superne in cupulam dilatata, e mycelio denso nigrescente (non sclerotio) orta, carnosa, extus imprimis in parte inferiore lanato-pubescentia. Cupula campanulata, margine majus minusve regulariter fisso. Hymenium colore læto. Asci longissimi, octospori. Paraphyses tenues, numerosæ, apice clavatæ, inter se irregulariter reticulatim connectæ v. ramosæ. Sporæ maximæ, unicellulares, enucleatæ, 3–4 guttulatæ. Fungi terrestres, vere primo thalamia proferentes.

The genus is distinguished from the allied *Sclerotinia* by the absence of a sclerotium, the branched paraphyses coalescing into bundles, and the size and form of the spores. The species *A. Winteri* is remarkable for the form and bright red colour of the long-stalked horn-shaped receptacles. It was found on the borders of woods in Lower Austria.

Conditions for the Development of the Pileus of Hymenomycetes.†—From observations made on specimens of *Polyporus squamosus* found growing on rotten elm-wood in a dark cellar, some of which were afterwards exposed to the light, while others were kept dark, Prof. R. Sadebeck concludes that the external condition on which mainly depends the formation of the pileus is a sufficient access of light.

Proliferous Shoots in Hymenomycetes.‡—Dr. F. Eichelbaum describes an instance of prolification of the conidiophore in a species of *Stysanus*, the pedicel renewing its growth, and bearing a secondary head of conidia at its apex. This simple prolification is, according to the author, not very uncommon in the mould-fungi. In *Stilbum vulgare* he met with a double dichotomous prolification, in which two hyphæ had sprung from the original conidiophore, passing through the original head of conidia, and each producing a secondary one at its apex.

Formation of Conidia in the Hymenomycetes.§—Dr. F. Eichelbaum points out how frequent is the formation of conidia in many Hymenomycetes, their production being especially promoted by wet weather, and how gradual is the transition from them to the ordinary basidiospores.

* Verhandl. K.K. Zool.-Bot. Gesell. Wien, xxxv. (1886) pp. 383–5 (1 pl.).

† SB. Gesell. Bot. Hamburg, Jan. 29, 1885. See Bot. Centralbl., xxv. (1886) p. 226.

‡ SB. Gesell. Bot. Hamburg, Nov. 28, 1884. See Bot. Centralbl., xxv. (1886) p. 193 (1 pl.).

§ SB. Gesell. Bot. Hamburg, Feb. 26, 1885. See Bot. Centralbl., xxv. (1886) p. 256 (9 figs.).

In the Tremellineæ the simultaneous production of both basidiospores is the rule, as in *Dacryomyces* and *Tremella*. The basidiospores of *Auricularia sambucina* might just as well be called conidia; and the same is the case with those of *Scleroderma Bovista*, in which the sterigma (basidium) is almost completely suppressed. *Polyporus zonatus* produces conidia even on the hymenium on the under side of the pileus in the tubes. The author failed in inducing any of these conidia to germinate.

When *Agaricus tenerrimus* is grown in very moist situations, its entire hymenial layer becomes transformed into one of conidia. While still attached to the hyphæ these conidia will sometimes bud in a torulose manner. Conidia are also produced on the upper surface of the pileus. *A. fimicola* produces conidia close to and among the ripe fertile basidia; they are borne both on the cystidia and on ordinary hyphæ. They can be easily produced by growing on dung under a watch-glass. *A. rugosus* furnishes an admirable example of the passage of ordinary conidia into basidiospores.

Endogenous Spore-formation in the Hyphomycetes.*—M. C. A. J. A. Oudemans describes a species of *Sporendonema* found in a green-house among tan, which he calls *S. terrestre*. The plant consists of a mycelium with hyphæ partly creeping, partly erect. In the latter are formed endogenous spores, characteristic of the species. Several are formed in each hypha, without the earlier being first separated by septa. The separation of the spores from one another and from the plant is effected by circular fissures which split the wall, and which cause the hypha to break up into tubular pieces, open at both ends, each of which contains a spore.

Turgidity in Phycomyces.†—M. E. Laurent has investigated the cause of the sudden stoppage of growth during the second and third of Errera's four stages of growth ‡ of the fructification of *Phycomyces*, the period of formation of the sporangium and detachment of the spores. The experimental test of the degree of turgidity employed was the plasmolytic method of De Vries, the measure of the turgidity within the cells of the fructification being the degree of concentration of a solution of potassium nitrate which was sufficient to cause a contraction of the organ perceptible under the Microscope. By this method it was shown that at the end of the first stage the zone of cell-wall most capable of extension, which had hitherto been below the apex, passed to the apex and swelled up into the sporangium, a large quantity of nutrient material being used up in this process, so that the growth of the sporangiophore ceased, and the power of extension of its membrane had greatly decreased. The same was the case during the third stage, while the spores were being formed. In the fourth stage the excess of nutrient material again contributed to the extensibility of the membrane of the sporangiophore and its renewed increase in length.

* Versl. Meded. K. Akad. Wetensch. Amsterdam, iii. (1885) pp. 115–22 (1 pl.).
† Bull. Acad. Roy. Sci. Belgique, x. (1885) pp. 57–79.
‡ See this Journal, v. (1885) p. 288.

Germination of Ustilago Maydis.*—Dr. G. Beck has observed the germination of the resting-spores of this fungus, and the penetration of the germinating tubes into the tissue of the host, the processes being in every way similar to those of *Tilletia*. The spores are usually produced singly at the ends of large sac-like branches, which are formed either irregularly at different spots of the hyphæ or in regular rows. Sometimes they branch dichotomously, and then develope two spores instead of one.

Exoascus.†—According to Prof. R. Sadebeck the ascospores are not formed in the ascus of *Exoascus flavus* and *alnitorquus* by free cell-formation, but by cell-division. The ascogenous cells are at first spherical and entirely filled with protoplasm in which is a distinct nucleus. As the cell developes into an ascus, it elongates in a direction vertical to the surface of the organ of the host, and assumes a cylindrical form. During this period the various stages of division of the nucleus can be followed in the interior, displaying the appearance of the nuclear figures, nuclear spindles, and equatorial plates, &c., altogether corresponding to the same processes in the higher plants. Only after the development of two nuclei by division of the original nucleus, does a membrane appear between the two nuclei, completing the differentiation of the organ into ascus and pedicel-cell. The eight ascospores are formed in precisely the same way within the ascus by three successive bipartitions from a single nucleus, following very rapidly one after another. Dr. Fisch has found the processes to be precisely the same in *Ascomyces endogenus*, a hitherto undescribed species.

The author enumerates twelve species of *Exoascus*, of which four are here described for the first time. He classifies them under two great groups. In the first the mycelium is persistent in the interior of the tissue of the host, putting out only at the beginning of a new period of growth in the host branches which reach the epidermis, where a new system of hyphæ is then formed between the epidermis and the cuticle. The fertile hyphæ are entirely used up in the formation of the asci; these are not closely crowded, and when the ascospores are being developed, stand on a pedicel-cell separated from the ascus by a septum. In the second group the mycelium persists only beneath the cuticle, and spreads only between the epidermis and cuticle at the commencement of a new period of growth in the host; the fertile hyphæ being formed only in the leaves of the young shoots. The fertile hyphæ may or may not be entirely used up in the production of the asci.

The author describes the nature of the ravages on the host committed by various species of *Exoascus*, especially *E. alnitorquus* on the alder, and *E. Ulmi* on the elm, and the best modes of getting rid of the disease, dependent on the different modes of life of the different species as described above.

* Verhandl. K. K. Zool.-Bot. Gesell. Wien, xxxv. (1886) pp. 28–9.

† Jahrb. Wiss. Anstalten Hamburg, i. (1884). See Bot. Centralbl., xxv. (1886) p. 168.

New Fungi.*—In the third century of their Enumeration of the Fungi of the province of Bologna, Sigg. G. Cocconi and F. Morini describe the following new species:—*Sphærella pulviscula* on the stems and leaves of *Dianthus brachyanthus*; *Phomatospora Luzulæ* on the leaves of *Luzula spadicea*; *Septoria Penzigi* on the leaves of *Aquilegia vulgaris* killed by *Æcidium Aquilegiæ*; *Septoria Phalaridis* on the leaves and leaf-sheaths of *Phalaris brachystachys*.

New Parasitic Fungi.†—M. V. Fayod describes the following:—

1. *Endomyces parasiticus.* This is parasitic on the lamellæ of *Agaricus rutilans*, causing what is often described as the abnormal pubescence of certain specimens, the mycelium vegetating abundantly among the paraphyses.

2. *Peziza mycetophila.* This forms, on *Agaricus vellereus*, a mouldiness which is at first white, but becomes afterwards a bright orange. It is pleomorphic, having two forms of fructification, gonidial and conidial, and a sclerotium. The gonidial form is probably identical with *Aspergillus lanæus* Lk.

3. *Hypomyces Leotiarum.* This attacks *Leotia lubrica*, giving it a green tinge.

Cleonus ucrainiensis, a new Fungus-parasite on Turnips.‡—Under this name M. F. Gawronski describes a fungus which is exceedingly destructive to turnip-crops. It is intermediate between *Cleonus punctiventris* and *sulcirostris*, and may probably be a hybrid between these species.

Fungus-parasites.§—Herr F. von Thümen publishes a complete account of the various parasitic fungi which attack gardens, field-crops, and trees, with a special view of practical use to the cultivator in the description of the modes of combating them. He treats separately the diseases of agricultural crops produced by parasites, those of orchards and gardens, those of the vine, and those of forest-trees.

Pathogenic Fungi.‖—Prof. R. Sadebeck supplies some new information on the diseases in plants produced by fungi.

The "witch-broom" which occurs in so many kinds of tree, is due to a variety of different causes. The cause of this phenomenon on the beech has not yet been discovered. From the examination of specimens on the copper-beech, Prof. Sadebeck believes it to be due to the mycelium of a fungus, but not of an *Exoascus*.

The "crab" of the larch, which commits frightful ravages in Northern and Central Germany, is caused by the mycelium of *Peziza Willkommii*.

* Mem. R. Accad. Sci. Bologna, vi. (1885) 32 pp. (2 pls.). See Bot. Centralbl., xxv. (1886) p. 33.

† Ann. Sci. Nat. (Bot.), ii. (1885) pp. 28–54 (2 pls.).

‡ Gazeta Rolnicza, xxv. (1885) pp. 374–5. See Bot. Centralbl., xxv. (1886) p. 112.

§ Von Thümen, F., 'Die Bekämpfung der Pilzkrankheiten unserer Culturgewächse,' Vienna, 1886. See Bull. Soc. Bot. France, xxxii. (1885), Rev. Bibl., p. 228.

‖ SB. Gesell. Bot. Hamburg, March 26, 1885. See Bot. Centralbl., xxv. (1886) p. 286.

Exobasidium Vaccinii attacks *Vaccinium Vitis-Idæa* and *V. Myrtillus* in quite different ways. In the former it causes a local hypertrophy of the parenchyma, having the form of bladdery swellings, which have always a pink colour. In *V. Myrtillus*, on the contrary, the leaves do not, when attacked, produce local swellings; but the whole leaf enlarges to two or three times its original size. The upper side of these leaves is a bright yellow colour, while the under side is covered by a white rime. It causes failure in the development of the flowers and the fruit.

Mycorhiza of the Spanish Chestnut.*—Herr O. Penzig, referring to the observations of Herr B. Frank on mycorhiza,† corrects his references to the writings of Sig. Gibelli. Herr Penzig himself considers the theory of a symbiosis between the fungus and the roots of the Cupuliferæ to be at present purely hypothetical.

Zimmermann's Atlas of the Diseases of Plants.‡—The most recently published parts of this work give photograms with descriptive texts of *Puccinia Violæ*, *P. ægra* (which two species the author regards as identical), *P. Cepæ*, *P. Asparagi*, *P. Ribis* (*Æcidium Grossulariæ*?), *P. Pruni-spinosæ*, *P. Cerasi*, *P. bullata*, *P. Iridis*, *P. Maydis*, *P. Anemones virginianæ*, *P. Arenariæ*, *P. Malvacearum*, *P. Asteris* (with which he unites *P. Tripolii*, *P. Ptarmicæ*, *P. Millefolii*, and *P. Doronici*), *P. Buxi*, *P. Galanthi*, and *P. Tulipæ*.

Protophyta.

New Microchæte.§—Under the name *Microchæte diplosiphon*, M. Gomont describes a new species from the neighbourhood of Paris. The filaments are unbranched and bear a basal as well as intercalary heterocysts. They are surrounded by a double sheath, the inner one sharply differentiated, and closely applied to the filament, the outer one looser and more mucilaginous. The hormogonia consist of from three to twenty cells, and are formed in the upper part of the filaments. After escaping from the mucilaginous sheath they form a new very thin one, and constitute the basal heterocysts of new filaments.

Origin of Saccharomyces.‖—Sig. G. Cuboni finds in the sap which flows from the stem of the vine in March and April numerous organisms identical with *Saccharomyces ellipsoideus*. These organisms, or drops of fluid infested by them, very rapidly cause the ordinary vinous fermentation in sterilized must. A close examination showed that these cells are buddings from the hypha of *Cladosporium herbarum*, which is universally distributed in the bark of the vine. If *Cladosporium*-hyphæ are sown in the drops of gum which exude on the cut surfaces of old branches or in drops of the exuding sap, similar

* Ber. Deutsch. Bot. Gesell., iii. (1885) pp. 301–2.

† See this Journal, v. (1885) p. 844.

‡ Zimmermann, O. E. R., 'Atlas der Pflanzenkrankheiten,' Heft 2–4, fol., Halle, 1885.

§ Bull. Soc. Bot. France, xxxii. (1885) pp. 209–12 (1 pl.).

‖ Rivista di Viticoltura ed Enologia Ital., 1885 (1 pl.). See Bot. Centralbl., xxv. (1886) p. 102.

colonies of cells identical with *Saccharomyces* are produced, and may be propagated by culture for several generations. The author concludes that *S. ellipsoideus* is probably the torula-condition of this Hyphomycete, which appears to be identical with *Dematium pullulans*, to which Loew had also referred it. The formation, under certain conditions, of endogenous spores in torula-cells finds its analogue also in the conidia of other filamentous fungi, and cannot be regarded as in itself a special characteristic of the Saccharomycetes.

Formation of Spores in the Saccharomycetes.*—Herr A. Zalewski has made a series of observations for the purpose of determining whether the spores of the Saccharomycetes are formed by free cell-formation or by division of the protoplasm, whether they contain a nucleus, and what part it takes in the process. The most favourable species for the observations he found to be *Saccharomyces ellipsoideus*, but *S. apiculatus* and *Mycoderma vini* were also examined.

In the first-named species the formation of spores begins to take place twenty-four hours after being placed in pure water. The protoplasm loses its strong refrangibility, becomes finely granular, and withdraws from the cell-wall, large vacuoles forming at the same time in the centre of the cell. The protoplasm now becomes denser, but a slight furrow is observed towards the cell-wall; the protoplasm collects on both sides of the furrow; and dark spots appear in these accumulations, which the author regards as the rudiments of nuclei. These dark spots afterwards disappear; the accumulations of protoplasm increase in size, round themselves off, and, after attaining their full size, invest themselves with a cell-wall. The formation of four spores instead of two in a mother-cell takes place in the same way, and the whole process is completed in four or five days.

The formation of spores by free cell-formation takes place in precisely the same way in *Mycoderma vini*, but the nuclei are much more evident.

The presence of a nucleus can easily be proved in the vegetative cells of the Saccharomycetes by placing them in pure water for a few hours, and then treating with hæmatoxylin and a solution of alum. It then exhibits a regular ellipsoidal form, with a small nucleolus in the centre, and surrounded by a denser layer of protoplasm. The nucleus can be detected even in the ripe spores, but not in those in which spores are being formed, or in those which are actively budding, possibly because it is in the act of dividing.

Saccharomyces capillitii.†—MM. C. A. J. A. Oudemans and C. A. Pekelharig propose to unite under this name the *S. sphæricus* and *S. ovalis* of Bizzozero, found in the scurf of the human head; or, since the torulose budding appears to be suppressed, they suggest that it may become the type of a new genus of Saccharomycetes, which they propose to call *Cercosphæra*. It does not produce alcoholic fer-

* Verhandl. Krak. Akad. Wiss., xiii. (1885) (1 pl.). See Bot. Centralbl., xxv. (1886) p. 1.

† Nederl. Tijdschr. Geneeskunde, xxi. (1885). See Bot. Centralbl., xxv. (1886) p. 198.

mentation in saccharine fluids, and its development is suppressed by the exclusion of air. The authors believe this parasite to be the cause of the disease "pityriasis capitis," which it always accompanies in large quantities.

Influence of Light on the Growth of Yeast.*—Dr. Key finds that the development of yeast proceeds equally well whether exposed to light or in darkness. A nutritive solution was prepared, containing in a litre 100 gr. of sugar, 2·5 gr. of asparagine, with 20 c.cm. of a solution of mineral salts; equal portions were placed under two bell-glasses, one black and the other clear, and exposed to a strong gaslight, the heat from which was absorbed by a layer of water, so that the temperature was the same in both; the number of cells at the beginning and end of the experiment was counted. Of eight experiments, three gave an excess in the dark glass, five in the illuminated.

Resting-form of Comma-bacilli.†—Dr. F. Hüppe has observed the development of comma-bacilli without the use of staining-reagents. He finds that the helix-form loses its mobility when the nutrient material is exhausted, and, at high temperatures, developes to a spiral form with two or more coils. The form of the helix shows but little constancy, and is greatly affected by the rapidity of its formation, the chemical nature of the food-material, or by mechanical influences; very different forms may be found in the same culture. Sometimes they resemble curved threads, or a helix drawn out flat (vibrio-form); sometimes they are more rigid, sometimes more flexible; and closely coiled spirals are found which are sometimes flexible (spirochæte), sometimes rigid (spirillum). On the same thread there may occur two or even three different forms. Even the spirulina-form is occasionally met with. When the filaments with longer coils break up, the fragments are moderately uniform in habit, the commonest being the more or less flexible spirochæte-spiral. No segmentation of the threads is usually seen.

At any spot in a filament, and at distances corresponding to the length of a comma-bacillus, arise two globules distinctly differentiated from the rest of the filament, only slightly exceeding the filament in diameter, but more refringent. Their membrane appears to become more strongly gelatinous; they separate to a greater distance from one another, but without altogether losing their connection. A second comma is then formed, and there are now four globules either all at nearly the same distance apart, or the two older ones at a slightly greater distance than the younger ones. Six globules were sometimes observed. At the spots where the segmentation began were seen a large number of globules, from which projected short comma-fragments. In one case, a previously motile comma divided directly into two globules, which at first touched one another, and afterwards separated to a short distance.

These globular cells are formed between 22° and 27° C. They

* Journ. Chem. Soc. Lond., l. (1886) p. 387, from Bied. Centr., xv. pp. 71–2.
† Fortschr. der Medecin, iii. (1885). See Bot. Centralbl., xxv. (1886) p. 45.

do not multiply by division, and consequently cannot be micrococci. The author several times observed them develope into short rods, their refrangibility at the same time diminishing; they display great resistance to desiccation from their distinct gelatinous investment. He concludes that they must, for these reasons, be regarded as resting-forms or arthrospores, corresponding to those already described by van Ermengem and Doyen.

Dr. Hüppe maintains that the "genera" of spiral bacteria cannot be distinguished by the character and arrangement of the coils, since these are subject to great variation, but by the mode of production of the spores. Those he calls vibrios, which, like *Vibrio rugula*, form endogenous spores with distinct broadening of the cell; spirilla, those which form endogenous spores without any broadening of the cell; and spirochætæ, those which do not produce endogenous spores, but arthrospores.

Abscess-producing Diplococcus.*—Dr. E. Bumm describes a microbe found in an abscess in the mamma, and which was apparently the cause of the inflammation, It differs from Rosenbach's *Staphylococcus pyogenes aureus* in being a true diplococcus, consisting of two hemispherical halves separated by a thin slit, but kept together by a common envelope, and in not having the golden-yellow colour of that microbe. By infection with the microbe reproduced by pure culture, abscesses were induced in rabbits. Its pathogenic properties were proved also in other ways.

Bacterium of Panic Fermentation.†—According to M. E. Laurent the principal agent in the fermentation of bread is a microbe which he calls *Bacillus panificans*. It may easily be obtained by taking leaven from the flour of wheat, rye, or spelt, and mixing it with a small quantity of sterilized water, and then using as the nutrient material Koch's gelatine acid or slightly alkaline. At the end of the second or beginning of the third day, the characteristic colonies are seen, of circular outline with entire margin. In reflected light they are a very pale chrome-yellow, by transmitted light of a brownish-grey tint, more or less marked at the end of some days. The development of the colonies is very slow, and they scarcely ever touch one another. At the ordinary temperature, 15° C., they do not liquefy gelatine. By these characters *B. panificans* is easily recognized in a mixture of other bacteria of putrefaction. Development takes place between 6° and 45°, the optimum temperature being from 33° to 34° C. In the first days of the culture very short and motile rods are seen; later, when the liquid becomes poorer, only elongated bacilli, sometimes very long filaments.

The spores of *B. panificans* are killed only by a temperature of 100° C. prolonged for ten minutes; the rods without spores resist even a higher temperature. It renders the gluten of paste readily soluble, and developes at the expense of cooked starch in a medium

* SB. Phys.-med. Gesell. Würzburg, 1885, pp. 1–7.

† Bull. Acad. Roy. Sci. Belgique, x. (1885) pp. 765–75. Cf. this Journal, iv. (1883) pp. 690, 885.

which is not too acid. In a gramme of bread there may be 500,000 of these bacilli. They are not destroyed in the stomach; the spores and rods both resist twenty-four hours' submersion in artificial gastric juice. In the digestive canal of man they find substances extremely rich in albuminoids and in cooked starch; and, in consequence of their power of living in both acid and alkaline media, they contribute greatly to the process of digestion.

Bacillus panificans is the bacterium of "ropy" bread, which is produced when the dough is insufficiently acid, and results from the transformation of the starch into a substance resembling erythrodextrin. The "rising" of bread is the result of the disengagement of carbonic acid caused by this organism.

Bacillus of Syphilis.*—Dr. Matterstock has endeavoured, by a large number of experiments, to determine the true microbe of syphilis. He finds uniformly, though always in small quantities, the bacillus described by Lustgarten;† but this bacillus is subject to so great variation that its diagnostic value is very small. Not only does it vary greatly in the length and thickness of the rods, but in the configuration of the rods themselves, some being straight and others with eel-like curves; the length is in some cases ten times that in others. As many as ten different forms were observed, which may possibly be stages in the development of the same organism.

De Bary's Lectures on Bacteria.‡—Prof. A. de Bary publishes, in a collected form, a series of lectures given at different times, on bacteriology, which give a good summary of the present state of our knowledge of the science. The terms "coccus," "bacterium," &c., are used throughout simply to designate forms of growth.

Garbini's Guide to Bacteriology.§—Sig. A. Garbini publishes a complete guide to bacteriology in accordance with the present state of the science. It treats of the necessary instruments, apparatus, and reagents, including staining-methods, the various modes and materials for culture, a description of special methods of investigation, and the morphology and classification of the known forms of Schizomycetes, in which the system of Cohn is followed. The work is illustrated by woodcuts.

* SB. Phys.-med. Gesell. Würzburg, 1885, pp. 65–73.

† See this Journal, v. (1885) p. 539.

‡ De Bary, A., 'Vorlesungen über Bakterien,' 146 pp. (18 figs.), 8vo, Leipzig, 1885.

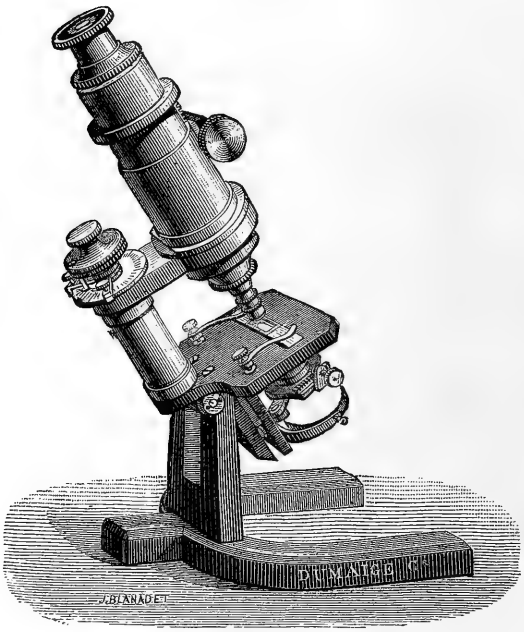
§ Garbini, A., 'Guida alla Bacteriologia,' xv. and 145 pp. (34 figs.), 8vo, Verona, 1886.

MICROSCOPY.

a. Instruments, Accessories, &c.*

Viallanes' Photographic Microscope—Compound Images by the Method of Successive Exposures.†—At the outset of an inquiry into the best methods and conditions of micro-photography, Dr. H. Viallanes premises that those instruments, in which the dark chamber is fixed directly to the tube of the instrument are subject to a serious defect, both because the weight of the chamber must affect the micro-

Fig. 82.



metric screw, and also because the tremors caused by inserting and removing the negative are communicated to the instrument, and may displace the object and with it the photographic image. It is a

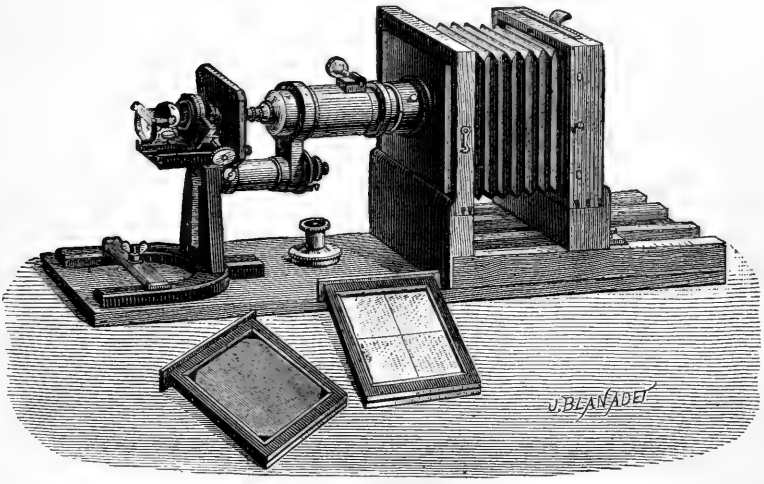
* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating Apparatus; (4) Other Accessories; (5) Photo-micrography; (6) Manipulation; (7) Microscopical Optics, Books, and Miscellaneous matters.

† Viallanes, H., 'La Photographie appliquée aux Études d'Anatomie Microscopique,' 63 pp. and 4 figs. (8vo, Paris, 1886).

primary necessity that the camera and the Microscope should not be in direct contact but united only by a cloth connection. The Microscope-tube may be either vertical or horizontal, but the latter is the position which insures the greatest stability and facilitates manipulation; it is true that this involves some difficulty in photographing an uncovered preparation which is liable to slip when the Microscope is horizontal, but in practice it is generally easy to fix the section to the object-carrier with a few drops of paraffin.

The Microscope and camera adopted by M. Viallanes are shown in figs. 82 and 83. The latter is a sliding collapsible camera similar to that used by photographers. In the front of the camera is a large hole to receive the eye-piece end of the Microscope, while at the

Fig. 83.



back are the usual arrangements for receiving in succession the ground glass for focusing, and the sensitive plate. The Microscope is fixed upon the base which carries the camera slide, and in such a position that the eye-piece end of the tube enters the circular hole in the front of the camera, the connection being made by a metallic washer faced on the inside with velvet to prevent the entrance of any external light. A stop insures the tube being brought into a strictly horizontal position.

On the means of obtaining as large a field as possible, the author says, "The modification required in the Microscope in order that as large an image as possible may be projected upon the sensitive plate, is easily effected; it is only necessary to increase the diameter of the tube, and this has been done in our photographic Microscope. The instrument with the tube thus enlarged can be employed just as well

as any other for ordinary observations, and for this purpose we have added an adapting piece by means of which the usual eye-pieces may be used. It is not difficult to understand the motives which have led the makers to construct narrow tubes in Microscopes designed for ordinary work; the dimensions of the tube are determined by those of the eye-piece, which, in order that the observer may not be fatigued, should only receive so much of the image as may be conveniently comprehended by the eye."

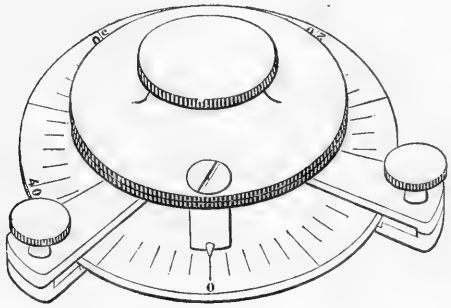
With regard to the special difficulties presented by objects which are not flat, the author writes, "We have already stated that to obtain a photograph well defined in every part, the object should be as nearly as possible a plane. Unfortunately, even in the case of sections, this condition is not always realized, while with certain objects, e. g. insects and Foraminifera, it can never be so. It is possible, however, by certain methods to obtain perfectly clear photographs of objects which lie in different planes. When such a case presents itself, it is well to use the weakest possible objective which will bring out the details that are to be reproduced. By employing a weak objective with long focus, many more planes can be simultaneously brought to a focus than with a more powerful one. The desired result may also be obtained by stopping the objective with a diaphragm; the smaller the diaphragm the greater will be the depth of focus, but at the same time the definition of the lens will be proportionately diminished. A happy mean must be preserved in the choice of a diaphragm.

If the above means are not sufficient, we must have recourse to the *method of successive exposures.* This method is based upon the fact that the same sensitive plate may receive two or more images without confusion; this may be shown as follows:—Place on the stage a micrometer, bring its divisions to a focus on the ground glass, then insert the sensitive plate and expose for say two minutes. Intercept the light, rotate the micrometer through an angle, and expose again for two minutes. The plate when developed will show two crossed images of the micrometer which are perfectly clear even at the point where they intersect. In this way, three or even four superposed images may be obtained upon the same plate. From the observation of these facts, I was led to use the method of successive exposures in the case of objects which could not be simultaneously focused in all their parts. If the same plate receives in succession the images of the different planes of an object, these will be superposed without confusion, and a compound image will be produced which is far more complete than that obtained by photographing a single plane.

In employing this method, the head of the micrometer screw should be provided with an index which moves upon a graduated circle (fig. 84). The lowest part of the object being first brought to a focus upon the ground glass, the division at which the index stands is noted, then the highest part of the object is focused and a second reading is made on the circle. These readings determine the limits between which the index must move if all the successive planes of the

object are to be photographed. The sensitive plate is now introduced and exposed three or four times, the index being set at different points between the limits; in this way three or four images are superposed and form a complete picture. To obviate the reading of angles, the circle is provided with two movable stops which can be fixed at the limiting positions by means of screw clamps, so as to limit the angular space through which the index can be turned, without

Fig. 84.



the necessity of any reading. In practice it is best not to attempt to obtain more than two or three successive impressions, since with a greater number the figure becomes confused. It must be added that the photographs are never so fine as those got from an object which can be completely photographed by a single exposure."

Beck's Demonstration Microscope.—The instrument shown in fig. 85 was devised by the late Mr. R. Beck for the purpose of securing delicate objects against injury at soirées and similar exhibitions.

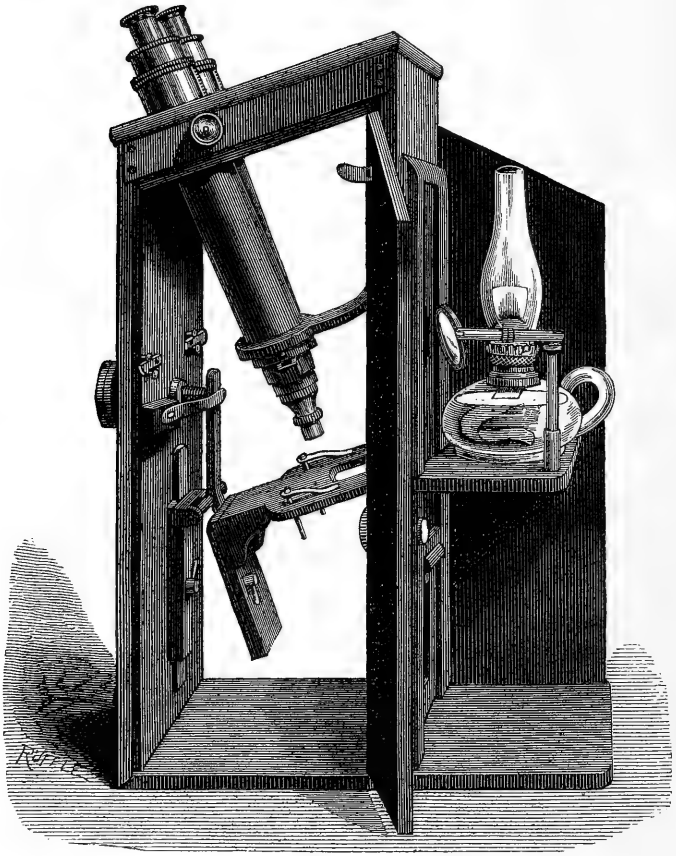
The special point consists in inclosing the Microscope in a box 7 in. $\times 6\frac{1}{2}$ in. $\times 19$ in., into which it is locked, there being doors on either side. The binocular body is fixed to the front of the box by a bar, and also to the top, and the draw-tubes can be extended by the milled head at the side.

At the back of the box is a horizontal pivot on which turns a lever-piece with two equal arms. The stage slides on the lower arm, to which it can be clamped. This enables the object to be placed approximately in focus. For a fine adjustment the top of the upper arm can be pressed forward against a spring by the milled head at the back, the stage being then slightly tilted. The pivot on which the lever-piece turns can also be raised or lowered and clamped. This we presume was intended to provide for a more extended motion of the stage than could be obtained by sliding it on the lower arm of the lever.

The lamp is placed on a bracket in front, which is attached to a vertical sliding piece having a circular aperture which admits the light

to the inside of the box. The bracket, lamp, and sliding piece can be raised or lowered according as it is desired to illuminate opaque or transparent objects. A bull's-eye is attached to the bracket.

Fig. 85.



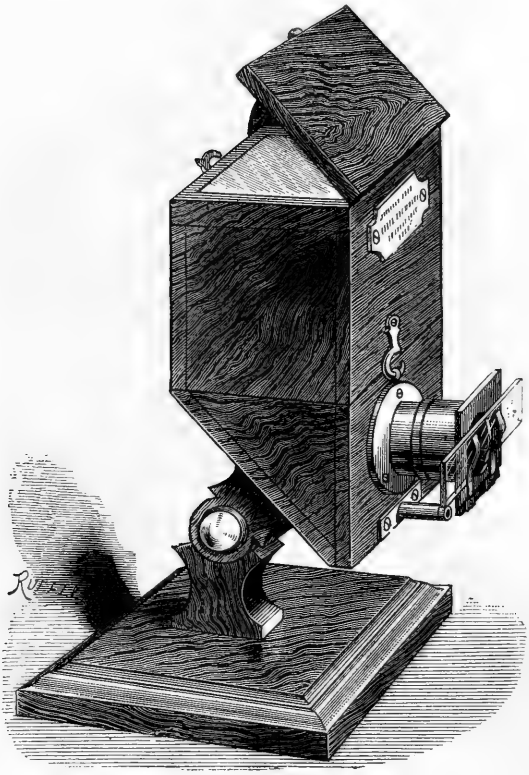
Projection Microscopes.—The exhibition of Messrs. Watson's Microscope (*ante*, Vol. V. p. 1064) has brought forward a somewhat large number of similar instruments, from which we select the following:—

Chevalier's Projection Microscope.—M. V. Chevalier designed the instrument shown in fig. 86 for the purpose of showing microscopic objects to a limited number of students.

The wooden box (which can be inclined on a hinge-joint and clamped) incloses a large right-angled prism by which the image from the objective is reflected upwards to a ground-glass plate (2½ in. square)

which can be shaded by a rising lid. The stage is attached to a piece of tubing fitting over the objective, and the objects can be illuminated either by direct light or by a mirror sliding in the socket below the stage. A lieberkühn fits over the objective for opaque objects.

FIG. 86.



Cooke's Projection Microscope.—The disadvantage of the preceding instrument is the small size of the image, an objection which is remedied in the form devised by Mr. C. Cooke and shown in fig. 87.

Here the stage is raised on four legs to a height of 18 in. above the table. One of the legs has an arrangement for lengthening or shortening it, by screwing in or out a separate piece at the foot. The objective is screwed to an adapter which slides in a tube-fitting beneath the stage. A mirror is attached to a gimbal sliding on a vertical rod above the stage, on which is also a socket for other apparatus. The rod is connected with a ring which rotates on the outer margin of the stage, carrying with it a clip with a lamp. The clip is made to grasp

the lamp by a sliding nut. The legs at their base form a square of 16 in., thus allowing room for a large image, which can be better seen if a piece of black cloth is thrown round three of the sides.

Fig. 87.

*Plössl's Electric Projection Microscope.**— Dr. G. Gärtner describes the Microscope made by Plössl and Co., which is used for demonstration purposes at the Institute of General and Experimental Pathology in Vienna by Prof. Stricker.

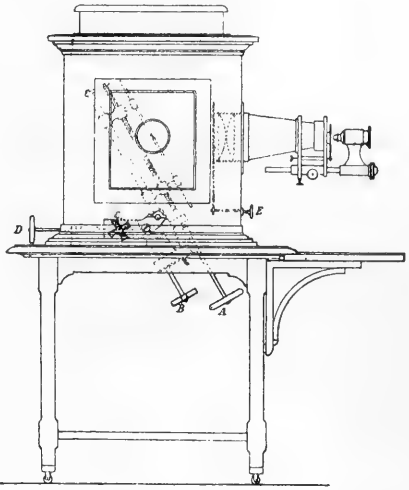
The source of light is an electric arc lamp, supplied by a dynamo driven by a 6 horse-power gas engine. The maximum illuminating power amounts to 2500 candles. An assistant regulates it by hand,

* Med. Jahrb. K.K. Gesell. Aerzte Wien, 1884, pp. 217–44 (1 pl. and 1 fig.).

as flickering cannot be avoided when an automatic regulator is used.

The general arrangement of the instrument is shown in fig. 88. It stands on a table 96 cm. high, running on wheels, so as to be readily movable. The case (with wooden sides) inclosing the carbons is 90 cm. high by 74 cm. deep by 45 cm. wide. It is purposely made large, to prevent the sides getting too hot, and to allow of the carbons being some distance from the lenses. The wooden parts are also lined with asbestos.

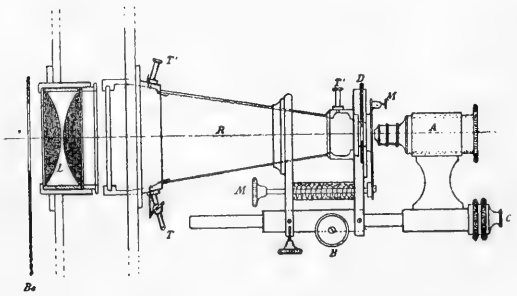
FIG. 88.



The carbons can be inclined and also moved in three directions by the three milled heads at B, C, and D; B raising or lowering them, C moving them from right to left, and D backwards or forwards. The regulator is at A, turning a rod with differential screws, so that the upper carbon moves twice the distance of the lower to compensate for the difference in the rate of consumption.

The special feature of the optical part (fig. 89) is that between the two plano-convex condensing lenses L and the stage D is interposed

FIG. 89.

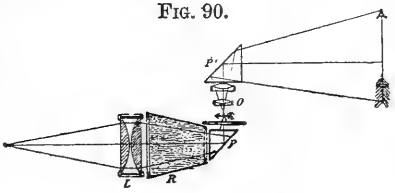


a conical reservoir R, 30 cm. long, filled with water, to cool the rays from the lamp. It is filled by the tube at T, those at T′ T′ allowing the air to escape. Experiments proved that practically nothing was

gained by using an alum solution instead of water. The objective is shown at A, the coarse and fine adjustments at B and C, the clamp for the objects M, the stage diaphragms at D, and a second diaphragm at the back of the condensers at B *e*. The latter is actuated by the screw E in fig. 88.

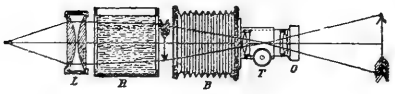
With objects which must remain horizontal, the contrivance shown in fig. 90 is used, with smaller condensers L and a shorter cone R, the rays being deflected by two prisms P and P′, above and below the stage and objective (O). It is only suitable for low powers, and has been used more especially for showing living chicken embryos.

FIG. 90.



A second subsidiary apparatus or "Sciopticon" (fig. 91) is used for small amplifications of very large objects, such as large brain sections. The water vessel R in front of the condensers L is rectangular, and the objective O is composed of photographic lenses. An extensible camera B is interposed between the object and the objective, and the focal adjustments are made either by compressing or extending the camera, or by moving the objective alone by the milled head T. At $4\frac{1}{2}$ m. distance from the screen amplifications of 18 to 25 times are obtained.

FIG. 91.



A table is given showing the amplifications, with the various objectives, from 370 to 8000; the highest powers used being Seibert's Nos. VIII. and X. water-immersion (3800 and 8000 respectively).

As a screen for the reception of the images, a plate made of the finest gypsum, 1·5 m. in diameter, is used, placed 4·5 m. from the objective. Upon this a human red blood-corpuscle appears, with a Seibert X objective, as a disc of 6 cm. in diameter. The amœboid movements of white blood-corpuscles are perfectly visible to a class of 300 persons (the more distant ones provided with opera-glasses). In order to make the white blood-corpuscles quite distinct, Professor Stricker passes through the fresh blood a solution of fuchsin in water, containing 0·6 per cent. of common salt. The living cells absorb the pigment very slowly, whereas the fluid in which they are contained takes a distinct red colour. The white blood-corpuscles, therefore, appear as bright, white spots on a coloured ground, and do not lose anything of their mobility.

In preparing sections for use with an electric Microscope they require to be somewhat deeply stained, and stains should be chosen which show the histological elements in strongly contrasted colours, such as carmine, gold, or silver staining.

Holmes' Microscope with Swinging Radial Mirror. *—This Microscope (fig. 92) was made by Mr. S. Holmes in 1872, and is an anticipation of the principle subsequently adopted in the Tolles-Blackham and similar Microscopes. The stage is attached to a disc mounted on a slide which is raised or lowered by rack and

FIG. 92.

pinion (forming the only adjustment for focus). At the periphery of this disc is a ring which is free to rotate between guides and to which is attached the mirror. The latter can thus be rotated completely round a line drawn through the centre of the stage, thus giving radial illumination above and below the stage.

* The stand is Holmes' Isophotal Binocular. There is a spiral pinion and diagonal rackwork to the stage-movement.

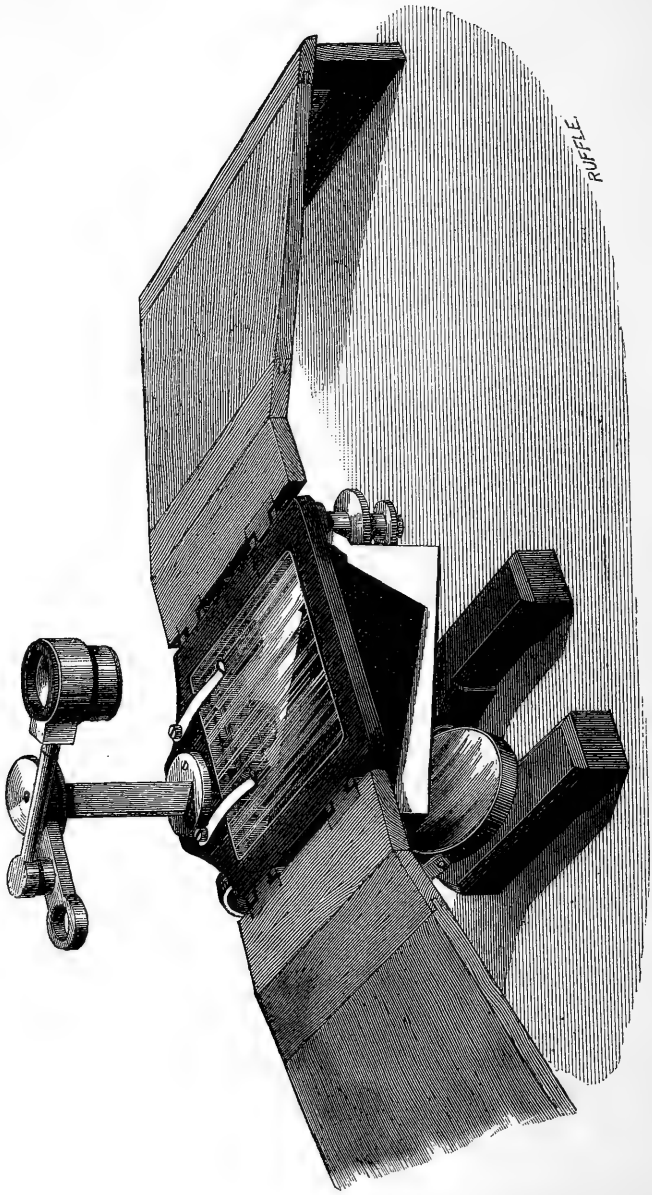


FIG. 93.

MAYER'S DISSECTING MICROSCOPE.

Mayer's Dissecting Microscope.—This (fig. 93) is one of the most convenient dissecting Microscopes which we have yet seen.

The stage consists of a large metal frame, 10 cm. square, to which are attached folding wooden supports for the hands. For minute objects a metal plate is dropped into the frame, in which is a small central opening, which can be closed by either a black or white disc as desired. For larger objects, especially living aquatic animals, the metal plate is replaced by glass, and white or black plates can be brought beneath it, according to the background required. These plates are turned away from the stage by the milled heads shown in front of the stage on the right.

There are three arms for lenses. The lower one shown in the fig. is for high powers (the upper being removed), while the upper is for Zeiss's aplanatic lenses (× 6 and 10). By the combination of the movements of the two arms the lenses can be made to traverse all parts of the stage. An extra holder is also supplied for the high powers, which can be moved in the same way over the whole stage.

Magic Lantern v. Microscope.*—Mr. T. King considers that for purposes of general teaching the magic lantern possesses the advantage over the Microscope of lessening both labour and expense. By means of micro-photography, the magnified image of minute objects, such as sections of vegetable tissues, diatoms, &c., can be photographed in a form available for use as a lantern-slide. With the aid of such slides, the teacher can at once explain to the whole class what can only with the Microscope be explained individually.

Inostranzeff's Comparison Chamber for the Microscopical Study of Opaque Minerals and other objects.†—M. A. Inostranzeff writes as follows:—

"The great importance of the Microscope in the study of rocks cannot be denied. To the Microscope we owe the modern classification of rocks, our knowledge of the structure of the rocks themselves, of the minerals which compose them, and of their inclusions, as well as of many modifications and metamorphoses to which rocks and minerals are subject. Up to the present time, however, scarcely any progress has been made to a rational method of investigating the opaque minerals which enter into the composition of rocks. Ten years ago I published ‡ a note on the study of opaque minerals, in which I proposed to employ the colour and lustre of these minerals to distinguish between them. By means of brilliant illumination from above, little differing from ordinary daylight, the lustre and colour may be made evident. In this way I succeeded in determining eight opaque minerals in the rocks of the district of Olonez, and in showing, in several cases, their genetic relations. But the determination of colour and lustre being liable to subjective errors, I have

* Proc. and Trans. Nat. Hist. Soc. Glasgow, i. (1886) p. xxx.

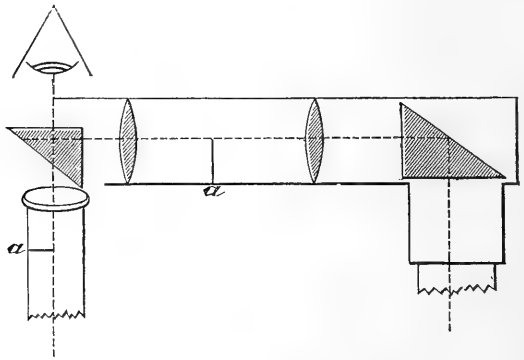
† Comptes Rendus, c. (1885) pp. 1396–8. Neues Jahrb. f. Mineral., ii. (1885) pp. 94–6 (2 figs.).

‡ Abh. d. Moskauer Naturforschergesellschaft, vi., Part 1.

been endeavouring for some time to devise a method of comparing unknown opaque minerals with others which have been already determined. For ten years no progress was made in this direction.

My first attempt was made by means of the camera lucida, which transmits perfectly both the colour and the lustre of opaque minerals; with the help of this instrument I transfer the image from one Microscope into a second, on the stage of which is a known mineral, and so am able to compare the two. But to prevent the image of the first Microscope from covering that of the second the following precautions must be taken. Into a Hartnack's camera lucida (fig. 94) I

Fig. 94.

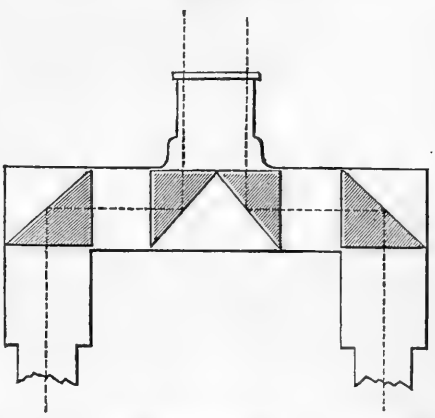


introduce a diaphragm *a*, which is placed in the lower part of the tube, so as to cover half the field of view; a similar diaphragm *a*, that is, one which also covers half the field, is introduced into the second Microscope, which contains the known mineral. By means of this arrangement of the diaphragms I see in the second Microscope on one side (the left) the image of the mineral to be determined, and on the other side (the right) that of the known mineral. The apparatus, as described above, has always one great fault, that is, that the comparison is made, so to say, between an object and a shadow, for the camera lucida always slightly increases the image which it transmits, and consequently diminishes its brightness. I have now, however, found a method of comparing minerals under identical conditions, and I have only mentioned the camera lucida and my first attempt because every one possesses this instrument, and can easily test the method.

To secure a complete identity between the image of the mineral to be determined and that with which it is compared, I have had a new apparatus constructed, which may be called the *Comparison Chamber* or *Microscopic Comparer* (fig. 95), which enables us, as it were, to elongate two Microscopes, and bend them at right angles. At the outer corners of the apparatus are placed totally reflecting prisms or small mirrors, which receive the rays that emerge from the Microscopes and reflect them at right angles. Below the opening, in

the centre of the top of the apparatus, are placed two other prisms, which reflect upwards the rays which they receive from the first pair of prisms. This comparison-chamber is fixed on two Microscopes without eye-pieces, and an eye-piece is placed above the central prisms. By these means I obtain a circular field of view composed of two halves, divided by a fine line; one half belonging to the image from the first Microscope, the other to that from the second. If now two minerals absolutely identical in colour and lustre are placed under the two Microscopes there will appear in the eye-piece of the chamber a completely uniform image, so that the line of division disappears. The slightest change in the tint of one of the objects causes the sudden reappearance of this line, the image being again divided into two distinct parts.

FIG. 95.



I think I am justified in supposing that my comparer may be applied not only to the study of minerals and rocks, but equally to all microscopic researches in which comparison is employed.

To bring out better the colour and lustre of the minerals, I illuminate them by means of small mirrors placed on the stage of the Microscope. For an account of the construction of these, and of the scale of comparison, I must refer to a detailed account which will shortly be published. I may add that in my scale I replace the natural opaque minerals, which would themselves be too expensive, by artificial colours prepared from the powder of these minerals. Under the Microscope the effect is precisely the same."

Astigmatic Eye-piece.*—Mr. E. Gundlach criticizes Dr. J. K. Stockwell's criticism† of his proposed astigmatic eye-pieces, and considers that the latter's suggestion of cylindrical lenses in spectacle-frames is objectionable on the ground that spectacles should never be used with any optical instrument, as they are always injurious to its proper performance, and, therefore, the wearer of spectacles should always remove them before using the Microscope or telescope.

That spectacles are injurious is attributable mainly to the following reasons: In the first place they prevent the eye reaching its proper place, in proximity, to the eye-piece. Secondly, the generally very eccentric and oblique position of the spectacle-glass to the optical axis of the eye, and, consequently, also of the instru-

* The Microscope, vi. (1886) pp. 63–5. † See this Journal, *ante*, p. 313.

ment, greatly injures the proper performance of the latter. The third objection is that spectacle-glasses add two light refracting and reflecting surfaces to those already existing. It is almost impossible for the observer wearing spectacles to even roughly place the optic axis of the spectacle lens, if worn in the ordinary manner, in line with that of the instrument.

On the other hand, Mr. J. Martin finds* that "in every case where test objects could be seen both with and without the spectacles, the definition was better when they were used."

Immersion Objectives.†—Mr. E. Gundlach has a wonderful paper under this title, which carries one back to the dark ages of microscopy. The following is quoted verbatim:—

"The refractive power of water being much lower than that of glass or homogeneous oil, it will, if put in place of those substances, exert a correspondingly smaller influence in correcting the aberrations. But, on the other hand, while the use of the homogeneous medium permits the preservation of the full working distance without any loss in correction, this loss, if water be employed, can, in a great degree, be regained if so much of the working distance as can be spared is sacrificed and the space filled with glass. This can best be done by adding to the thickness of the front lens so much that only just enough of the working distance is left as is practicable, and then fill the comparatively small immersion-space with water. Indeed, by a skilful balancing of the interfering conditions, the difference between the adaptation of water and homogeneous oil can be reduced to a minimum, and yet the working distance be as long as is practically required.

"The high optical superiority of the modern homogeneous immersion objectives over the old water-immersion may seem to disprove this theory. But I do not hesitate to claim right here that the wonderful performance of these objectives is due in a comparatively small degree only to the homogeneous immersion; it is due in a far greater degree, to the increase of the number of lenses and, consequently, the number of refracting surfaces. We remember that at the same time as the homogeneous immersion the four-system principle was introduced. Probably a more important advantage of the homogeneous over the water-immersion, than that of the higher corrective power, may be found in the fact that adjustment for cover-thickness is unnecessary. But even this merit is doubted by many first-class authorities on the manipulation of the Microscope, and the demand for adjustable homogeneous objectives is on the increase.

"Under such circumstances, weighing its merits and its faults, it must be admitted that the practical advantages of the homogeneous immersion principle are at least doubtful. This cannot be said of the four-system principle. It is unnecessary to enter into a thorough theoretical investigation of this matter. It may suffice to call to mind the fact that the aberrations of higher order are inversely pro-

* The Microscope, vi. (1886) pp. 79–80.

† Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 51–3.

portional to the number of refracting surfaces. The objection that there is also a corresponding loss of light, although practically true, is of no consequence whatever, as is sufficiently demonstrated by the extensive experience in the use of this class of objectives.

"Summing up, we come to the conclusion that the future high-power objectives will be the four-system water-immersion. Or, the immersion will be done away with altogether as an incurable inconvenience, and the four-system dry-working objective will be used."

Has not Mr. Gundlach heard of such an important property of objectives as aperture, and does he not know that the limit of aperture of a "dry-working objective" is 1·0 N.A., while a homogeneous-immersion objective may approach 1·52 N.A.?

The microscopist of the future who "does away with immersion altogether as an incurable inconvenience" must, to be consistent, refuse to ride by railway or to send or receive communications by telegraph or telephone. He will probably not carry his consistency so far as to insist upon walking the streets in a state of nature and without the "incurable inconvenience" of clothing, only because he will have just sense enough left to appreciate the fact that his so doing would land him in a prison or an asylum—in the latter he ought at least to be.

Application of Very High Powers to the Study of the Microscopical Structure of Steel.*—Dr. H. C. Sorby writes as follows:—

"Though I had studied the microscopical structure of iron and steel for many years, it was not until last autumn that I employed what may be called 'high powers.' This was partly because I did not see how this could be satisfactorily done, and partly because it seemed to me unnecessary. I had found that in almost every case a power of 50 linear showed on a smaller scale as much as one of 200, and this led me to conclude that I had seen the ultimate structure. Now that the result is known it is easy to see that my reasoning was false, since a power of 650 linear enables us to see a structure of an almost entirely new order, and of such a character that, if it had been on a scale of a quarter or a half the actual magnitude, it would probably never have been recognized, on account of being beyond the resolving power of the Microscope for fine parallel lines. . . . With this arrangement [the Vertical Illuminator] high powers give as good, or even better, illumination than low. Speaking generally, a power of 650 linear is about ten times that previously employed, which is, of course, enough to open out a new field for research.

This great increase has, however, shown little or nothing more in the case of malleable iron containing little or no carbon, or in the case of the intensely hard constituent of spiegel iron, of white refined iron, and of blister steel. It has also shown but little more in the case of inclosed slags, or of the graphite in cast iron; but it has enabled me to see to great perfection crystals which are probably silicon, and has thrown a flood of light on the nature and character

* Paper read at the Iron and Steel Institute on May 14, 1886. Cf. the Ironmonger, 1886, p. 905.

of that constituent of steel which in my lecture at the last annual meeting I described as the pearly compound. High powers show that it really has a structure closely resembling that of pearl, the surface being marked by fine straight or curved parallel lines, due to the presence of alternating very thin plates of varying hardness. After only a few hours of observation I felt almost certain that these thin plates were iron free from carbon, and the intensely hard substance seen so well in blister steel; but the facts were so extraordinary and so unlike anything I had ever seen or heard of in any mineral substance, that it was not until after several months devoted to the careful study of all the chief kinds of iron and steel that I felt confidence in the results.

The chief facts are best seen in the case of an ingot of steel of medium temper. On fracture comparatively large crystals are visible, radiating from the surface to the interior. When a properly prepared microscopical section is viewed with a moderate power, it is easy to see that, after having crystallized out from fusion at a high temperature, these large crystals break up on further cooling into much smaller, as described in my lecture. What is now seen with very high powers is that these smaller crystals finally split up into alternating very thin plates. Taking all the facts into consideration, it appears as though a stable compound of iron with a small amount of carbon exists at a high temperature, which at a lower breaks up into iron combined with a larger amount of carbon, and into iron free from it. If these two products had not differed so much in hardness, or if the alternating plates had been considerably thinner, or if definite plates had not been formed, such a compound structure would never have been suspected. It has probably never been specially looked for in other substances, and might exist without being visible, even with the highest and best magnifying powers. In those cases where no subsequent segregation has occurred, these alternating plates are often remarkably regular and uniform in thickness; and as far as I am able to judge, the softer plates are about double the thickness of the harder. If so, we may say that the thickness of the softer plates is about 1/40,000 in., and of the thinner 1/80,000, thus giving well-marked striæ 1/60,000 in. apart. To define even these requires very careful adjustment of the object-glass; and, considering all the circumstances of the case, it could not be expected that the two bounding edges of the thinner hard plates could always be defined so as to show a flat intermediate surface. We are, in fact, brought face to face with an optical difficulty, depending on the considerable length of waves of light compared with the objects under examination, and are obliged to infer the nature of the very fine structure from what is seen when it is somewhat coarser. In some cases it is easy to trace the gradual passage from these extremely thin plates up to those which are sufficiently thick to show clearly that the structure is due to thin plates of the hard substance between soft iron. No mere cleavage would explain all the facts, though it is extremely probable that the direction of the alternating plates was determined by the previous crystalline structure. In some cases the plates are less well marked, and the structure is more granular.

To give a good idea of the size of the plates, I would refer to what is seen in a longitudinal section of medium steel forged from an ingot 3 in. in diameter down to a bar 1 in. square. When broken it shows a very fine grain, and when a prepared section is examined with a moderate power this grain is seen to be due to crystals often about 1/1000 in. in diameter, which are not drawn out or distorted, as they would have been if they had existed previously to final cooling after hammering, and as they are distorted if the steel be hammered at a lower temperature. Examined with a power of 650 linear, these crystals only 1/1000 in. diameter are seen to contain something like sixty of the alternating plates, and even this extremely delicate structure shows little or no trace of distortion. Of course it is impossible to separate and analyse such thin plates, and we must rely on induction to furnish us with a knowledge of their nature....

It will thus be seen that the use of very high magnifying powers opens out a wide field for research, and has already placed a number of important questions in a new light. As far as I am able to judge, all the facts seen in the various kinds of iron and steel hitherto examined may be explained in accordance with the views here described; but the time spent in studying the fundamental questions prevented me from finishing a comprehensive illustrated memoir which was already in large part written before using very high powers."

Use of the Microscope with Convergent Polarized Light.*—Dr. A. Wichmann considers that the methods proposed some years ago, almost at the same time by Bertrand, Klein, and Lasaulx, for converting the Microscope into a polarizing instrument for convergent light, in spite of their utility in the microscopic analysis of rocks, have not as yet fully answered the expectations which were formed of them. The obstacle to their success is the want of intensity in the interference figures when the sections are very thin, which makes it difficult to observe them with certainty. Where, however, this objection does not apply, the method, as is shown by a paper by Herr F. Becke, gives good results.†

Experiments with the Electric Incandescent and Arc Lights.‡—Dr. M. Flesch has made experiments with the arc light of a Duboscq lamp, with two Edison incandescent lamps of 16 and 8 candle power respectively, and a Swan lamp of 2½ candle power. Tests were applied for the discrimination of colours, and for resolving power by the electric light as compared with daylight. For colour was used a histological preparation injected with Berlin blue, and stained with carmine and iodine green; for resolution the test-objects employed were *Surirella gemma* and *Nitzschia sigmcidea* of Möller's test-slides. The arc light was used at a distance of 1 metre, and the incandescent lamps at a distance of 30–40 cm. from the mirror; the same results were obtained from both, namely, very good distinction of colours, considerably better than by daylight, and improved resolv-

* Zeitschr. f. Wiss. Mikr., i. (1884) p. 139.
† Tschermak's Mineralog. und Petrogr. Mitth., v. (1883) p. 527.
‡ Zeitschr. f. Wiss. Mikr., i. (1884) pp. 561–3.

ing power; the latter was also increased by interposing a blue-green glass, but diminished by the use of red and orange-yellow glasses.

Dr. Flesch concludes, as the result of his experiments, that the incandescent light excels every other artificial light for clearness and brightness of field and for steadiness. He is opposed to any plan of fixing the lamp to the stand of the instrument, better results being obtained when the lamp is placed immediately below the condenser than when the light is reflected by a mirror.

Mayer's Black-ground Illuminator.*—This is a simple form of black-ground illuminator, devised by Prof. A. M. Mayer, for the study of aquatic life with low-powers of aperture up to 60°, showing aquatic organisms as brilliant objects on a black ground, so that they are instantly detected among the more opaque particles of ooze. The interior structure of rhizopods, infusoria, rotifers, worms, &c., is also brought out in a manner which is said to be very striking. With dark-ground illuminators which give large angles to the emergent pencils, the interior structure of translucent bodies is not so well seen.

The optical combination consists of three plano-convex lenses in contact with one another, which the author denotes as A, B, and C, in their order from below upward. A is a plano-convex lens with its plane side facing the mirror; the radius of its curvature being $2\frac{1}{4}$ in. and its thickness 0·175 in. B and C are plano-convex lenses with their convex sides down; radius 1 in. and thickness 0·4 in. On B is cemented a stop, formed of a piece of paper blackened with lamp-black in shellac. The diameter of the central stop is 0·71 in., and the width of the annular opening round the stop 0·1 in.

Each of the lenses in the experimental form of the illuminator exhibited had a diameter of $1\frac{1}{2}$ in. It is evident that this diameter may be lessened in the lenses B and C, so that the combination when mounted will have the form of the frustum of a cone. With this form, the combination could enter the aperture of the majority of stages, and its upper lens be brought even in contact with the under side of the slide.

The mean angle of the emergent rays at the upper lens C is $69\frac{1}{2}°$. The mean diameter of the annular opening of the stop is calculated in reference to the curvatures of the lenses, so that the central rays issuing from this stop fall normally on the convex surface of the lens C, and thus traverse it without refraction. This also tends to correct the chromatic dispersion of the pencil of rays emerging from B, whose boundaries of red and blue fall in directions inclined towards the normal of the lens C, on opposite sides of this normal.

The plane mirrors, as generally made, of nearly all Microscopes, except those of the large models, are too small in the front and rear diameter to illuminate the lower lens of dark-ground illuminators; and the author obviates this defect by cutting an ellipse out of a piece of plane mirror, and attaching this to the frame of the ordinary mirror. The ellipse has a mirror axis a little larger than the diameter of the lower lens of the illuminator, and the major axis is so long that

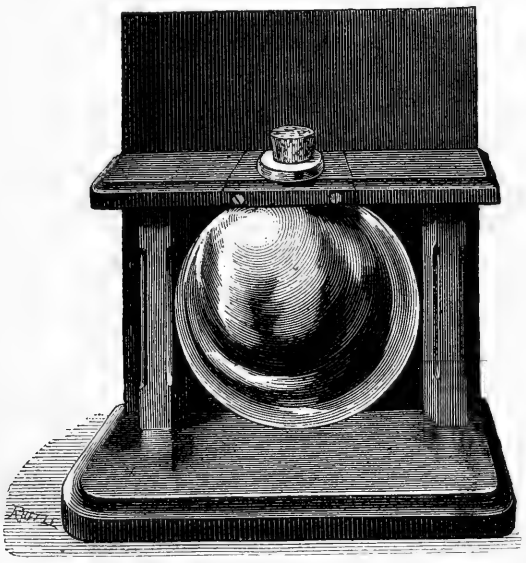
* Journ. New York Micr. Soc., ii. (1886) pp. 28–30.

when the mirror is inclined as much as it will ever need to be to the axis of the Microscope, the whole of the surface of the lower lens of the illuminator is covered by reflected light.

Zeiss's Monochromatic Illuminator.—Dr. Zeiss supplies the apparatus shown in fig. 96 for obtaining monochromatic light for photo-micrography, or ordinary microscopic work.

A glass globe 7 in. in diameter is held by the neck in a wooden frame consisting of a base-plate, two uprights, and a cross piece.

Fig. 96.



The globe is filled with ammonio-copper solution, and placed in front of the lamp, so that monochromatic light can be received by the mirror or condenser. The space between the globe and the uprights is closed by a thin wood screen, which also extends 5 in. upwards, and 3/4 in. on each side of the uprights, shutting off extraneous light more completely.

The lamp intended to be used with the globe is a Siemens gas-burner, and should be placed about 6 in. behind the globe, while the mirror should be at the same distance in front of the globe. The concentrated part of the rays should fall exactly on the mirror. It will be remembered that Hooke* made use of a glass globe filled with water as a bull's-eye condenser, and that Mr. Kitton, in 1881,† also suggested the use of a globe filled with water as well as with a dilute solution of sulphate of copper.

* 'Micrographia,' 1665.

† See this Journal, i. (1881) p. 112.

Theory of the Camera Lucida.*—The first ten pages of Dr. E. Giltay's paper deal with the theory of lenses, nodal points, &c., the constitution of the eye (with a diagram of the cornea, lens, and retina), and contain a discussion of how the image is formed in the eye, whilst the last six pages are devoted to a consideration of the use of lenses between the pencil and the eye (previously published by the author, and noted in this Journal, III. 1883, p. 278). In the rest of the paper the author discusses the best conditions for illuminating the field of view and the drawing paper.

Take first the case of a white chalk pencil on a black slate. Let fig. 97 represent the image on the retina of the field of view with illumination ω and the object with illumination δ, so that ω is great in comparison with δ; let fig. 98 represent the image of the slate with

Fig. 97.

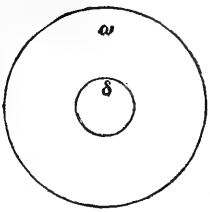


Fig. 98.

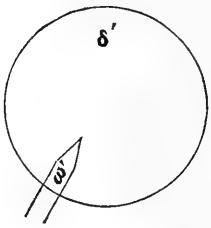
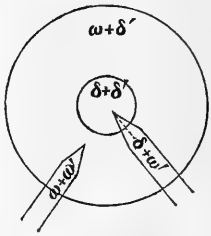


Fig. 99.



illumination δ' and the chalk pencil with illumination ω'. When the two are superposed fig. 99 is the result. The pencil with illumination $\delta + \omega'$ will always be clearly seen upon a faintly illuminated object of which the brightness is $\delta + \delta'$; whether it is also clearly visible upon the background will depend (since δ' is small) upon the relation between ω and ω'; it will be if ω is small in comparison with ω'. If ω is too great in comparison with ω' it must be diminished.

Fig. 100.

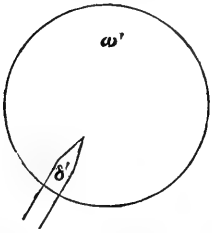
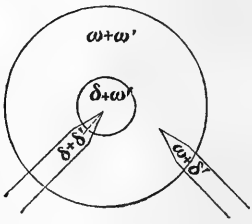


Fig. 101.



The case of a dark pencil upon white paper is represented in figs. 100 and 101, where ω' is now the illumination of the paper and δ' of the pencil. As before, whether the pencil will be easily visible

* Zeitschr. f. Wiss. Mikr., i. (1884) pp. 1–23 (10 figs.).

depends upon the relation between ω and ω'. If ω is too great in relation to ω' it must be reduced.

It is generally assumed that to ensure the best conditions the paper and the field of view must be equally illuminated, i. e. $\omega = \omega'$; whilst in fact ω' should be greater than ω. This may be proved by obscuring half the field of view by a semicircular piece of cardboard placed upon the diaphragm of the eye-piece. Using a weak objective, and having diminished the illumination until it is most convenient for drawing the object with the camera, shift the drawing paper until it occupies only the obscured half of the field; it will then be seen at once that the field is much darker than the paper, i. e. ω is less than ω'.

On the other hand, the brightness of the paper must not be too great in comparison with that of the field, or the object will not be clearly visible. In the use of high powers, therefore, the illumination of the paper must be reduced by interposing glass of different tints between the camera and the paper. These should, however, be sparingly used, and only when the illumination of the paper is such as to obscure the object.

Vorce's Combined Focusing and Safety Stage for use in Micrometry with High Powers.*—Mr. C. M. Vorce's device (fig. 102) consists of two perforated brass plates, the upper bearing two spring

Fig. 102.

clips to hold the slide, and the lower having springs lifting the upper plate, and also a micrometer screw at each end passing up freely through the upper plate, which is depressed by milled nuts on the micrometer screws, opposed by the lifting-springs of the lower plate. "The object of the device is to move the slide instead of the objective in focusing, in order that when making measurements by projecting the image on a screen the distance of the screen from the focal point of the objective may remain absolutely unchanged, which is necessary to avoid the objection that the power has been changed by changing this distance. In micrometry it is essential to avoid, so far as possible, every theoretical as well as every practical source of error, even if it should be too minute to effect, appreciably, the result. And especially is this true of micrometry applied to determine, judicially, important questions. In micrometry there are, with all the ordinary appliances, some theoretical sources of error, which, although in most cases so minute as to be, in their effect upon the accuracy of the result, practically *nil*, are sufficient to afford pretexts for objection on the part

* Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 115–9 (3 figs.).

of those who seek to magnify every defect to be found in the work of others whose results are not agreeable to the views or wishes of those who so object. The identity of results by different methods, and correlation of tests, may often show a given method to be practically exact, yet, if any theoretical objection can be raised against it, it may often be so treated as to completely discredit results that are in point of fact accurate and reliable, and, unfortunately, the less scrupulous the party who thus seeks to discredit such results, the greater the success likely to attend his efforts."

The foregoing, with other considerations, induced Mr. Vorce to adopt the following method of micrometry for high powers:—Instead of using extremely high-power objectives to gain great magnification, tube length, as advocated by Dr. Beale, is employed, and the image is viewed direct, i. e. without magnification by eye-piece, the method having been suggested in part by former experience in the micrometry of blood, and in part by experience in photo-micrography. A base-board is provided, some four or five feet long, at one end of which the lamp is placed enclosed in a light-tight box. A magic lantern answers admirably for illumination, connecting its condenser tube with the stage of the Microscope by means of a light-tight sleeve. The Microscope is placed horizontally with the amplifier in place and the tube as short as possible, and internally blackened to avoid reflection. A movable vertical screen, faced with white cardboard or glass, is adjusted on the base-board at such distance from the Microscope as is found suitable, but need not ordinarily exceed two feet, and is clamped in place when adjusted. The focusing stage is adjusted on the Microscope stage, clamped in place, and a micrometer is put in place and focused, the image being observed on the screen. When the desired power is gained by moving the screen along the base-board it is clamped in place, and the lines of the micrometer, as seen on the screen, are traced by means of a ruler and pen on the face of the screen, and by the use of dividers the spaces may be further subdivided. In the measurements to be made the Microscope and screen are not moved in the least, nor even touched, except to turn the screws of the mechanical stage. The micrometer is removed by pressing down the top plate of the focusing stage, the slide containing the objects to be measured is substituted, and the plate, on being released, brings the slide into focus, if it is of the same thickness as the micrometer, if not, it is brought into focus by the focusing screws of the focusing stage. When focused, the image on the screen is viewed and the measurement read off and noted as the slide is passed along by the movement of the mechanical stage. If, owing to uneven thickness or curvature of the slide or cover, the object begins to pass out of focus, it is focused by means of the screws of the focusing stage. The operator sits, ordinarily, near the screen, working the stage with the left hand and noting the measurements with the right; the milled nuts of the focusing stage are easily reached, and the work proceeds rapidly; although two operators, one to note down the measurements as called off by the other, and occasionally changing places, facilitate the work.

It is obvious that with this device the power employed is always the same, when once adjusted, and enlargement up to 5000 diameters may be obtained. The micrometer eye-piece, where the body is moved by the fine adjustment, is also practically unchanging in power, but cannot easily afford the same amount of magnification, unless with unusually high-power objectives whose short working distance usually precludes their use with tube lengths sufficient to give so great amplification.

A very convenient method of using the focusing stage in micrometry is to so adjust the screen that 0·001 in. of the stage micrometer exactly equals 1 in. of the paper scales used by architects and divided into hundredths of inches; by pasting one of these scales across the screen and bringing the micrometer lines (of 0·001 in.) to coincide with the inch lines of the scales, and clamping the screen in that position, a scale upon the screen is obtained reading to $\frac{1}{100000}$ in., which is far finer than can ordinarily be utilized, although by sunlight the striæ of some diatoms, such as *F. saxonica* and *A. pellucida*, will puzzle the eyesight in attempting to count their striation by means of the scale.

An incidental feature of this focusing stage is that it will not allow the slide or cover to be broken in focusing, and is therefore a safety stage as well.

In making measurements by this method the same spaces of the scale should be used for every measurement, and, preferably, the central ones, thus removing any question as to the variation of power or aberrations in the extreme edges of the field. Thus, if the objects measured are about $1\frac{1}{2}$ or 2 divisions of the scale, and two are in the field at once, do not read the dimensions and record them as they stand, but bring first one of the objects to the central line and read from that, and note the measurement; then bring the other object to the *same side* of the central line, read and record as before; both are then measured by the same part of the scale to the extent of the smaller.

Logan's Life-Slide.*—Mr. J. H. Logan's slide (fig. 103) consists of a glass slip of the usual size, but 1/4 in. thick. An annular channel

Fig. 103.

as deep as the thickness of the slide allows is ground out for an air-space, and outside of this a much narrower and quite shallow channel is cut. This last is for holding beeswax or wax and oil, to cement down the cover and prevent evaporation of the enclosed fluid. A drop of water placed in the centre of the slide and flattened down to a stratum as thin as the objects under examination will permit, is in a very favourable condition for examination. Infusoria, thus confined,

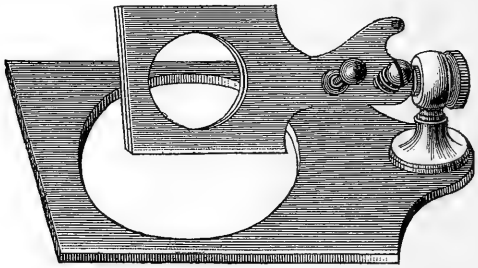
* Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 110–1 (1 fig.).

can move freely in every direction except the vertical, and are always in focus. The air channel also serves to hold any excess in the amount of fluid, above that required to fill the area of the circular field. Infusoria may also be isolated and sealed up, when they may be kept alive and in good condition for a week or more. In some temporary slides, where the air-space was much too small, there being no channel, rotifers, *amœbæ* and other forms, were alive and active for nearly a week.

Beeswax alone seems the best cement for sealing. If put in a syringe having a very small nozzle, and warmed, the wax may be forced out as a long, thin thread. This can be wound on a spool and kept ready for use when a slide is to be sealed up. A piece long enough to fill the outer channel is placed therein. A glass slip placed over the cover-glass, and pressed down securely, seals the cell, and, as the wax is soft, the stratum of fluid can be made as thin as desired.

Watson's Reversible Compressor.—Mr. G. Watson's apparatus (fig. 104) consists of a base-plate carrying a compressor which can be

Fig. 104.



completely rotated on its horizontal axis—so as to exhibit the object on both sides or even in an intermediate position—as well as on the vertical pin which fits into the socket of the base-plate. The two plates of the compressor are separated by a screw acting against a spiral spring, while the upper one pivots over the lower to allow the object to be inserted.

Ruled Plate for Measurement of Blood-corpuscles.*—Prof. W. A. Rogers describes a plate ruled in 1,300,000 squares which when not in use is covered in order to protect the filling of the lines. Whenever it is to be used, it is uncovered and the lines filled with graphite by rubbing the surface diagonally with a camel's-hair brush pressed upon the glass with the fingers. A very slight amount of powder upon the brush will be sufficient. After the lines are filled, the blood placed directly upon the slide will not interfere with their visibility. When the examination is completed, the surface of the glass should be cleaned with cotton.

* 11th Ann. Rep. Amer. Postal Micr. Club, 1886, p. 13.

Beautiful slides have been prepared upon small circles of speculum metal, in which the lines are protected by nickel plating. The lines are very sharp under the nickel. With a vertical illuminator and very high powers this form is recommended.

Yeast Counting Apparatus.— Herren Klönne and Müller supply an apparatus for use by brewers in counting the number of cells in yeast and thus judging of its quality. It is practically identical with the blood-corpuscle counters, and consists of a slide with a cell of definite capacity, a reticular micrometer, and a pipette.

Metal Micrometers.*—Mr. M. D. Ewell calls attention to the fact of the very great superiority of metal micrometers over glass. To say nothing of their greater durability, in point of clearness and sharpness of outline there is no comparison whatever between the two. With a high power the edges of lines ruled upon glass appear rough and uneven; but the author has never yet been able to find a power high enough to produce an effect upon a speculum metal centimetre ruled to 1/100 mm., though he has examined it with a Zeiss 1/18, Bausch and Lomb amplifier, and 1/2 in. solid eye-piece, with the draw-tube drawn out to its greatest length.

Circulation Plate for Frogs, &c.†—Prof. S. H. Gage says that an excellent circulation board for *Necturus* and frogs may be prepared by boring a hole about 2 cm. in diameter in a pine board 8×30 cm. and 15 mm. thick. The hole should be about 5 cm. from one end and near one side. A perforated cork or hollow cylinder of wood should be fitted to this hole. Over the top of the perforated cork should be placed a very thick cover-glass or a piece of thin glass slide, and sealed with sealing-wax; finally the whole board should be covered with woollen cloth or cotton flannel. The perforated cork should be capable of being moved so that it will stand a centimetre above the surface of the board if desired.

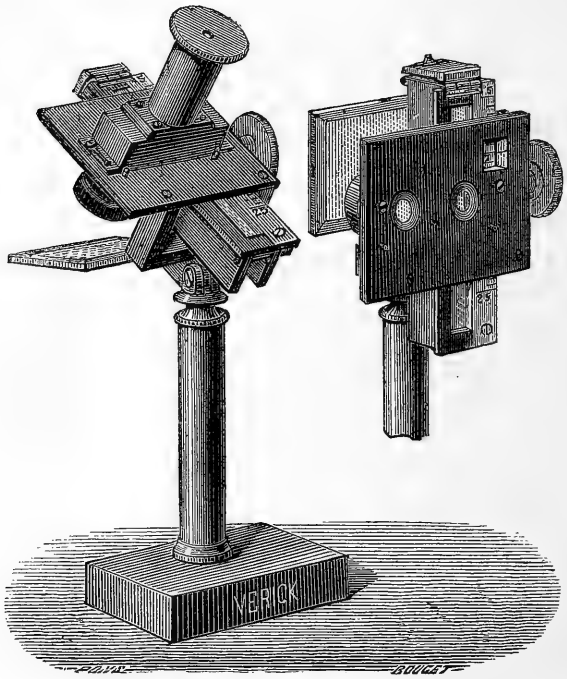
Malassez's Hæmochromometer.‡—Dr. L. Malassez's instrument serves to estimate the intensity of the colour of blood by placing in a wedge-shaped trough a solution of the blood to be examined and then determining at what point of the wedge the solution reproduces the tint of a fixed standard. This point will, of course, be so much the nearer to the apex of the wedge as the blood examined is richer in hæmoglobin. Dr. Malassez's apparatus is therefore the inverse of the old one.

A small metal plate (fig. 105) forms a screen having in its centre two circular holes. Behind one of these is placed the coloured standard and behind the other the vessel for the solution of blood. The coloured standard is formed by a small glass trough inclosing a solution of picrocarmine, which reproduces exactly the colour of a solution of 1 in 100 of blood containing 5 per cent. of hæmoglobin. The trough is mounted in a brass box, and fixed in a metal ring. The

* The Microscope, vi. (1886) p. 63.
† Notes on Histological Methods, 1885-6, p. 10.
‡ Arch. de Physiol., 1882.

trough is in the form of a very elongated wedge. The lateral walls are of metal which hold firmly between them the glasses which form the oblique walls of the trough. This trough is fixed to a carrier which can be moved up or down by a milled head. To the right near the top of the screen is a square orifice through which the scale engraved on the carrier can be seen. Behind the screen and the trough is placed either a piece of ground glass, or a mirror with ground surface, according as the examination is conducted by direct or reflected light.

Fig. 105.



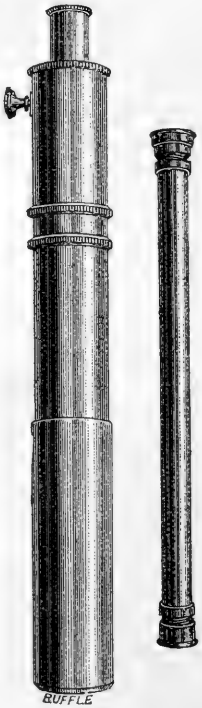
To the anterior face of the screen and in front of the two central orifices a small apparatus can be applied, consisting of two total double-reflection prisms, a very narrow diaphragm, and a lens. The screen is attached to a vertical support, which obviates the necessity of holding it in the hand, and it can be placed vertically or inclined as desired.

The accessories comprise (1) a guarded lancet, (2) a "mélangeur" (identical in construction with the "Mélangeur Potain," see this Journal, II. (1882) p. 561, fig. 107, but differently graduated) for making the solutions of blood, and (3) a small vessel to receive them temporarily.

The method of using the instrument is briefly as follows:—A solution of blood (1 in 50, 1 in 100, or 1 in 200) is made by the mélangeur and put in the trough; the latter is then placed in its carrier and moved up or down by means of the milled head till the precise point is reached at which the tint of the solution seen through the central aperture exactly matches that of the coloured standard. The figure is then read off by the index, and if the solution is 1 in 100 it will indicate direct the quantity of hæmoglobin contained in 100 parts of blood; but if the solution is 1 in 200 this figure must be doubled, or if 1 in 50 halved.

Thierry's Hæma-Spectroscope.*—M. M. de Thierry designed this apparatus for the detection of infinitesimal quantities of blood in any fluid (water, urine, humours) or in spots on linen, wood, metals, &c. The principle of the apparatus is based on the optical properties of oxyhæmoglobin and reduced hæmoglobin, one of which gives two absorption-bands between the lines D and E of the spectrum and the other a single band between the others.

FIG. 106.



It consists of a brass tube, in which slides another tube of much smaller diameter, the latter having a spectroscopic apparatus of new design, furnished with a prism of great dispersive power and having a slit the width of which can be regulated symmetrically on both sides of the median line. Into the apparatus can be introduced at will three glass tubes with their ends closed by small glass discs. The tubes are 1, 3, and 5 dm. long and 1 cmq. in section. They hold the fluid to be investigated, and according to its richness in colouring matter one or other of the tubes is taken. It can be adapted either for a separate stand with a concave mirror or more simply for an ordinary Microscope.

In use the mirror is adjusted so as to illuminate the tube strongly, and the opening of the slit is regulated and focused so that the spectrum is very clearly seen. The urine or fluid in which the linen, paper, &c., supposed to be spotted with blood has been previously macerated, is placed in one of the tubes. If the fluid is colourless or the colour is very faint the 5 dm. tube is used; if it is highly coloured it is diluted with water, until it is of a bright rose colour when seen through a pretty considerable thickness and placed in the 1 dm. or 3 dm. tube. If the solution is too highly coloured it will completely absorb the light, and consequently the two characteristic bands will not be visible.

* Comptes Rendus, c. (1885) pp. 1244–6.

Owing to the thick stratum of fluid traversed by the light, the absorption-bands appear, even with a solution only containing 1/100,000 of hæmoglobin. A drop of blood the size of a grain of wheat, on a piece of linen exposed three months in the open air, showed very distinctly after maceration in fluid enough to fill the 5 dm. tube the absorption-bands of hæmoglobin, and the author has found the absorption-bands still perfectly visible in a fluid which under ordinary circumstances presented no colour, and which only contained 1 c.cm. of blood in 30 lit. of water. With urine the results are almost as satisfactory.

The tubes being entirely of glass, the fluids can be submitted to the chemical actions which allow the oxyhæmoglobin to be reduced, and its presence verified by the appearance of the characteristic black band.

This apparatus can of course be used in all cases where the process of spectroscopy by absorption admits of application, as in the determination of the presence of chlorophyll. The author has, moreover, applied it to the detection of very small quantities of ergot in wheat-flour, by means of the distinctive absorption-spectrum which the colouring matter of ergot presents.

Apparatus for Microscopical Observation of Vapour-drops.*—Prof. J. L. Soret describes an apparatus by which drops of vapour

FIG. 107.

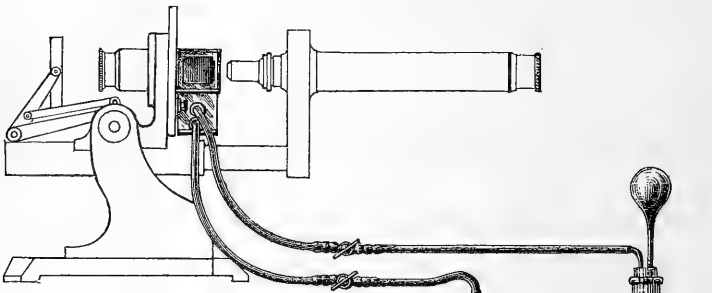
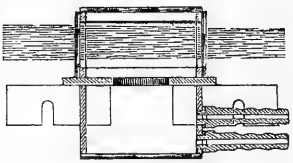


FIG. 108.



can be examined microscopically. It depends upon the principle that when moist air is rarefied by an air-pump a precipitation of vesicular

* Arch. Sci. Phys. et Nat., xiv. (1885) pp. 575–6.

vapour is formed, which disappears in a few minutes. When the exhaustion is feeble the vapour is scarcely visible in diffused light, but becomes very apparent when a beam of solar or electric light is directed on it.

A small box with glass walls, shown in position in fig. 107 and in section in fig. 108, is placed on the stage of the Microscope, and to it are attached two tubes fitted with stop-cocks. One of them communicates with a vessel partly filled with water for obtaining moist air, the other with the receiver of an air-pump. The air in the glass box can alternately be rarefied, and moist air allowed to enter at each dilatation. By means of sunlight or electric light, the globules of vapour formed can be examined; but the author has not yet arrived at any conclusion as to their constitution.

ABBE, E.—**Changing Eye-pieces without altering focus, &c.**
[Letter written in 1881 pointing out that to do this it is the anterior principal focus of the eye-piece that must keep the same place in the Microscope-tube.]
Micr. Bulletin (*Queen's*), III. (1886) pp. 9–10 (1 fig.).

American Society of Microscopists.—Working Session.
["Schedule of Demonstrations," &c.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 203–7.

BULLOCH, W. H.—**Magnification.**
[Answers to his questions, *ante*, p. 149.]
Amer. Mon. Micr. Journ., VII. (1886) p. 78.

BURRILL, T. J.—See Stratton, S. W.

C[AMPBELL], J. A.—**Fine Adjustment.**
[1. Criticism of Mr. Mayall and Mr. Swift's views of his adjustment, *ante*, p. 375. 2. Criticism of Anderson's fine adjustment, *ante*, p. 325.]
Engl. Mech., XLIII. (1886) p. 148.

COLE, A. H.—**A new self-adjusting Frog-plate.** [*Post.*]
Micr. Bulletin (*Queen's*), III. (1886) p. 11 (1 fig.).

Connor's (R.) Pen-and-ink drawings of objects viewed with the Microscope.
[Vol. V. p. 1077.] *Nature*, XXXII. (1885) p. 633.

COX, J. D.—**The Actinic and Visual Focus in Micro-photography with High Powers.**
[See Vol. V. (1885) p. 1070.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 29–32 (1 heliotype), and pp. 229–30.

CRAMER, C.—**Ein neuer beweglicher Objecttisch.** (A new movable stage.)
[*Post.*] *Zeitschr. f. Wiss. Mikr.*, III. (1886) pp. 5–14 (2 figs.).

CZAPSKI, S.—**Ueber ein Mikrorefractometer.** (On a Micro-refractometer.)
[Description of Exner's, *ante*, p. 328, with critical remarks, and a suggested improvement as regards the independent action of the screws on the screen.]
Zeitschr. f. Instrumentenk., VI. (1886) pp. 139–41 (2 figs.).

D'ARSONVAL, A.—**Recherches de Calorimétrie.** (Researches on Calorimetry.)
[Describes various forms of (1) apparatus for maintaining a constant temperature, (2) regulators, (3) calorimeters.]
Journ. Anat. et Physiol. (*Robin*), XXII. (1886) pp. 113–61 (26 figs.).

DETMERS, H. J.—**The Numerical Aperture of an Objective in relation to its angle of aperture in air, water, and balsam.**
[Two tables: (1) Air angle, water angle, balsam angle, and N.A. for every 2° of *air angle* from 1° and 2° to 180°. (2) Balsam angle, water angle, and N.A. for every 2° of *balsam angle* from 1° and 2° to 180°.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 199–202.

DILLER, J. S.—**The Microscopical Study of Rocks.**
[Brief notes on the history of the subject, on French and German petrological Microscopes, and on mounting.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 41–2 and 59.

DUDLEY, P. H.—**Photo-micrographs of Wood Sections.**
[Exhibition only. Photographs 0·93 in. in diameter, taken by lamplight on 8 × 10 in. bromo-gelatin plates, with a magnification of 10,000.]
Trans. N. York Acad. of Sci., III. (1885) p. 107.

DUNNING, C. G.—**Note on a new form of Live-box or Zoophyte-trough.**
[*Ante*, p. 138.] *Journ. Quek. Micr. Club*, II. (1886) pp. 249–51 (3 figs.).

ETERNOD, A.—**Planche à dessin universelle pour les laboratoires de Microscopie.** (Universal drawing-board for microscopical laboratories.) [*Post.*]
Internat. Monatsschr. f. Anat. u. Histol., II. (1885) No. 6.

EWELL, M. D.—**Metal Micrometers.** [*Supra*, p. 521.]
The Microscope, VI. (1886) p. 63.

F.R.M.S.—**Campbell's Fine Adjustment.**
[Reply to Mr. Campbell's letter, *supra*, and pointing out that Mr. Nelson did originally recommend it for students' Microscopes. Gundlach and Ross have already applied the differential screw to fine adjustments.]
Engl. Mech., XLIII. (1886) p. 239.

FENNESSEY, E. B.—**[Eyes of Animals as Objectives.]**
["Have the eyes of animals ever been substituted for the objective of the Microscope? I often see the eyes of fish and birds fading into nothingness, and I feel regret that some means of utilizing them for optical purposes is not practised. Doubtless such lenses are perfect. Could they not be frozen with an ether spray whilst using them, or could not our scientists think of some substance which will preserve them from decay without destroying their form or impairing their transparency?"]
Engl. Mech., XLIII. (1886) p. 133.

FRANCOTTE, P.—**Microscope de voyage de Nachet.** (Nachet's Travelling Microscope.)
[Cf. Vol. II. (1882) p. 98.] *Bull. Soc. Belg. Micr.*, XII. (1886) pp. 60–1.

Girard, A. C.—See *Peyer, A.*

Glasgow Microscopical Society, Formation of. *Nature*, XXXIV. (1886) p. 14.

Graff, T. S. Up de, Memoir of.
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 216–22. See also pp. 230–2.

GRIFFITH, E. H.—**Some new and improved Apparatus.**
[Substage diaphragm (*ante*, p. 130). Mechanical finger objective (Vol. V., 1885, p. 709).]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 112–4 (4 figs.).

" " **Our Eighth [Ninth ?] Annual Meeting.**
[As to the prospects, &c., of the Chautauqua Meeting of the Amer. Soc. of Micr.]
The Microscope, VI. (1886) pp. 58–60.

GUNDLACH, E.—**On Immersion Objectives.** [*Supra*, p. 510.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 51–3, 236–7.

" " **Astigmatism and its relation to the use of optical instruments further considered.** [*Supra*, p. 509.] *The Microscope*, VI. (1886) pp. 63–5.

HAGER, H.—**Das Mikroskop und seine Anwendung. Ein Leitfaden bei mikroskopischen Untersuchungen für Apotheker, Aerzte, Medicinalbeamte, Kaufleute, Techniker, Schullehrer, Fleischbeschauer, &c.** (The Microscope and its Use. A guide to microscopical investigations for chemists, physicians, medical officers, merchants, technicians, school-teachers, meat-examiners, &c.) 7th ed., viii. and 240 pp., 316 figs. (8vo, Berlin, 1886).

HEURCK, H. VAN.—**Le Microscope à l'Exposition Universelle d'Anvers.** (The Microscope at the Antwerp Universal Exhibition.) (*Concld.*)
[Preparations (Prince of Monaco—Montaldo's Wood Sections)—Photograms—Various accessories.]
Journ. de Microgr., X. (1886) pp. 75–80.

HEURCK, H. VAN.—**Nouveaux Objectifs et Oculaires de Zeiss.** (New objectives and eye-pieces of Zeiss.) [*Ante*, p. 316.] *Ibid.*, pp. 91–3, from *Moniteur du Praticien*, Feb. 1886.

HITCHCOCK, R.—**Photo-micrography. V., VI.**
[Focusing. Exposure. 4. Developing.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 67–70, 92–5.

[HITCHCOCK, R.]—**Postal Club Boxes.**
[List of contents.] *Amer. Mon. Micr. Journ.*, VII. (1886) pp. 16–8, 57–8.

" " **A New Objective.**
[H. R. Spencer and Co's. 1/16 in. homogeneous immersion.] *Ibid.*, p. 57.

HOEGH, E. v.—**Nachtrag zu 'Die Achromatische Wirkung der Huyghens'schen Okulare.'** (Addition to 'The achromatic action of the Huyghenian Eye-pieces.') [Cf. *ante*, p. 338.]
Central-Ztg. f. Optik. u. Mech., VII. (1886) p. 85.

HOPKINS, G. M.—**Microscopical Examination of Ciliated Organisms by intermittent Light.** [*Supra*, p. 135.]
The Microscope, V. (1885) pp. 279–81, from *Scientific American*.

HOWE, L.—**An Imperfection of the Eye and Test Objects for the Microscope.**
[*Ante*, p. 147.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 91–2, pp. 244–5.

KELLICOTT, D. S.—**An efficient Pipette.** [*Ante*, p. 180.]
["An equally good, perhaps better, way to secure a pipette with all required advantages is as follows:—Take a proper piece of large rubber tubing, e.g. 3 in. long, with half or three-fourths inch bore, and two short rubber corks to fit, pass the tube through one stopper and into the other; drill a hole in the glass tube near the upper one, and bring all to place. This form works promptly, is durable, and has one advantage, when laid on the work-table the point is free from the same, so it does not gather dust.]
Amer. Mon. Micr. Journ., VII. (1886) pp. 4–5.

KESTEVEN, W. B.—**Microscopical Drawing.**
[Thin glass cover in brass revolving frame placed at an angle in front of the eye-piece.]
Scientif. Enquirer, I. (1886) p. 68.

KING, T.—**On the use of the Magic Lantern for purposes of Teaching.**
[*Supra*, p. 507.]
Proc. and Trans. Nat. Hist. Soc. Glasgow, I. (1886) p. xxx.

KINKELIN, F.—**The Dioptrograph.**
[Mechanical drawing apparatus for drawing the outlines of macroscopic objects, consisting of a pantograph, in which the tracer is represented by a tubular diopter, supported on a square table. For smaller objects the diopter is furnished with a lens.]
Amer. Naturalist, XX. (1886) pp. 406–8 (1 fig.), from *Humboldt*, I. Part 5.

KLÖNNE, J., and G. MÜLLER.—**Pendel-Objekttisch für Mikroskope.** (Pendulum stage for Microscopes.) [*Ante*, p. 127.]
Title only of German Patent No. 35,174, K. 4238, 14th July 1885.

KÜCH, R.—**Petrographische Mittheilungen aus den Südamerikanischen Anden.** (Petrological communications from the South American Andes.)
[Description of apparatus. *Post.*]
Neues Jahrb. f. Mineral., Geol., u. Palæontol., 1886, I. pp. 35–48 (2 figs.).

LAUDY, L. H.—**The Magic Lantern and its applications—Microscope attachment.**
Anthony's Phot. Bulletin, XVII. (1886) pp. 234–6 (4 figs.).

LEES, W.—**Acoustics, Light and Heat.**
[Microscopes, pp. 150–1. "The eye-piece is usually formed of several glasses . . . . The glasses are all made achromatic."]
New ed., 320 pp. and 209 figs. (8vo, London and Glasgow, n.d.).

LEWIS, W. J.—**Some new features in connection with electric illumination as applied to the Microscope.** [Title only.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, p. 249.

LOGAN, J. H.—**A new form of Life-slide.** [*Supra*, p. 519.]
Ibid., pp. 110–1 (1 fig.).

LOGAN, J. H.—**Remarks on a device for enabling two observers to view objects simultaneously.**

["Half of the rays from the object proceed directly up the main tube, and the other half are reflected into the other one. The reflected rays, however, do not cross those of the main tube, but are reflected outside; otherwise the arrangement resembles that of the Wenham binocular prism. Either such a modified Wenham prism may be used, or two plain reflectors. The one submitted for examination is an experimental one, and works fairly well. Experiments are still being made, the endeavor being to perfect an apparatus that will utilize the whole aperture of the objective in each tube, instead of half, as in the present arrangement."]

Ibid., pp. 120–1 (1 fig.).

MALLARD, E.—**Traité de Cristallographie géométrique et physique. Tome II. Crystallographie physique.** (Treatise on geometrical and physical Crystallography. Vol. II. Physical Crystallography.)

[Includes Microscope, apparatus, and methods.]

184 figs. and 8 pls. (8vo, Paris, 1884).

MARTIN, E. W.—**Photomicrography—Processes and results.**

[Title of paper only, with discussion by Dr. Julien and the President (Dr. J. S. Newberry). The latter thought that "the problem of a satisfactory microscopic attachment to the lantern still remained unsolved at present."]

Journ. N. York Acad. of Sci., III. (1885) pp. 105–6.

MARTIN, W. J.—**Astigmatism and the Microscope.** [*Supra*, p. 510.]

The Microscope, VI. (1886) pp. 79–80.

Matthews, Dr. J., Death of. *Journ. Quekett Micr. Club*, II. (1885) p. 279.

MAYER, A. M.—**A simple and inexpensive form of Black-ground Illuminator.**

[*Supra*, p. 514.] *Journ. New York Micr. Soc.*, II. (1886) pp. 28–30.

MERCER, F. W.—**Small Photo-micrographic Camera.**

[Described Vol. IV. (1884) p. 625.]

The Microscope, VI. (1886) pp. 60–2 (2 figs.).

MICHIE, W. E.—**Microscopical Optics.**

[Queries and answers. (1) The binocular prism fitting does not reduce the aperture of high-power objectives when used monocularly. (2) 1 in. diameter is too small for low-power eye-pieces.]

Micr. Bulletin, III. (1886) pp. 7–8.

Micrometer, Standard, Report of Committee on.

["Little progress in the work of obtaining copies of the standard for general use among microscopists." One copy broken. Standards should be made of material less liable to destruction than thin glass. Prof. Rogers has consented to prepare a series of copies on thick plate glass or other suitable material.]

Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 212–3.

MITTENZWEY, M.—**Ueber die acromatische Wirkung der Okulare von Huyghens und Ramsden.** (On the achromatic action of Huyghenian and Ramsden eye-pieces.) *Central-Ztg. f. Optik u. Mechanik*, VII. (1886) p. 61.

MÜLLER, G.—See Klönne, J.

NELSON, E. M.—**Some remarks on the interpretation of Microscopic images with high powers.** [*Post.*]

Journ. Quekett Micr. Club, II. (1886) pp. 255–9, 283–4, and 286–7.

NOE, L. H.—**Magnification.**

[Reply to Mr. Bulloch's queries, *ante*, p. 149.]

Amer. Mon. Micr. Journ., VII. (1886) pp. 58–9.

OBERSTEINER, H.—**Ein Schnittsucher.** (A section-searcher.) [*Post.*]

Zeitschr. f. Wiss. Mikr., III. (1886) pp. 55–7 (1 fig.).

Objectives, the new Abbe. *Amer. Mon. Micr. Journ.*, VII. (1886) pp. 76–7, 88–92; *The Microscope*, VI. (1886) pp. 87–8, 111–9; *Science*, VII. (1886) pp. 247, 413–4; *Nature*, XXXIV. (1886) pp. 57–8.

ORTH, J.—**Cursus der normalen Histologie zur Einführung in dem Gebrauch des Mikroskopes, sowie in das practische Studium der Gewebelehre.** (Course of normal histology as an introduction to the use of the Microscope as well as to the practical study of histology.)

[Contains an introduction on the Microscope, and methods of preparation, pp. 1–65, 11 figs.]

4th ed., xii. and 360 pp., 108 figs. (8vo, Berlin, 1886).

P., W. G.—**The Huyghenian Eye-piece.**

[The answer to the question, "Is it achromatic?" requires a distinction to be made before we can give it. When it receives parallel rays it is achromatic; but when placed as it is in a telescope it is very far from being so.]

Engl. Mech., XLIII. (1886) p. 255.

PELLETAN, J.—**Microscope Minéralogique** (moyen modèle) de Bézu, Hausser et Cie. (Bézu, Hausser, & Co.'s Mineralogical Microscope—medium size.)

Journ. de Microgr., X. (1886) pp. 185–6.

Peyer, A.—**An Atlas of Clinical Microscopy.** Translated by A. C. Girard.

200 pp., 90 pls., and 105 figs. (8vo, New York, 1886).

ROGERS, W. A.—**Determination of the absolute length of eight Rowland gratings at 62° F.**

[Contains a description of a new comparator made in 1884.]

Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 151–98 (3 figs.).

" " **Ruled plate for Blood-corpuscles.** [*Supra*, p. 520.]

11*th Ann. Rep. Amer. Post. Micr. Club*, 1886, p. 13.

ROYSTON-PIGOTT, G. W.—**Microscopical Advances.**

[VII. "A thing of beauty, a joy for ever." Diatomic marvels. VIII., IX., X. Focal planes, their measurement by the focimeter and diatomic images.]

Engl. Mech., XLIII. (1886) pp. 115–6 (2 figs.), 159–60 (1 fig.), 203–4 (3 figs.), and 247–8 (5 figs.).

Also reply to Dr. Edmunds, *ante* p. 337, p. 126.

RUNYON, E. W.—**[Exhibition of Oxy-hydrogen Microscope.]**

[Construction only generally described—"The nose-piece to which the objectives are attached slides on three polished steel rods, as does also the stage with its substage, and both can be clamped in any desired position."]

Proc. San Francisco Micr. Soc., 1886, March 24th.

SCHIEFFERDECKER, P.—**Ueber eine neue Construction der Mikrometerschraube bei Mikroskopen.** (On a new construction of the micrometer screw for Microscopes.) [*Post.*]

Zeitschr. f. Wiss. Mikr., III. (1886) pp. 1–5 (2 figs.).

SCHULTZE, E. A.—**Electrical illumination for the Microscope.**

[Reports the successful use for the purpose of a small gas engine and dynamo.]

Journ. New York Micr. Soc., II. (1886) pp. 16–7.

SHANKS, S. G.—**A Contribution to Blood Measurements.**

[Description of the Microscope used and mode of measurement, with table of 242 measurements. "A blood-corpuscle seen with the vertical illuminator presents a novel appearance. It appears smaller than with transmitted light, that is, without coma."]

Amer. Mon. Micr. Journ., VII. (1886) pp. 25–6.

SMITH, H. L.—**Presidential Address.**

[The unconscious influence of science studies. See Vol. V. (1885) p. 1081.]

Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 5–28.

" " **Device for testing refractive index of immersion fluids.**

[See Vol. V. (1885) p. 1066.]

Ibid., pp. 83–5 (1 fig.).

SORBY, H. C.—**The application of very high powers to the study of the microscopical structure of steel.** [*Supra*, p. 511.] *Ironmonger*, 1886, pp. 905–6.

Nature, XXXIV. (1886) p. 63.

Spencer and Tolles Memorial Fund.

[Report to Amer. Soc. Micr. of the condition of the fund, now amounting to $60·20.]

Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 249–50.

STEIN, S. T.—**Das Licht im Dienste wissenschaftlicher Forschung.** Heft III. Das Licht und die Lichtbildkunst in ihrer Anwendung auf anatomische, physiologische, anthropologische, und ärztliche Untersuchungen. (Light as an aid to scientific investigation. Part III. Light and the art of photography in their application to anatomical, physiological, anthropological, and medical researches.)

2nd ed., viii. and pp. 323–472, 172 figs. and 2 photogr., 8vo, Halle, 1885.

STRATTON, S. W. AND T. J. BURRILL.—**A Heliostat for Photo-micrography.**

[Description of a moderately cheap instrument, and "simple and so adjustable as to eliminate as many of the errors of construction as possible, quickly put in operation, easily kept in order, and requiring but little attention after once being properly set and regulated."]

Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 103–7 (2 figs.).

THIESEN, M.—**Ueber die Ablesung von Normalbarometern und überhaupt von grösseren Flüssigkeitsoberflächen.** (On the reading of normal barometers and especially with large fluid surfaces.) [*Post.*]

Zeitschr. f. Instrumentenk., VI. (1886) pp. 89–93 (3 figs.).

Tolles Memorial Fund.—See Spencer.

VORCE, C. M.—**A combined focussing and safety-stage for use in micrometry with high powers.** [*Supra*, p. 517.]

Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 115–9 (3 figs.).

WALMSLEY, W. H.—**How to make Photo-micrographs. III.**

[Describes the author's first camera (Vol. III., 1883, p. 556), and his enlarging, reducing, and copying camera, *post.*]

The Microscope, VI. (1886) pp. 49–53 (2 figs.).

ZIMMERMANN, O. E. R.—**Atlas der Pflanzenkrankheiten welche durch Pilze hervorgerufen werden. Mikrophotographische Lichtdruckabbildungen der phytopathogenen Pilze nebst erläuterndem Texte.** Heft 2. (Atlas of Plant-diseases produced by Fungi. Photo-micrographic illustrations of the phytopathogenic fungi, with explanatory text. Part 2.)

pp. 17–22 and plates III. and IV. with 15 figs. each.

Text 8vo, atlas fol., Halle a. S., 1885.

β. Collecting, Mounting and Examining Objects, &c.*

Hunting for Amœbæ.†—Dr. J. E. Taylor has found the following simple device for catching *Amœbæ* to be successful in the highest degree. He lowers one of the ordinary shilling glass troughs to the bottom of the fresh-water aquarium, and when the trough has been immersed about twenty-four hours, on being carefully brought up, numerous *Amœbæ* will be found crawling on the inner surfaces of the glass.

* This subdivision contains (1) Collecting Objects; (2) Preparing, (*a*) in general, (*b*) special objects; (3) Separate processes prior to making sections; (4) Cutting, including Imbedding and Microtomes; (5) Staining and Injecting; (6) Mounting, including preservative fluids, cells, slides, and cabinets; (7) Examining objects, including Testing; (8) Miscellaneous matters.

† Sci.-Gossip, 1886, pp. 113–4.

Preparing Sections for Examination with the highest Powers.* —Mr. J. W. Gifford thinks there is no more successful plan for demonstrating minute structure than Beale's process of preparing and staining tissues in glycerin and then teasing them out with needles, followed by the judicious application of heat and pressure, and finally mounting in pure glycerin. The method, however, prevents the use of the freezing microtome as glycerin freezes at so low a temperature, and it therefore occurred to him whether the substitution of a colloid, such as gum, for the glycerin at one stage of the process might not act as well as glycerin in preventing change.

The fresh material cut into small pieces should be placed in Beale's glycerin-carmine until the bioplasm is stained (10 to 15 hours), or better, inject the whole body or part with the stronger glycerin-carmine, and allow it to remain until stained; it should then be cut into pieces. After this place it in 2 parts glycerin to 1 water for 24 hours, followed by pure glycerin saturated with picric acid for 48 hours. The pieces are then taken out of the glycerin and (of course without washing) placed in a thick solution of gum acacia, also saturated with picric acid, for 48 hours. The small quantity of glycerin which adheres to them when placed in the gum and picric acid does not much retard freezing, and sections may easily be cut.

As soon as the sections are cut they are placed in a mixture of 5 drops of acetic acid to 1 oz. of glycerin, and after remaining in this for several days or a week will have swelled out to their original size if shrunk at first by the glycerin, and may then be mounted in glycerin with a trace of acid in the usual way.

Osmic Acid and Merkel's Fluid for Pelagic Fish-eggs, &c.†—Dr. C. O. Whitman proceeds by placing the eggs with a little sea-water in a watch-glass; then by the aid of a pipette a quantity of osmic acid (1/2 per cent.) about equal in volume to that of the sea-water is added. At the end of from five to ten minutes the eggs are washed quickly in water and transferred to a chrome-platinum solution, differing from Merkel's mixture in having a 1 per cent. solution of chromic acid. In this they remain from one to three days. By this treatment the blastoderm may be easily freed from the yolk and then having been thoroughly washed in water for some hours, the preparation is passed through the usual grades of alcohol, stained and sectioned or mounted *in toto*. The platinum chloride not only completes the work of hardening, but at the same time removes much of the brown or black colour imparted by the osmic acid. By this method a very marked differentiation is generally obtained as early as the 16-cell stage. In later stages of cleavage the distinction between central and peripheral cells becomes still stronger, so that it becomes possible to trace the entire history of the origin of the so-called parablast.

For the eggs of *Clepsine* Merkel's fluid is used, of its ordinary strength, for one or two hours only. Here the differential effects extend not only to the different germ-layers, but also to cell-groups

* Scientif. Enquirer, i. (1886) pp. 25–7. † Amer. Natural., xx. (1886) p. 200–3.

destined to form central nervous system, nephridial organs, larval glands, &c.

The author treats frogs' eggs, first with osmic acid for about twenty minutes, and then transfers directly to the chrome platinum solution (same strength as for pelagic eggs), for twenty-four hours. The eggs are next placed in water and freed from their gelatinous envelopes with needles and dissecting Microscope. They are next washed in flowing water for two hours, then treated with alcohol and stained.

Method of Killing Gephyrea.*—According to Dr. W. Apel the only successful method of killing these animals, in an extended condition, is by the use of hot water. The animal may be placed in a vessel of sea-water, and the temperature gradually raised to about 40° C.; or it may be seized by a pair of forceps while in a condition of extension, and plunged for a moment into boiling water. This latter treatment does not kill the animal, but renders it completely limp, in which condition it should be cut open and then placed in some hardening fluid.

Macerating Mixture for central nervous system of vertebrates.†—The following mixture, discovered by Landois, is recommended by Dr. H. Gierke as an excellent macerating agent, especially for the central nervous system of vertebrates:—Chromate of ammonium 5 grm.; phosphate of potassium 5 grm.; sulphate of sodium 5 grm.; distilled water 100 grm.

Pieces of fresh tissues are left in this fluid from one to three, or even four or five days, then transferred to a mixture (in equal parts) of this fluid with ordinary ammonia-carmine (24 hrs.).

Preparing the Hen's Egg.‡—A very important addition to this branch of technique has been made by M. M. Duval.

First in importance are the methods of orientation. After the appearance of the primitive streak, at about the twelfth hour of incubation, it becomes easy to distinguish anterior, posterior, and later regions in the blastoderm. Hitherto it has been a matter of conjecture whether anterior and posterior regions became morphologically defined at any considerable time before the formation of this streak; and no one, before Duval, attempted to clear up the question, simply because it appeared impossible to find any means of orienting sections at an earlier date. Duval addressed himself to the task of finding out the transformations of the blastoderm, which lead up to the establishment of the primitive streak, and to this end he was compelled to seek, first of all, for some reliable means of exact orientation.

Method of Orientation.—It was noticed by Balfour, and confirmed by Kölliker, that the axis of the chick embryo lies constantly at right

* Zeitschr. f. Wiss. Zool., xlii. (1885) pp. 459–529 (3 pls.). See this Journal, *ante*, p. 73, and Amer. Natural., xx. (1886) p. 315.

† Arch. f. Mikr. Anat., xxv. (1885) p. 445. Amer. Natural., xx. (1886) p. 315.

‡ Ann. Sci. Nat.—Zool., xviii. (1884) 208 pp. and 5 pls. See this Journal, v. (1885) p. 615, and Whitman's 'Methods in Microscopical Anatomy and Embryology,' 1885, pp. 163-7.

angles to the longer axis of the egg. If an egg, after one or two days' incubation, is opened, while held in such a position that its large end is turned to the left and its small end to the right of the operator, it will be found that the caudal end of the embryo is directed towards the operator, while the cephalic end is turned in the opposite direction. Out of 166 cases, Duval found only three that could be regarded as exceptions to the rule. Assuming that the orientation is the same before the appearance of the primitive streak, we have then a very reliable means of recognizing, even in the freshly-laid egg, when the blastoderm has a homogeneous aspect, the future anterior and the future posterior region. But this fact alone is not all that is required for complete orientation; the blastoderm must be hardened, and the means of orientation must be preserved. That portion of the vitelline sphere which bears the blastoderm must be so marked that the anterior and posterior regions of the blastoderm may be recognized after the process of hardening, and after the blastoderm, together with some of the circumjacent yolk, has been cut free from the rest of the egg. This may be done in different ways, according to the method employed in hardening.

I. *Osmic Acid Method.*—1. Make a triangular box without bottom, by folding a strip of paper 5 mm. wide and 50 mm. long.

2. After opening the egg carefully from the *upper* side, remove with a pipette the thin layer of albumen which lies above the cicatricula, so far as this can be done with safety.

3. Place the triangular box over the blastoderm in such a manner that the base corresponds to the future anterior region, and the apex to the future posterior region. While pressing slightly on the box in order to bring it into close contact with the surface of the yolk, fill it by means of a pipette with osmic acid (1/3–1/4 per cent.), and allow the acid to act for some minutes.

4. As soon as the area inclosed by the box begins to blacken, the whole should be immersed in a vessel of chromic acid, in which the paper box may be detached, and the vitelline sphere freed from the albumen and the shell.

5. The vitellus may now be transferred, by the aid of a very deep watch-glass, to another vessel of chromic acid, where it is allowed to remain one or two days, until the peripheral layers harden and form a sort of shell around the central portion which is still soft.

6. A triangular piece of this shell, inclosing the triangular area browned by the osmic acid, is next to be cut out with a pair of sharp scissors. The excised piece is then left a day or more in the chromic solution before treatment with alcohol.

II. *Alcohol Method.*—1. Open the egg as before, and, without attempting to remove the albumen, place the triangular paper box over the blastoderm; slight pressure causes the box to sink into the albumen till it is brought into contact with the yolk. By the aid of a pipette, fill the box with absolute alcohol; this coagulates rapidly the inclosed albumen, while the albumen outside the box remains fluid.

2. After cutting the chalazeæ close to the vitellus, the fluid

portion of the albumen is carefully drained off, leaving only the vitellus and the box with its coagulated contents in the shell.

3. The shell may now be filled with absolute alcohol until the yolk is completely covered, and then left for some hours, during which the more superficial layers of the yolk harden sufficiently to form a shell-like envelope of the softer central portion.

4. The triangular mass formed by the box, and the hardened albumen, is now ready to be cut out, in the same manner as in the osmic acid method. During this process, the paper box may become detached, either spontaneously, or with some assistance; or it may adhere so firmly that it cannot be safely removed. There is no inconvenience in leaving it in place, as it will cut easily when the piece is ultimately sectioned.

5. The piece is further hardened twenty-four hours in absolute alcohol, then preserved in alcohol of 36° (80 per cent.).

III. *Hot Chromic Acid.*—1. Treat with osmic acid as in I.

2. Place the whole in a solution of chromic acid, and heat to the point of boiling, over a water-bath.

3. After cooling, cut out the triangular piece as in I. (6), leave it for a few days in chromic acid, then transfer to alcohol.

Imbedding and Cutting.—Duval imbeds, after each of the foregoing methods, in collodion. The surface of each section is collodionized some seconds before drawing the knife, by allowing a drop or two of thin collodion to flow over it.

Staining.—The sections are placed in serial order on a slide, and then covered with picro-carmine, strongly diluted with glycerin. The sections may be left in the staining fluid twenty-four to forty-eight hours, the admixture of glycerin preventing drying. After they are sufficiently coloured, the staining fluid is allowed to drain off, and the slide is carefully washed with a pipette. The sections, still in place, are treated with successive grades of alcohol, and then mounted in balsam after being clarified in benzine ("benzine collas").

Mounting the Blastoderm in toto.*—During the first three or four days of incubation, Dr. C. O. Whitman has obtained good surface preparations of the blastoderm in the following manner:—

1. Break the shell by a sharp rap of the scissors at the broad end; then carefully cut away the shell, beginning at the place of fracture and working over the upper third or half.

2. After removing as much of the white as possible without injury to the blastoderm, place the rest of the egg, while still in the shell, in a dish of nitric acid (10 per cent.), deep enough to cover it.

3. The coagulated white should next be removed from the blastoderm by the aid of a brush or a feather, and the egg then allowed to remain in the acid thirty minutes.

4. Cut round the blastoderm with a sharp-pointed pair of scissors, taking care to cut quickly and steadily. After carrying the incision completely round, float the blastoderm into a watch-glass, keeping it right side up and flat.

* Whitman's 'Methods in Microscopical Anatomy and Embryology,' 1885, pp. 166–7.

5. Remove the vitelline membrane by the aid of dissecting forceps, and the yolk by gently shaking the watch-glass and by occasional use of a needle. The yolk can sometimes best be washed off by means of a pipette.

6. Wash in water (several times changed).

7. Colour deeply with carmine or hæmatoxylin.

8. Remove excess of colour by soaking a few minutes in a mixture of water and glycerin in equal parts, to which a few drops (about 1 per cent.) of hydrochloric acid have been added.

9. Wash and treat thirty minutes with mixture of alcohol (70 per cent.), 2 parts; water, 1 part; glycerin, 1 part.

10. Transfer to pure 70 per cent. alcohol, then to absolute alcohol. Clarify with creosote or clove-oil, and mount in balsam.

The above method of treatment will also serve for blastoderms which are to be sectioned.

Preparing Siphonophora.*—Dr. A. Korotneff has obtained good sections of the very contractile stem of Siphonophora in the following way:—

After the Siphonophora has settled down a watch-glass full of chloroform is floated on the surface of the fluid, and the vessel covered up with a bell-jar. The animal, benumbed by the chloroform vapour, becomes extended. The bell-jar is then removed, and the animal suddenly immersed in some hardening fluid. The author employed a 1/2 per cent. chromic acid solution and a 1 per cent. hot sublimate solution. In the latter case, the animal was quickly transferred to 20–30 per cent. alcohol. With regard to the tentacles, it may be mentioned that the mucous layer separates into long unicellular tubes after teasing out and being treated with osmic acid. These tubes, the author thinks, are glandular, as they stain deeply with hæmatoxylin and alum carmine.

Preparing Spinal Ganglia.†—Herr M. v. Lenhossek found a 1–1·5 per cent. solution of superosmic acid to give most satisfactory results in the study of the structure of the spinal ganglia of the frog. The ganglia were left three-quarters of an hour in the fluid. Bichromate of potassium and alcohol were used for hardening, and celloidin was found most convenient for imbedding. Good results, especially in the investigation of the finer relations, were obtained by the use of gold chloride.

Modification of Pancreatic Cells during active secretion.‡—In studying the behaviour of the cells of the pancreas during very active secretion, Dr. S. W. Lewaschew used for hardening purposes alcohol and concentrated solution of sublimate, which proved very satisfactory. The tissue was then laid in turpentine or bergamot oil. Ehrlich's hæmatoxylin solution gave the best staining reactions. Ogata's suggestion of combined staining with various fluids—hæmatoxylin, eosin, &c., was also adopted.

* MT. Zool. Stat. Neapel, v. (1884) pp. 229–88 (6 pls.).
† Arch. f. Mikr. Anat., xxvi. (1886) pp. 370–453 (2 pls.).
‡ Ibid., pp. 453–85 (1 pl.).

Mounting Fresh-water Algæ.*—Mr. L. B. Hall finds a very successful process to be the use of pure glycerin, carbolated. The objects are first placed in a dilute solution of iodine (tinct. iod. 2 min., water 1 oz.) 2–5 minutes, then stained (iodine-green), and put into dilute glycerin (10 per cent.), and gradually transferred to thick glycerin.

Cultivation of Microbes.†—According to Dr. H. Fol, it is possible to obtain a perfectly sterile liquid by one of four methods, viz.:—

1. Filtering through some material whose meshes are sufficiently fine to arrest the smallest organisms. The only material really practicable for this purpose is the unglazed porcelain used by Pasteur and Chamberland.

2. Obtaining the liquid directly from the internal organs of one of the superior animals; the digestive tract being considered, for this purpose, an external organ. Pasteur's experiments have shown that the tissues of such animals are the most perfect filters known, neither permitting the entrance, nor tolerating the existence, of any foreign material, unless the tissues are diseased.

3. Sufficiently prolonged exposure to a temperature of at least 110° C. This is the lowest necessary for the destruction of spores, although 80° C. is sufficient to kill bacteria in the growing condition. The length of the exposure must not be less than an hour; the longer the time beyond this, the greater the security.

4. Intermittent heating, invented by Tyndall, and much used in Germany. This consists in making the spores germinate, in order to kill the full-grown bacteria at 80° C. For this purpose the vessels containing the fluid to be sterilized are kept at 20–30° C. to favour the growth of the spores, and are every day raised to 80° C. for one hour, to destroy such bacteria as have become fully developed. This method takes much time, and its results are always uncertain.

Of all these methods, the third, that of destroying the germs once for all, is the one giving the greatest security and ease of manipulation. It has but one fault, that of coagulating all albuminous substances which can be solidified at the temperature of boiling water.

Pure Cultivations of Bacterium aceti.‡—In order to obtain pure cultivations of *B. aceti*, Mr. A. J. Brown adopted, as the most suitable method, a combination of Klebs' "fractional" and von Nägeli's "dilution" methods. The author describes the appearance presented by the film formed on beer and other solutions. He considers that, besides *B. aceti* and *B. Pasteurianum*, there is a third species capable of oxidizing alcohol to acetic acid; he therefore describes the morphology of *B. aceti*, and the action upon it of various reagents. He then describes the action of *B. aceti* upon various substances. It oxidizes ethylic alcohol to acetic acid, and a trace of (probably) succinic acid. In an insufficient quantity of oxygen a trace of a substance resembling aldehyde is formed. When no alcohol is

* 11th Ann. Rep. Amer. Postal Micr. Club, 1886, pp. 13–4.
† La Nature, 1885. See Science, v. (1885) p. 500.
‡ Journ. Chem. Soc. Lond., l. (1886) pp. 172–87.

present, acetic acid is reduced by the bacterium to carbonic acid and water. With normal propylic alcohol, propionic acid is formed after fourteen days. Methylic alcohol had to be purified before *B. aceti* would act upon it, and then the solution became alkaline, ammonia being formed; this happened only after three weeks. *B. aceti* did not oxidize isoprimary butylic alcohol, and the organism will not even grow in amylic alcohol. From dextrose the author obtained gluconic acid; with cane-sugar he was unable to obtain any action; from mannitol, lævulose was obtained, without any acid being formed. The author gives constitutional formulæ for the products, constructed from considerations of the action of *B. aceti*. He concludes by saying that the above reactions "help to show that the vital functions of certain organized ferments are most intimately connected with the molecular constitution of the bodies on which they act."

Microphytes of Normal Human Epidermis.*—Dr. G. Bizzozero employed the following methods for demonstrating these organisms.

After removing the fat from the epidermis by means of alcohol and ether, the epidermic scales were either (A) soaked on a slide in a 50 per cent. acetic acid or a 10 per cent. solution of caustic potash, and examined after putting on a cover-glass; acetic acid preparations may be permanently preserved by placing a drop of glycerin round the edge of the cover-glass; or (B) they are teased out in glycerin, slightly coloured with methyl-blue, and then examined; or (C) they are placed in a small drop of 50 per cent. acetic acid on a cover-glass and after soaking for a quarter of an hour are needled out. The acetic acid is then driven off by gentle heat, the cover-glass passed twice or thrice through the flame of a spirit-lamp, the dried layer is then wetted for half-an-hour with some nuclear anilin stain (methyl-blue is the best), and having been next carefully washed with distilled water, the preparation, when dry, is mounted in dammar or Canada balsam.

Preparing Tubercle-bacillus.†—Dr. Glorieux has much improved Neelsen's method for demonstrating the presence of tubercle-bacilli in cover-glass preparations of sputum. The first step of Neelsen's process is to immerse the cover-glass in the following solution:—Fuchsin 1 grm.; absolute alcohol 10 grm.; 5 per cent. solution of phenic acid 100 grm.

The second step is to decolorize in a 25 per cent. solution of sulphuric acid. It is this second stage which has been modified by Dr. Glorieux, whose formula is:—Sulphuric acid 10 grm.; alcohol 15 grm.; distilled water 50 grm. Methyl-blue to saturation; filter.

Thus treated, cover-glass preparations may be double-stained in from 60 to 90 seconds.

Schulze's Dehydrating Apparatus.‡ — Prof. F. E. Schulze describes a simple contrivance for securing the rapid and yet uninjured dehydration of small and delicate objects.

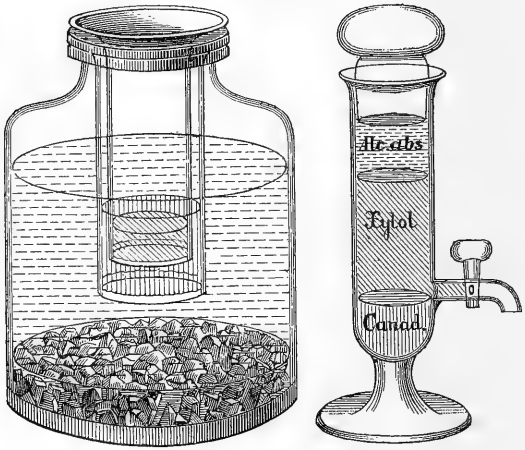
* Virchow's Arch. f. Path. Anat., xcviii. (1885) p. 441. See this Journal, v. (1885) p. 849.

† Bull. Soc. Belg. Micr., xii. (1886) pp. 44–8.

‡ Arch. f. Mikr. Anat., xxvi. (1886) pp. 539–42 (1 fig.).

The apparatus (fig. 109) is on the principle of a dialyser, and consists of a broad glass tube with a projecting upper rim (like that of a hat), and with a paper membrane at the lower end. This is inserted in a larger vessel with a broad rim at the neck. The two rims fit together closely, and seal the larger vessel. The latter is

Fig. 109.



filled to a convenient level with absolute alcohol, the smaller contains the object with a little of the weak alcohol in which it previously lay. A gradual diffusion occurs and a very perfect dehydration is rapidly effected. The process may be made more gradual by the use of a double tube, the outer containing weaker alcohol. At the foot of the large vessel is a layer of burnt sulphate of copper which prevents the dilution of the absolute alcohol. The dehydration of the inner tube containing the object may be conveniently tested (after twenty-four hours or so) by removing a little of the fluid in a pointed pipette, and allowing a drop to pass slowly into a test-tube with 98° alcohol. If the fluid be absolute alcohol, a small portion from the pipette will be detected passing upwards, or downwards if the fluid be below 98°.

Prof. Schulze also describes a modification of a method of securing the safe preparation of delicate objects by allowing them to sink through layers of different fluids. In his improved form a closed tube contains an inferior layer of Canada balsam, above that 3 c.cm. of xylol, and uppermost 1 c.cm. of absolute alcohol. At the level of the Canada balsam there is a cock for allowing the upper layers to flow off, after which the object is removed from the Canada balsam into which it has sunk.

Efficiency of the Micrometer-screw.*—Herr J. Ost discusses the action of the micrometer-screw as used in microtomes, and endeavours

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 295–300.

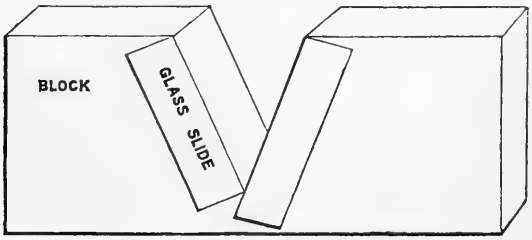
to show that it affords the most convenient and surest means of raising the object, as applied in the microtome which he has devised. Errors in the construction of the screw are not cumulative, and will not amount to anything that is appreciable in section-cutting; the thread of the screw regarded as formed by the hypothenuse of a right-angled triangle wound upon a cylinder is merely a particular application of the inclined plane of Rivet's microtome, and has the advantage of being more accurate and of insuring a longer surface of contact between the fixed and moving parts than is the case with the slider of the latter.

The author tested the accuracy of a microtome-screw (and that one which worked loosely in its bearings), observing under a Microscope the motion of a fine needle-point carried by the screw, using an eye-piece micrometer. The displacements produced by a single turn of the screw were measured for 25 turns; of these, 7 gave a motion of 543 μ, 8 of 534 μ, and 10 of 537 μ; similarly the displacements corresponding to each two divisions on the head of the screw, which was divided into 50 parts, were in 18 cases 20·8 μ, in 4 cases 19·5 μ, and in 3 cases 22·2 μ. The difference of 1·3 μ may reasonably be ascribed to errors of observation, and the author concludes that the accuracy of the screw is all that can possibly be required. Backlash may be got rid of by the use of a spring.

Rapid Section-cutting.*—For the benefit of those who have so little time for microscopic work that every minute is precious, Mr. J. E. Whitney describes a contrivance for section-cutting which is nearly as rapid as free-hand cutting, and yet enables really good sections to be made with more certainty. Where one wishes to make sections of numerous vegetable tissues for comparative study, and has only a short time for the purpose, the tedious process of imbedding necessary with ordinary machines is a serious obstacle.

To avoid the necessity of imbedding the object, the author simply cuts in a block of hard wood (say 3 in. by 4 in., and $1\frac{1}{2}$ in. thick) a wedge-shaped opening, $1\frac{1}{4}$ in. by 2 in. or thereabouts (fig. 110), into

FIG. 110.



which the object to be cut is placed so that its sides touch the tapering sides of the opening, and prevent motion. On the top of the block over which the blade of the razor is to pass cement two pieces of glass

* Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1886, pp. 122–3 (1 fig.).

slides with their smooth edges parallel with the edges of the wedge-shaped cut.

For the ordinary rapid examination of vegetable tissues, the specimen is held gently in the opening by the thumb of the left hand, while the razor dipped in alcohol is drawn steadily over the glass slips towards the apex of the wedge, with the cutting edge held at the usual angle. After the first cut, if uniformity in the thinness of the sections is not necessary, the object can be simply advanced slightly by the hand, and after a few trials it will be found that really thin sections can easily be made in this simple way.

When, however, it is necessary to have sections of extreme or uniform thinness, it is best to screw across the under side of the block a strip through which a thumb-screw with fine thread is fitted to work. By this means the object can be raised regularly any desired distance at each cutting.

The block can be prepared in a few minutes by any one, and with all ordinary vegetable tissues very satisfactory sections can be cut. Hard wood cannot be cut safely in a section-cutter without being first soaked or steamed, and as a keen-edged plane will cut beautiful sections quickly and easily, it is best to cut such wood in that way. Sections of different kinds of wood can be cut at the same time by screwing small blocks of each together and taking a section of all at one stroke of the plane.

Natural Injection of Leeches.*—Dr. C. O. Whitman has often noticed that leeches hardened in weak chromic acid, or in any chromic solution, are beautifully and naturally injected with their own blood. Where the circulatory system is to be studied by means of sections, this method seems to be the simplest and most reliable one. Not only the larger sinuses, but the intra-epithelial capillaries may be easily traced by this method, as was first pointed out by Prof. E. R. Lankester.†

Methods of Injecting Annelids.‡—For annelids with dark tissues like *Hirudo*, M. M. Jaquet recommends that a light-coloured (white or yellow) injection-mass should be employed, while for transparent animals dark colours are preferable. Chrome yellow serves as a good colouring substance. It is easily obtained by mixing solutions of bichromate of potassium and acetate of lead. A copious yellow precipitate is formed, which should be washed on the filter, and then exposed to the air until nearly dry. The pigment, after being reduced to a pulp-like state. is added to an ordinary aqueous solution of gelatin; and the mass is then filtered warm through linen. If the injection-mass is to be blue, then the gelatin may be dissolved directly in liquid Prussian blue, and the mass filtered through paper.

As a rule, annelids must be killed before they can be injected. Chloroform and alcohol are the means commonly employed in killing

* Amer. Natural., xx. (1886) pp. 313-4.

† Quart. Journ. Micr. Sci., xx. (1880) p. 306.

‡ MT. Zool. Stat. Neapel, vi. (1885) pp. 298-300. Cf. Amer. Natural., xx. (1886) p. 314.

for the purpose of injection; fresh water may also be used for some marine species. A leech, for example, is placed in water containing a small quantity of chloroform; after a few moments it sinks to the bottom and remains motionless. It should be allowed to remain in the water for one or two days before attempting to inject it.

The simplest and most convenient form of syringe consists of a glass tube drawn to a fine point at one extremity, and furnished at the other with a rubber tube. Preparatory to injecting, the glass should be plunged in warm water for a few moments; then, after expelling the water, it may be filled with the injection-mass by sucking the air from the rubber tube. If the injection-mass is turned into the large end of the glass, it may happen that granules are introduced which are large enough to obstruct the narrow passage of the small end. After inserting the cannular end in the vessel, clasp both with the forceps, and then force the injecting fluid, by aspiration through the rubber tube, which is held in the mouth. When the operation is completed, place the animal in cold water, in order to stiffen the injected mass.

Anilin Staining.*—Dr. Bareggi, in order to render more permanent preparations stained with anilin colours, proposes to merely cover the section, &c., with Canada balsam dissolved in chloroform, and to allow the balsam to dry slowly, no cover-glass being used.

When working with dry or with water-immersion lenses, such preparations can be examined without detriment, as water is not miscible with balsam. But when working with oil-immersion lenses and with cedar oil, which dissolves balsam, it is necessary to be careful during the examination.

It would perhaps be preferable to use instead of cedar oil the salt solutions which have been proposed for this purpose, or the solution of chloral hydrate in glycerin, or still better, the solution of zinc iodide in glycerin.

Chrome Alum in Microscopical Technique.†—Dr. G. Martinotti, from a consideration of the behaviour of potash alum which is a prominent constituent of certain stains (carmine, hæmatoxylin, &c.), wished to make some experiments with ammonia and chrome alums. The results from the use of ammonia alum were not encouraging, but by substituting chrome alum or the double sulphate of potassium and chromium for potash alum he obtained sufficiently satisfactory results.

Chrome alum is isomorphous with potash alum and crystallizes in dark violet octahedra soluble in water, but insoluble in alcohol. If the watery solution be heated above 80° C. the violet colour turns to a green, and this hue is retained on cooling. Carmine chromate is prepared by boiling 10 parts cochineal in 500 parts water and adding 1 part chrome alum, filtering while hot and then allowing it to stand. The residue is carefully washed and dried at a temperature not exceeding 30° C. It is easily soluble in ammonia, and possesses

* Gazzetta degli Ospitali, 1884, p. 645.

† Zeitschr. f. Wiss. Mikr., i. (1884) pp. 361–6.

all the properties of ordinary carmine except in being of a dark violet colour. Over this the author is not so enthusiastic as over the next two solutions where he has substituted chrome alum for potash alum in the formulas given by Czokor and Grenacher for making alum cochineal and alum carmine. The ingredients are mixed in the exact proportions as given by Czokor and Grenacher. The mixture is then left in an oven at the temperature of about 70° C. for 24 to 48 hours. When cold the liquid is filtered.

Both fluids are of a violet colour, and both stain nuclei perfectly. The author gives the palm to the cochineal stain. Preparations may remain in this solution for more than 24 hours without becoming diffusely stained. If the preparations are to be preserved in resinous media it is necessary to wash carefully in water, otherwise the alum chromate, which is insoluble in water, is precipitated on the surface of the section as brownish needles. A special advantage of this cochineal chromate solution is that it keeps well for an indefinite period without the addition of any preservative agent. Another advantage is that the nuclei assume a violet colour closely resembling that given by hæmatoxylin.

Modification of Arcangeli's Carmine Stain.*—M. P. Francotte finds that in Arcangeli's first formula † 50 cgrm. carmine is too much, and proposes the following modified formula, which is based on the solubility of boric acid in alcohol. Alcohol at 90, 75 cc.; distilled water 25 cc.; boric acid 5 grm.; carmine 40 cgrm. This mixture is boiled for fifteen minutes, and a beautiful red alcoholic solution is obtained on filtration.

Staining the Central Organs of the Nervous System.‡—Prof. C. Golgi, after some strictures on gold chloride methods (which he condemns because neither the manner in which the interlacement of the fibres takes place, nor the different parts which contribute to their formation, are demonstrated) states that whatever success he has had is due to the three following methods:—

1. Method of black staining obtained by treating specimens successively with potassium or ammonium bichromate and silver nitrate.

2. Method of the successive action of a mixture of osmic acid and potassium bichromate followed by silver nitrate.

3. Method of the combined action of potassium and ammonium bichromate and perchloride of mercury (by transmitted light the colour is apparently black; by direct light, a metallic white).

By the method of the combined action of bichromate of potash and of nitrate of silver, the black staining is obtained as the result of two operations. Pieces of nervous tissue about a centimetre square are hardened in a 2 per cent. solution of bichromate, or in Müller's fluid. The strength of the bichromate may be gradually increased from 2 to 5 per cent. In any case, this fluid should be frequently

* Bull. Soc. Belg. Micr., xii. (1886) pp. 48–51.
† See this Journal, v. (1885) p. 1094.
‡ Arch. Italiennes de Biologie, vii. (1886) pp. 15–47.

changed. The proper degree of hardening is reached in from two weeks (in warm weather) to seven weeks (in cold weather). The second step is to immerse the hardened pieces in a 0·75 per cent. solution of silver nitrate for twenty-four to forty-eight hours. The room in which this silver process is carried on must be kept *well warmed*.

The black staining is successively imparted to the axis-cylinders of the nerve-fibres, the ganglion-cells, and, lastly, the neuroglia-cells. When the black staining is attained, and this is verified by examining a few trial sections in glycerin, the pieces are placed in alcohol, frequently changed, until the alcohol remains clear, in order to remove all traces of the silver nitrate. This must be done effectually, otherwise the specimens will not keep. The treatment preparatory to mounting in dammar, which is preferable to Canada balsam, consists in washing several times in absolute alcohol, transferring to creosote, and in clearing up in oil of turpentine or in oil of origanum. The sections are to be preserved in dammar *without* the imposition of a cover-glass. The author mounts his specimens on large cover-glasses and then adjusts them in a wooden frame or slide with a window, so that the sections are kept quite free from dust, and can also be examined from both sides. It is of course necessary to preserve the mounted specimens in a dark place.

The disadvantages of the method, says Prof. Golgi, are the length of time required to obtain the requisite reaction, the uncertainty arising from the varying periods necessary to produce the proper degree of hardness, and the different conditions in which the different layers of the same piece are frequently found. These disadvantages are modified by :—(*a*) Copious and frequent injections of either a $2\frac{1}{2}$ per cent. solution of bichromate, or a similar solution in which five or six grammes of gelatin have been dissolved. The injection may be made with an ordinary syringe or a siphon apparatus, through the aorta or carotid. (*b*) By hardening with bichromate at a constant temperature. In an incubator, maintained at a temperature of 20°–25° C., the reaction point was reached in eight or ten days. (*c*) By hardening in equal parts of Erlicki's and Müller's fluid, the necessary consistence was obtained in five to eight days.

The second method consists in hardening the pieces in a mixture of bichromate and osmic acid, followed by immersion in silver nitrate. It may be applied as follows: by immersing small pieces of quite fresh nervous tissue in the following mixture:—of potassium bichromate 2 to $2\frac{1}{2}$ per cent. solution, eight parts; of osmic acid 1 per cent. solution, two parts. Having been transferred to the silver nitrate solution, as in the first method, the black reaction is found to begin on the second or third day, and to be completed by the tenth or twelfth. But in this method the pieces must be allowed to remain in the silver nitrate until they are wanted for section, allowing two days for soaking in alcohol. Although this treatment gives sufficiently good and rapid results, it is better to place the pieces in the bichromate solution for two to thirty days, and then change to the mixture of osmic acid and bichromate, and afterwards in due

course to the silver nitrate. In this case, too, the pieces should remain in the silver solution until wanted for immediate use, when they are repeatedly soaked in frequently changed alcohol, passed through absolute alcohol, creosote, oil of turpentine, to dammar.

This last is the method most preferred by the author.

In the method of the successive action of bichromate of potash and of perchloride of mercury, the first stage is the same as that which is given for the bichromate and silver methods. This over, the pieces are placed in a 0·5 per cent. solution of perchloride of mercury. The reaction is effected in not less than eight days for small pieces, while for large, such as whole brains, two months at least are required. The perchloride solution must be renewed daily, until it is no longer tinged with yellow. When the reaction has reached its maximum, the nervous tissue is quite pale, and resembles fresh brain matter recently washed in water. The pieces of nervous tissue may be allowed to remain in the mercury solution for an indefinite period. The sections may be mounted in some resinous medium, but in either case frequent washing in water is necessary, in order to prevent the formation of a deposit of acicular crystals upon the surface. The sections are then dehydrated in alcohol, and having been cleared up in oil of cloves or creosote, are mounted in dammar or in Canada balsam.

Application of Weigert's modified Hæmatoxylin Stain to the Peripheral Nervous System.*—Dr. T. Gelpke's experience of the above method is that while it is most excellent in principle, giving most brilliant results with normal nerves, yet, when used to demonstrate certain morbid states, e. g. sclerosis, the nerve-fibres were found to remain quite unstained, either in longitudinal or in transverse section. By controlling experiments made with osmic acid and carmine on sclerosed nerves, and also by showing that the Weigert stain itself acted efficiently on normal nerves, the author concluded that the want of success was to be sought in the decoloration process. Further, that the ferridcyanide solution was too strong, and as the result of his experiments, he found that decoloration was most safely effected by using very dilute solutions of the reagent.

The author's emendation of this process is that for transverse sections the ferridcyanide solution should be diluted down to one-fiftieth of the strength given by Weigert. For longitudinal sections a somewhat stronger solution may be employed. Naturally, the time occupied by the stage is now much longer, decoloration taking from one to twelve hours.

Fixing Sections to the Slide.†—Mr. H. E. Summers says that the following method has been tested with paraffin and celloidin sections. For either kind of sections the slides are first coated with collodion, either by flowing from a bottle or by a brush, and allowed to dry. The celloidin used for imbedding, thinned with alcohol and

* Zeitschr. f. Wiss. Mikr., ii. (1885) pp. 484–9.

† The Microscope, vi. (1886) pp. 66–7.

ether, answers admirably. The coated slides may be kept indefinitely before using.

Paraffin sections are arranged upon the slide and a small amount of a mixture of equal parts of alcohol and ether is then dropped upon the slide. The liquid will be immediately drawn under the sections. Bubbles of air will rarely remain beneath the sections, but, if they do, they may easily be displaced by gently touching the section with a soft brush. The liquid is allowed to evaporate spontaneously. When quite dry, which will take but a few minutes, the paraffin may be dissolved and the sections will be found firmly fixed.

Celloidin sections are placed for a few minutes in 95 per cent. alcohol, and then arranged on the coated slide. They are drained as free of alcohol as possible, and as soon as their surface is nearly dry, as is shown by its assuming a dull appearance, the mixture of alcohol and ether is dropped upon them rather freely. When this has evaporated until the surface of the sections again assumes a dull appearance, the slide is placed in 80 per cent. or weaker alcohol, and may then be treated by any of the reagents applicable to paraffin sections fixed with collodion.

The advantages claimed for this method are three: the use of heat is dispensed with, and thus one source of inconvenience and injury to the sections is avoided; the paraffin is not removed (or melted) until the sections are fixed, and thus in sections consisting of disconnected parts, the position of these parts is preserved; labour and work-table space are saved by having a single method, which is applicable to both paraffin and celloidin sections.

Peirce Cell for Opaques.*—This form of cell was devised by Prof. J. Peirce, for "dry mounts" (figs. 111 and 112). The cell and cap are made from sheet brass, the latter fitting not too tight nor too loose. While dust is perfectly excluded, the cover-glass and its frequent accompaniment of "dewed" under surface is done away with. "This gives the additional advantage that the light by which the object is seen does not have to pass twice through a cover-glass, and thus the object is seen in its full clearness and beauty." Prof. Peirce also recommends the use of these cells soldered to a 3 × 1 tin slide.

FIG. 111.

FIG. 112.

A.—**Mounting Odontophores of Snails.**

[Best mounted in a weak form of Goadby's solution.]

Scientific Enquirer, I. (1886) p. 68.

APEL, W.—**Beitrag zur Anatomie und Histologie des** *Priapulus caudatus* **(Lam.) und des** *Halicryptus spinulosus* **(v. Sieb.).**

[Method of killing Gephyrea. Amer. Natural., XX., 1886, p. 315; *supra*, p. 532.]

Zeitschr. f. Wiss. Mikr., XLII. (1885), pp. 459–529 (3 pls.).

See this Journal, *ante*, p. 73.

B.Sc.—**Double-staining Botanical Preparations.** [*Post.*]

Scientif. Enquirer, I. (1886) p. 33.

---

* Micr. Bull. (Queen's), iii. (1886) p. 3.

Beatty's (G. S.) Methods for staining and double-staining vegetable tissues.
[Reprinted from 'Pop. Sci. Monthly' and 'Amer. Journ. of Micr.']
Amer. Mon. Micr. Journ., VII. (1886) pp. 43–8.

BESSELL, J. B.—**Mounting Fish Skins.**
[For the polariscope, wash, dry under pressure, soak in spirits of turpentine for two or three days, and mount in balsam or balsam and benzole.]
Scientif. Enquirer, I. (1886) p. 73.

BIDWELL, F. H.—**Staining for diagnosis.**
[Has used ordinary eosine ink for staining urinary deposits.]
Micr. Bulletin (*Queen's*), III. (1886) p. 8.

BIZZOZERO, G.—**Nuovo metodo per la dimostrazione degli elementi in cariocinesi nei tessuti.** (New method for the demonstration of the elements in karyokinesis.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 24–7.

BOULT, H. R.—**Mounting Bird Parasites.**
[Directions for mounting the smaller kinds.]
Journ. of Micr., V. (1886) p. 119.

BUCHNER, H.—**Ueber das Verhalten der Spaltpilzsporen zu den Anilinfarbstoffen.** (On the behaviour of the spores of schizomycetes with the anilin stains.) [*Post.*]
Sep. Rep. SB. Gesell. Morph. u. Physiol. München, 1885, 4 pp. and 1 fig.
Cf. *Bot. Centralbl.*, XXVI. (1886) pp. 55–6.

C., A.—**Mounting Chemical Crystals.** [*Post.*]
Scientif. Enquirer, I. (1886) pp. 70–1.

CUNNINGHAM, K. M.—**[Arranged and other Slides from Vienna.]**
Amer. Mon. Micr. Journ., VII. (1886) p. 78.

CURTIS, L.—**The Cultivation of Bacteria and the Cholera Bacillus.**
[Describes:—the preparation of peptonized gelatin and plate and needle cultures; growth of forms in hanging drops; culture on potatoes; cholera bacillus.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 142–50.

CUSHING, E. W.—**Bacillus tuberculosis.**
[Koch's method of preparing and other remarks.]
Micr. Bulletin (*Queen's*), III. (1886) pp. 2–3.

DEBES, E.—**Sammeln und Behandlung lebender Diatomaceen.** (Collection and treatment of living Diatomaceæ.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 27–38.

Diatoms, Sections of.
[Cementstein from Mors, Denmark.]
Micr. Bulletin (*Queen's*), III. (1886) p. 5.

DIENELT, F.—**Durability of White Zinc Cement.**
[Calling attention to transverse cracks caused by shrinkage, and suggested remedy by the editor of a coat of shellac in alcohol.]
Amer. Mon. Micr. Journ., VII. (1886) p. 78.

DRAPER, E. T.—**Graphic Microscopy. II.**
[No. 3. Ovary of toad × 40. No. 4. Vertical section of tooth of cat × 30.]
2 pp. and 2 pls. (8vo, London, 1886).

EWING, P.—**On mounting small Mosses for Microscopic Examination.**
["The following was the medium employed, the specimens being mounted as transparencies on cards of a suitable size:—7 parts pure glycerin, 1 part French gelatin, 6 parts distilled water; add 1 drop carbolic acid to every 100 drops of above mixture. The whole to be boiled till the flakes caused by the carbolic acid disappear, and filtered through spun crystal."]
Proc. and Trans. Nat. Hist. Soc. Glasgow, I. (1886) p. xlviii.

F., M.—**A Hint on the keeping of Melicerta ringens.** [*Supra*, p. 450.]
Scientif. Enquirer, I. (1886) p. 46.

FLESCH, M.—**Notizen zur Technik mikroskopischen Untersuchungen am Centralen Nervensystem.** (Notes on the technique of microscopical investigations of the central nervous system.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 49–52.

GAGE, S. H.—**Notes on Histological Methods,** including a brief consideration of the methods of pathological and vegetable histology and the application of the Microscope to Jurisprudence. 56 pp. (8vo, Ithaca, N.Y., 1885–6).

GIERKE, H.—**Die Stützsubstanz des Centralnervensystems.**
[Macerating mixture (Amer. Natural., XX. 1886, p. 315), *supra*, p. 532.]
Arch. f. Mikr. Anat., XXV. (1885) pp. 441–554.

Gierke, H.—**Staining Tissues in Microscopy. X.**
Amer. Mon. Micr. Journ., VII. (1886) pp. 70–3, 97–9.

GIFFORD, H.—**Eine Methode, unbehandelte Serienschnitte in situ aufzubewahren.** (A method of preserving series sections *in situ*.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 45–7.

GIFFORD, J. W.—**A Method for the preparation of Sections for examination with the highest powers.** [*Supra*, p. 531.]
Scientif. Enquirer, I. (1886) pp. 25–7.

GLORIEUX.—**Le Bacille de la Tuberculose.** (*Bacillus tuberculosis.*)
[*Supra*, p. 537.] *Bull. Soc. Belg. Micr.*, XII. (1886) pp. 44–8, from *Rev. Médicale*, Louvain.

GOTTSCHAU, M.—**Erwiderung an die Herren J. Ost und Dr. A. Brass.** (Reply to J. Ost and Dr. A. Brass. [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 14–8.

GRIFFIN, A. W.—**Smith's Stannous Chloride Mounting Medium.**
[The stannous chloride must be of the utmost purity.]
Scientif. Enquirer, I. (1886) pp. 46–7.

GRIFFITH, E. H.—**Some new and improved Apparatus.**
[Turntable No. 4 improved; No. 6. *Post.*]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 112–3 (2 figs.).

GROULT, P.—**Le nouveau Microtome à levier.** (The new lever microtome.)
[*Post.*] *Le Naturaliste*, VIII. (1886) pp. 241–3 (8 figs.).

H., J.—**Balsam Mounts.**
[Pressure is a mistake. "For if, where the balsam is made to inclose the object, the cover is pressed down with but a very moderate degree of force, and so left, as the balsam shrinks by the evaporation of its essential oil it must pull the cover closer and closer to the slip, so that the ultimate pressure on the cover is in direct proportion to the amount of hardening which the balsam has undergone."]
Scientif. Enquirer, I. (1886) pp. 66–7.

HALL, L. B.—**Mounting Fresh-water Algæ.** [*Supra*, p. 536.]
11th Ann. Rep. Amer. Post. Micr. Club, 1886, pp. 13–4.

HALLER, B.—**Untersuchungen über marine Rhipidoglossen.**
[Macerating fluid for central nervous system of marine Rhipidoglossata (Amer. Natural., XX. 1886, p. 316). Glycerin, 5 parts; glacial acetic acid, 5 parts; distilled water, 20 parts. It causes no shrinkage and accomplishes its work in 30–45 minutes.]
Morphol. Jahrb., XI. (1885) pp. 321–430 (8 pls.).
See this Journal, *ante*, p. 225.

[HITCHCOCK, R.]—**Wax Cells.**
["We do not favour them so much as we did a few years back, for there is almost certain to be a deposit on the cover-glass after a time."]
Amer. Mon. Micr. Journ., VII. (1886) p. 56.

HÜPPE, F.—**Die Methoden der Bakterien-Forschung.** (The methods of investigating bacteria.) [*Post.*]
3rd ed., 244 pp., 40 figs. and 2 pls. (8vo, Wiesbaden, 1886).

IMHOF, O. E.—**Methoden zur Erforschung der pelagischen Fauna.** (Methods for the investigation of the pelagic fauna.) [*Post.*]
Zool. Anzeig., IX. (1886) pp. 235–6.

JAMES, F. L.—**Shrinkage of Cement Cells the Cause of Leakage in Glycerin Mounts.**
[Discussion only.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 228–9.

JAMES, F. L.—**A new Injecting Apparatus.** [*Post.*]
St. Louis Med. and Surg. Journ., L. (1886) pp. 237–9 (1 fig.).

" " **Elementary Microscopical Technology.**
[VII. Section-cutting (*contd.*). The section knife. Other accessories. Arrangement of the work-table. Cutting. Care of instruments. VIII. Staining animal tissues.]
Ibid., pp. 239–44 (1 fig.), 305–10.

" " **Cleaning old and damaged Slides.**
[Put them into a mixture of gasolin or benzin, spirits of turpentine and alcohol in equal parts. A good wiping and polishing leaves the slide optically clean.]
Ibid., p. 304.

JAQUET, M.—**Recherches sur le Système vasculaire des Annelides.**
[Methods of injecting annelids. (Amer. Natural., XX. 1886, p. 314.) [*Supra*, p. 540.]
MT. Zool. Stat. Neapel, VI. (1885) pp. 298–300.

JELGERSMA, G.—**Notiz über Anilinschwarz.** (Note on anilin-blue-black.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 39–40.

JOLY, J.—**On the Melting-points of Minerals.**
[Account of experiments with the Meldometer.]
Nature, XXXIV. (1886) p. 22
(Report of Proceedings of Dublin Univ. Exper. Sci. Assoc., March 16).

Kinne Self-centering Turn-table.
[Now made with projecting hand-rest.]
Micr. Bulletin (*Queen's*), III. (1886) p. 6.

KLEEBERG, A.—**Die Markstrahlen der Coniferen.**
[Directions for removing resin from conifers. *Ante*, p. 270.]
Bot. Ztg., XLIII. (1885) pp. 673–86, 689–97, 705–14, and 721–9 (1 pl.).

KÜNSTLER, J.—**Sur la Structure des Flagellés.** (On the structure of the Flagellata.) [Methods, *post.*]
Journ. de Microgr., X. (1886) pp. 17, 58–63 (1 pl. and 1 fig.).

LATHAM, V. A.—**The Microscope and how to use it. VI.**
[Double staining, *contd.*] *Journ. of Micr.*, V. (1886) pp. 105–11.

LENHOSSÉK, M. v.—**Ein neues Hülfsmittel zur Herstellung von Serienpräparaten aus dem centralen Nervensystem.** (A new expedient for making series preparations of the central nervous system.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 53–5 (1 fig.).

LETT, H. W.—**Mounting Fish Skins.**
[Clean with potash and water and dry for two months in a warm spot. Mount dry.]
Scientif. Enquirer, I. (1886) p. 73.

LIST, J. H.—**Beiträge zur mikroskopischen Technik.** (Contributions to microscopical technique.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 43–4.

MADAN, H. G.—**Note on some organic substances of high refractive power.**
[(1) Naphthyl-phenyl-ketone dibromide. Ref. Ind. 1·666. (2) Metacinnamene. Ref. Ind. 1·593. (3) Monobromo-naphthalene. Ref. Ind. 1·662. "The most hopeful direction in which to look is undoubtedly towards some of those complex organic compounds which are now being built up by many workers in England and Germany."]
Proc. Phys. Soc. Lond., VII. (1886) pp. 364–6.

MANTON, W. P.—**On the preparation of Chick Embryos for microscopical examination.**
[Directions for preparing.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 66–70.

MIGULA, W.—**Notiz über eine Ausbewahrungsmethode von Algenpräparaten.** (Note on a preservative process for algæ.) [*Post.*]
Zeitschr. f. Wiss Mikr., III. (1886) p. 47.

MOLL, J. W.—**Micro-chemical determination of Tannic Acid.** [*Post.*]
St. Louis Nat. Druggist, VIII. (1886) p. 188, from *Chem. Ztg.*

MOORE, A. Y.—**The detection of renal tube casts.**
[Directions for examining urine. Also as to mechanical stages. *Post.*]
The Microscope, VI. (1886) p. 80–3.

Moore's (A. Y.) Stained Amphipleura. [*Ante*, p. 376.]
Micr. Bulletin (*Queen's*), III. (1886) p. 3.

NÖRNER, C.—**Zur Behandlung mikroskopischer Präparate.** (On the treatment of microscopical preparations. [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 19–23 (1 fig.)

ONDERDONK, C.—**Native Styrax.**
[Recommending native liquidambar from the tree for mounting.]
Micr. Bulletin (*Queen's*), III. (1886) p. 8.

PFITZNER, W.—**Zur Kenntniss der Kerntheilung bei den Protozoen.** (On nuclear division in the Protozoa.)
[Method of preparing *Opalina*. Amer. Natural., XX. 1886, pp. 408–10. See this Journal, *ante*, pp. 258–60.]
Morphol. Jahrb., XI. (1885) pp. 454–67 (1 fig.).

Pierce's (J.) Cell for Opaques. [*Supra*, p. 546.]
Micr. Bulletin (*Queen's*), III. (1886) p. 3 (2 figs.).

PRISMATIQUE—**Transparent Cements.**
[First English opticians that made cemented work were his grandfather and A. Ross. (Cf. *ante*, p. 337, Edmunds, J.) In præ-balsamic times serum from human blood was used.]
Engl. Mech., XLIII. (1886) p. 174.

REYNOLDS, R. N.—**Remarks on improved Methods.**
[1. To transmit sections by mail (*post*). 2. To mark desirable parts of mounts without Maltwood finder or special diamond. 3. To safely handle fresh balsam mounts. (Two pieces of thin gummed paper, 3/8 in. square, applied to the slide on opposite sides of the cover-glass, extending about 1/16 in. upon the cover.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 124–5.

Rocellin. [*Post.*] *The Microscope*, VI. (1886) p. 95.

Santonine, Preparing.
[Directions by H. F. Parsons, C. F. Tootal, and A. Nicholson.]
Journ. of Micr., V. (1886) pp. 118 and 119.

SCHIEFFERDECKER, P.—**Mittheilung vertreffend das von mir verwandte Anilingrün.** (Communication on the anilin-green employed by me.) [*Post.*]
Zeitschr. f. Wiss. Mikr., III. (1886) pp. 41–3.

SEDGWICK, W. T.—**An alcoholic drip for the Thoma-Jung Microtome.** [*Post.*]
Amer. Natural., XX. (1886) pp. 488–90 (3 figs.).

SHANKS, S. G.—**A method of mounting several groups of small microscopic objects under one cover.** [*Post.*]
Amer. Mon. Micr. Journ., VII. (1886) pp. 64–5.

„ „ **Mounting Starch.**
[Very thick Farrants' solution is the best.]
11th Ann. Rep. Amer. Post. Micr. Club, 1886, p. 14.

SMITH, H. L.—**Mounting Media of High Refractive Index.**
[See Vol. V. (1885) p. 1097.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 86–90 (1 fig.).

„ „ **A new High-refractive Mounting Medium.**
[*Ante*, p. 356, and remarks by the President, C. Van Brunt.]
Journ. New York Micr. Soc., II. (1886) pp. 13–6, 18–9.

SMITH, T.—**Notes on the Biological examination of Water, with a few statistics of Potomac drinking-water.** *Amer. Mon. Micr. Journ.*, VII. (1886) pp. 61–4.

STEEL, T.—**Method of mounting objects with Carbolic Acid.** [*Post.*]
Scientif. Enquirer, I. (1886) p. 41–3.

STRENG, A.—**Ueber einige mikroskopisch-chemische Reaktionen.** (On some micro-chemical reactions. *Contd.*
Neues Jahrb. f. Mineral., Geol., u. Palæontol., I. (1886) pp. 49–61 (6 figs.).

SUMMERS, H. E.—**New method of fixing sections to the slide.** [*Supra*, p. 545.]
The Microscope, VI. (1886) pp. 66–7.

SUMMERS, H. E.—**Improved method of constructing Slide Cabinets.** [*Post.*]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 108–9 (1 fig.).

TAYLOR, G. H.—**Water-washed Diatoms.**
[Describes the process of cleaning diatoms from mud by treatment with clean water, without the use of acids—at one point boiling in water with the addition of a little cooking soda.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 207–8.

" " **Cleaning Diatoms from Marine Muds.**
[Detailed directions.] *Ibid.*, pp. 208–10.

TAYLOR, J. E.—**Hunting for Amœbas.** [*Supra*, p. 530.]
Sci.-Gossip, 1886, pp. 113–4.

TAYLOR, T.—**Butter and Fats.** To distinguish one fat from another by means of the Microscope.
[General examination of butter and its substitutes by the naked eye. Microscopic test. How to crystallize butter and other fats, and separate the crystals so as to be seen with the naked eye or pocket lens. The butter of several States examined. Mounting butter crystals. Sulphuric acid and other tests for butter, oleomargarine, and butterine. How to detect the crystals of lard by the eye, unaided by a lens. General notes.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 128–38 (no plate yet) pp. 234–5.

" " [Reply to Prof. Weber.]
The Microscope, VI. (1886) pp. 78–9, see also pp. 85–6.

THOMPSON, J. C.—**Mounting** *Dermanyssus.*
[To avoid curling up of legs, allow it to walk on the slide, then drop tolerably cool glycerin jelly on it, and then warm cover.]
Journ. of Micr., V. (1886) p. 119.

Trichophyton tonsurans.
[Directions by T. Sympson and V. A. L. for preparing.]
Scientif. Enquirer, I. (1886) pp. 55–6.

Typical Slides.
[Report of Committee of Amer. Soc. Micr. as to collecting, storing, and circulating typical slides of mounted objects and illustrations of special methods, and recommendation to the Society "to acquire, hold, and circulate the same." Also rules for storing and circulating the objects.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 246–7.

UDE, H.—**Ueber die Rückenporen der terricolen Oligochæten.**
[Methods for showing dorsal pores of terricolous Oligochæta. *Post.*]
Zeitschr. f. Wiss. Zool., XLIII. (1885) pp. 87–143 (1 pl.).

VAN BRUNT.—See Smith, H. L.

VORCE, C. M.—**Killing Insects' Eggs.**
[Soaking in carbolic acid will destroy vitality without affecting the appearance for a dry or balsam mount.]
11*th Ann. Rep. Amer. Post. Micr. Club*, 1886, p. 14.

W[ARD], R. H.—**Curtain-ring Mounts.**
["Regularly go to pieces in the circuits," and comment by R. Hitchcock. "This we believe need not be. Curtain-rings are exceedingly useful in mounting, and it will be a pity if we must give them up."]
11*th Ann. Rep. Amer. Post. Micr. Club*, 1886, p. 15.

White Zinc Cement.
[Unfavourable reports of experiences with it, and comment by R. Hitchcock.] 11*th Ann. Rep. Amer. Post. Micr. Club*, 1886, p. 15.
Amer. Mon. Micr. Journ., VII. (1886) p. 56.

WHITMAN, C. O.—**Natural Injection.** (Leeches.) [*Supra*, p. 540.]
Amer. Natural., XX. (1886) pp. 313–4.

WHITNEY, J. E.—**Rapid Section-cutting.** [*Supra*, p. 539.]
Proc. Amer. Soc. Micr., 8th Ann. Meeting, 1885, pp. 122–3 (1 fig.).

WIARD, M. S.—**Preparing section of Human Toe-nail.**
[Place between two strips of moderately hard wood and plane off thin smooth shavings with an ordinary carpenter's plane—mount in balsam and benzole.]
11*th Ann. Rep. Amer. Post. Micr. Club*, 1886, p. 14.

PROCEEDINGS OF THE SOCIETY.

MEETING OF 14TH APRIL, 1886, AT KING'S COLLEGE, STRAND, W.C., THE PRESIDENT (THE REV. DR. DALLINGER, F.R.S.) IN THE CHAIR.

The Minutes of the meeting of 10th March last were read and confirmed, and were signed by the President.

The List of Donations (exclusive of exchanges and reprints) received since the last meeting was submitted, and the thanks of the Society given to the donors.

	From
Balfour, F. M., The Works of. Memorial edition. 4 vols. (8vo, London, 1885)	*The Relatives.*
Cheshire, F. R., Bees and Beekeeping, Scientific and Practical. A complete Treatise on the Anatomy, Physiology, Floral Relations, and Profitable Management of the Hive Bee. Vol. I. Scientific. viii. and 336 pp., 71 figs. and 8 pls. (8vo, London, 1886)	*The Author.*
Draper, E. T., Graphic Microscopy, No. 1. 4 pp. and 2 pls. (8vo, London, 1886)	*The Author.*
Hudson, C. T., and P. H. Gosse. The Rotifera or Wheel-animalcules. Part III., pp. 81–128, Preface and Title to vol. i., pls. 11–15. (8vo, London, 1886)	*The Publishers.*
Lubbock, Sir J., Flowers, Fruits, and Leaves. xv. and 147 pp. and 95 figs. (8vo, London, 1886)	*Mr. Crisp.*
Rees's Encyclopædia. 39 vols. (4to, London, 1819)	*Dr. Millar.*
Microscope, Apparatus and Slides	*The late Miss Tucker.*
Slides of Pumice-stone	*Dr. H. J. Johnston-Lavis.*
Slides of leaf of *Deutzia scabra* and seeds of *Orthocarpus* ..	*Mr. W. E. Damon.*

Mr. Deby exhibited and described his "Twin Microscope" (see Vol. V. p. 854), which he had improved by the addition of a mechanical finger worked by a small micrometer screw. By this means he was able with the greatest facility to pick up a diatom or other minute object appearing in the field of one Microscope, and to swing it round and place it in any required position upon a slide upon the stage of the other. He thought this arrangement likely to be useful to any one whose hand was not steady enough for such delicate work, as it would enable them to arrange diatoms after the manner of Herr Möller.

Mr. Crisp said that in this connection might be mentioned the apparatus devised by M. Inostranzeff for testing the exact colour of minerals. He used two Microscopes placed side by side, one having on the stage the standard object, and the other the mineral to be tested. By means of an arrangement of reflecting prisms the two images were received in one eye-piece, and a comparison readily made. (*Supra*, p. 507.)

Mr. Crisp exhibited and described Mayer's new form of dissecting Microscope (*supra*, p. 507). It was designed by Dr. Mayer, of the Naples Zoological station, and had been very highly commended.

Amongst its special features was the very convenient arrangement of sliding plates, one white and the other black, either of which could be used as a background.

Mr. J. Beck said he saw this Microscope in use when he visited the station a short time ago, and it seemed to him to be a very complete instrument for the purpose of dissecting. There was abundance of play for the mirror, so that plenty of light could be obtained in any direction; but there was no means of rotating the stage. Although this rotation was but rarely provided in a dissecting Microscope, he thought it was a very desirable provision, as it was much more inconvenient to have to move the mirror or lens, and perhaps the source of light also, than it was to move the object. He had pointed this out to Dr. Mayer, who agreed that it would be a desirable improvement.

Mr. E. M. Nelson read a note in explanation of some models of the markings of diatoms, which he exhibited.

The President said that Mr. Nelson's communication was a most interesting one, and the models had made the subject exceptionally clear.

Mr. Nelson also exhibited a new achromatic oil-immersion condenser of 1·28 N.A., made by Mr. Powell. He said that the great advantage of it was that it allowed of the use of such a large central solid cone of light. He had never previously been able to get a condenser which had a greater angle than 1·0 N.A., and he had, therefore, never before been able to examine test-objects as effectively as was now possible, although it was not every objective which would stand the full blaze of light from the whole aperture of the condenser.

Mr. Deby's letter was read, in which he stated that he was prepared to open his library on Saturdays, from 10.30 A.M. to 10 P.M., to all Fellows engaged in special scientific research. Besides the principal standard works on the following subjects and most of the principal periodicals, he had collected in the last thirty years the following portfolios of pamphlets, &c.:—Bryozoa 10, Insect Anatomy 12, Arachnida 5, Crustacea 10, Vermes 10, Rotifera 4, Cœlenterata 4, Protozoa 25, Desmids 5, Diatoms 36, and Microscopy proper 15.

The President said that the meeting had already, by the applause which followed the reading of Mr. Deby's letter, expressed its appreciation of the generosity of the writer in throwing open his library. It appeared to be a specialized library of considerable value, and the offer was therefore one well worthy of their appreciation and thankfulness.

Prof. Stewart, after remarking that it was a well-known fact that certain insects and others of the lower forms of animal life possessed the means of producing sounds by which they could warn

their enemies or call to their friends, said that this kind of primitive language was also found amongst a few of the crustacea and the myriopods, and he exhibited, and by means of black-board drawings described, the stridulating organs found in some of the decapod and other crustacea.

Prof. Bell exhibited two young grayling, which he said were, in some respects, very interesting. For one thing, the eggs of the grayling were remarkable amongst those of the Salmonidæ as being quite transparent, so that their course of development could be very clearly observed. Since they came under his observation, the specimens on the table had come out of the eggs, and were to be seen with the yolk-sacs still adherent, and the heart beating. Another interesting point was the bending up of the notochord at the end of the tail. In the sharks the tail was always asymmetrical, but in the case of the Salmonidæ it was symmetrical. It would, however, be seen that in the early section the notochord had an upward bend, and although in the shark this was never cured, in the salmon it was cured by the peculiar arrangement of the supporting bones.

Mr. G. Massee gave an extended *résumé* of his paper on "The Structure and Evolution of the Florideæ," illustrating the subject by numerous drawings upon the black-board (*post*).

The President said that, whether or not they had made this subject a special study, they must all have been convinced that it was one of great interest, and that their thanks were due to Mr. Massee for giving them such a summary of the contents of his paper.

Mr. A. W. Bennett thought that the Society might well congratulate itself that one who was so competent for the work which he had taken in hand as Mr. Massee was, had been devoting himself to matters of such great interest as the subject of the communication which he had laid before them; for, though these forms of vegetable life were such exceedingly common objects, there was, perhaps, no group in relation to which it might be said that there remained so much to be discovered. To the scientific botanist the Florideæ were especially interesting, from the fact that they were the only class of cryptogams in which there were distinct sexual organs, and in which the male organ had no power of motion by means of vibratile cilia; also as illustrating the very important part which marine organisms, such as the *Vorticellæ*, perform in the process of fertilization. One point referred to by Mr. Massee was of extreme interest, and that was the connection between *Chantransia* and *Batrachospermum*. He quite agreed that the term "alternation of generations" was misapplied in this case, the phenomenon not being of the same kind as that which occurs in ferns; but was simply due to the circumstance that a difference of habitat induced different conditions of development, a large amount of light forming the one and the absence of light giving rise to the other. With regard to the genesis of the Florideæ, he thought there could be but little doubt that they had sprung from the green sea-weeds. He was himself always glad when he found that hard

and fast lines were disappearing. The difference between an apical cell and a group of apical cells was not an invariable distinction between the higher and the lower forms of the vegetable kingdom. Mr. Massee had brought out so many points of interest arising out of this subject that it was obviously quite impossible to discuss them in a short time.

Mr. Cheshire asked if it was correct to say that ferns presented true instances of alternation of generations?

Mr. Bennett said that the term was properly used to express the fact that the process of sexual union produced a plant which did not immediately again produce a sexual plant; but before this occurred it passed through an intermediate form. They had an instance of this in the case of ferns which alternately produced the non-sexual generation and the prothallium.

Prof. Bell said he was particularly glad to hear one remark of Mr. Massee's, because it seemed to him to answer a requirement which he had felt for some time. Within the last eighteen months Prof. Weismann had raised the question of the immortality of protoplasm, and those who read other journals besides their own had, no doubt, seen an article upon the subject in a journal not always remarkable for its accuracy on scientific subjects, in which it was said that this had always appeared to be a purely academic discussion. Mr. Massee's remarks doubtless would appear in the same way, as regarded the question of supply and demand, so that if Prof. Weismann was wrong, as he believed him to be, these things would go on until they came to an end at last from want of food, just as this academic discussion would come to an end also.

The President announced that the Second Conversazione of the Session would be held on May 5th.

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

Prof. Bell:—Young Grayling.

Mr. Bolton:—Larvæ of Caddis-fly.

Mr. Crisp:—(1) Mayer's Dissecting Microscope; (2) Malassez's Camera Lucida.

Mr. Deby:—Twin Microscope.

Mr. Nelson:—(1) Models of markings of Diatoms; (2) Powell's Achromatic Oil-immersion Condenser of 1·28 N.A.

Prof. Stewart:—Stridulating organs of Crustacea.

New Fellows.—The following were elected *Ordinary* Fellows:—Messrs. Arthur Clegg Bowdler, Lewis M. Eastman, M.D., and Francis John Fraser, M.A.

MEETING OF 12TH MAY, 1886, AT KING'S COLLEGE, STRAND, W.C., THE PRESIDENT (THE REV. DR. DALLINGER, F.R.S.) IN THE CHAIR.

The Minutes of the meeting of 14th April last were read and confirmed, and were signed by the President.

The List of Donations (exclusive of exchanges and reprints) received since the last meeting was submitted, and the thanks of the Society given to the donors.

	From
Baker, H., The Microscope made easy. 5th ed., xvi. and 324 pp., 15 pls. (8vo, London, 1769)	*Mr. Crisp.*
Gage, S. H., Notes on Histological Methods, including a brief consideration of the methods of Pathological and Vegetable Histology, and the application of the Microscope to Jurisprudence. 56 pp. (8vo, Ithaca, N.Y., 1885-6)	*The Author.*
Gerlach, J., Die Photographie als Hülfsmittel Mikroskopischer Forschung. 86 pp., 9 figs. and 4 pls. (8vo, Leipzig, 1863)	*Mr. Crisp.*
Gould, C., The Companion to the Microscope, with full directions for preparing the Vegetable Infusions to produce Animalcules. 3rd ed., 47 pp. and 3 pls. (8vo, London, 1828)	"
Slide of *Synedra lævigata*	*Dr. Bossey.*
Slide of spicules, *Spongilla fluviatilis*	*Mrs. Farquharson.*

The President referred to the death of Dr. Matthews—a Member of the Council—which had recently occurred. He was with them at their last meeting with his usual geniality, and he had some pleasant conversation with him on that occasion. He was shocked to hear but a few days afterwards that Dr. Matthews was dead. The Council had that evening recorded their sense of the affectionate regard in which Dr. Matthews was held by the Fellows of the Society, and of the loss which they had sustained by his death. They had also passed a resolution of sympathy and condolence with the surviving relatives, in which he invited the meeting to join. The resolution of the Council was then adopted by the meeting.

Mr. J. Mayall, jun., exhibited and described a new pattern of the Radial Microscope, by Mr. Swift, which he thought would be found to embody several useful improvements upon those previously constructed upon that principle. The first of these consisted of a rack and pinion applied to the arc inclining movement by means of which the Microscope could be smoothly and readily placed at any required inclination by turning the milled head instead of using manual force. Another improvement, for which he was himself responsible, was a modification of the mechanical stage applied in a very simple manner to the rotating glass stage of the instrument. He had repeatedly tried to impress upon opticians the importance of

making a mechanical stage without plates, so that the object might rest at once upon the most solid part of the stage itself. The device which he now exhibited fulfilled this requirement, the slide being held in its place by a clip, to which motion in two directions could be given by means of milled heads, whilst the whole rested upon the glass stage-plate perfectly free from any flexure. Moreover, if the mechanical movement was not wanted to be used, it was readily removable, leaving the stage clear. Another small improvement had been made, by means of which the mirror could be placed in a fixed position, so as to get variations in the inclination of the light from the fixed mirror when the radial movement was used.

The President thought that the ease with which the mechanical movement could be removed from the stage made Mr. Mayall's modification a most excellent feature.

Mr. G. D. Hirst's communication was read referring to the report in the Journal of the Royal Society of New South Wales (*ante*, Vol. V. 1885, p. 1077), attributing to him the view that a highly refractive mounting medium enabled objectives of small aperture to compete in resolution with wide-angled oil-immersion objectives. Mr. Hirst explained that the report was unfortunately worded so as to convey a totally erroneous impression of what he claimed, which was only that the highly refractive medium would render difficult test diatoms so easy to a good high-angled water lens, that the superiority of the oil-immersion objective will not be apparent, except under the very deepest eye-piecing.

Dr. Hudson's request was read for specimens of *Brachionus pala*, which he was unable to procure in his own locality, and which he required for the purpose of illustration in his 'Rotifera.'

Mr. C. D. Ahrens's paper "On a new Polarizing Prism" was read (*supra*, p. 397). Mr. Crisp said that, having asked the opinion of Professor Silvanus P. Thompson as to the merits of the prism, he had received from him the following reply:—"My opinion of Ahrens's new prism is that for use as a polarizer it is absolutely unrivalled. Flat ends, wide angle, absence of distortion, absence of troublesome coloured fringes, all go in its favour. The line that marks the junction of the sections is all but imperceptible, and never troubles the clearness of the field, as used for this purpose. For use as an analyzer I am not so clear about the prism; but even so it works very well. Take it all round, I consider it the best polarizing prism that has yet been devised."

Dr. Sternberg's paper "On *Micrococcus Pasteuri*" was read (*supra*, p. 391), in which he called attention to the characters which distinguish it in a very definite manner from the microbe of fowl-cholera,

it differing from the latter not only in its morphology, but in the fact that it is not fatal to fowls.

Mr. Dowdeswell said that the question of the specific identity of organisms of this kind was as difficult as it was also important. Dr. Sternberg was a great authority upon the subject, and his opinion was entitled to great consideration. He thought that the additional particulars now adduced, so far disposed of the question of identity that he must accept the conclusions arrived at.

The paper was further discussed by Mr. Michael and the President, who referred to the death of Dr. T. R. Lewis, the discoverer of the microbe of the human mouth.

Mr. F. H. Evans exhibited some photo-micrographs produced by the Woodbury-type process, from negatives taken by himself and transferred to glass for the purposes of lantern illustration, and so that in many cases the objects could be seen on the screen more perfectly than under the Microscope. To show what an advance had been made in this direction, sixty of the slides were shown upon a portable screen by Mr. George Smith (of the Sciopticon Company), who had printed the slides from the original negatives. The objects illustrated comprised Diatoms and Desmids, Foraminifera, Polycistina, star-fish, sections of *Echinus* spines, insect preparations, animal parasites, and anatomical and vegetable sections, the remarkable clearness of most of the photographs calling forth frequent favourable comments from the Fellows present.

Mr. Evans, who had temporarily lost his voice, handed in the following note from himself and Mr. Smith:—

"These slides are intended specially for educational purposes, to help the optical lantern to fulfil its manifest destiny as the great educational demonstrating instrument of the future.

They are not put forward as perfection, but as an earnest effort towards the limit of perfection attainable by human skill.

The measure of success already reached is controlled to a great extent by the inherent imperfection of even the most skilfully constructed lenses; but while the definition is possibly less perfect than may be considered desirable, it is certainly not inferior to that obtainable by any ordinary high-class Microscope, while, if the degree of magnification is taken into account, it is probable that it is not likely to be greatly surpassed. It has also to some extent been controlled by the character of the photographic plates in commercial use, which from the exigences of the case have been necessarily employed—for while rapidity is an extremely important feature of modern commercial photography, the granular character of the sensitive film, apparently almost inseparable from the enhanced rapidity, is decidedly inimical to microscopic work, where structureless films are specially important. It is a curious fact in the development and improvement of photographic processes that the important feature of structureless films and development has been overlooked and neglected in favour of rapidity, generally attended by granularity of the deposit. The wet-collodion process with pyrogallic development, as given to the world

by Scott Archer, gave a structureless film and a pure stain-like deposit, but this was speedily and completely superseded by the iron development and coarse granular deposit for the sake of the meretricious advantages of redevelopment and local intensification as a correction for error of exposure.

The question of illumination of microscopic objects has its importance too; in this matter the slides must speak for themselves. It is well known that the same objects may be shown very differently under various degrees and qualities of light. In all cases, in order that a comparison between the enlargements to be shown upon the screen may be made with the aspect under the Microscope itself, the light used for producing the photograph has been the ordinary mineral oil lamp. Indeed, no unusual accessory of any kind has been employed—no monochromatic light or any other expedient, but the object was arranged in the ordinary way, examined and adjusted with the A eye-piece, and the photographic image obtained at once by placing the camera in front of the eye-piece, the only change being the readjustment of focus, according to the degree of enlargement required in the negative. No allowance, or correction, was found necessary with the objectives employed to make the visual and actinic foci agree. The objectives were high class, of English make.

It is hardly necessary to say that the negatives are entirely untouched, excepting to remove mechanical defects inseparable from the mounting of microscopic objects, and that otherwise the resulting slides are the result of pure photography.

The process employed is that known as the Woodbury-type process."

[The remainder of the note deals with the Woodbury process, and the "Sciopticon" used. See Mr. Smith's remarks *infra*.]

Mr. Crisp said that Mr. Evans claimed that he had been more than ordinarily successful in overcoming the chief difficulty in the matter, that of obtaining such a focus as would properly represent the various planes of even deep objects, and this without loss of natural effect.

The President said that the meeting were very much obliged to Mr. Evans and his colleague for this exhibition, which was certainly the most interesting which he had yet seen. He had been much struck by the beauty of many of the pictures, and inquired if there was anything special in the mode of preparation, which allowed of so much delicate detail being shown without any sacrifice of natural character or beauty of result.

Mr. Smith said there was nothing special in the mode of production. The photographs were all taken with an A eye-piece, and by the light of an ordinary paraffin Microscope lamp. The slides were prepared by what was known as the Woodbury process—that is they were printed from metal plates—the result being that they got very much greater transparency and better detail, with a uniform colour. When once the proper tone had been obtained any number of prints could afterwards be produced of exactly the same depth. The process was undoubtedly the finest possible for the purpose.

Mr. Curties inquired if any special means were adopted in photographing the opaque objects. He thought it must be admitted that they had been extraordinarily well shown, their sharpness of detail being such that he had supposed they must have been taken by the electric light.

Mr. Smith said that there was nothing unusual about the process in any way, it was simply a question of manipulative skill. Some of the transparent objects were illuminated by the spot-lens, and ordinary objectives were used.

Mr. Crisp said that for the next number of the Journal he had written a note on the question whether photographs of microscopic objects were better for purposes of class illustration than the objects themselves thrown on the screen, and had expressed himself in favour of the natural objects. What, however, he had seen that evening certainly required him to alter his opinion.

Mr. Smith in reply to an inquiry as to what kind of lantern apparatus had been used for showing the slides upon the screen, said it was the ordinary form of lantern known as the Sciopticon, the illumination being by a paraffin oil lamp with a double burner. It was very simple to use, did not produce an unusual amount of heat, and held enough oil to burn well for several hours. A dissolving apparatus was added for the purpose of changing the slides.

Dr. Millar asked how the slides were prepared; were they printed upon the glass?

Mr. Smith said that in the first instance a photographic negative was taken in the usual way; this negative was upon a glass plate, and was so called because all the lights and shadows were reversed from what they were in the natural picture. From this negative an ordinary photograph was produced by printing from it in the usual way. The Woodbury-type process made use of the property acquired by gelatin when mixed with bichromate of potash, in virtue of which it became insoluble after being exposed to the action of light. A film of gelatin, so prepared, had the photograph placed upon it and after being exposed to light was washed in hot water which dissolved away those parts which the light had not affected. In this way a very delicate film was obtained not exceeding the 1/300 in. in thickness, but containing every line of the picture in relief. This film was put upon a steel plate, and a piece of lead having been placed upon it, they were subjected to a pressure of many tons weight, by which means an intaglio mould was formed upon the lead. The plates were practically casts from this mould made in gelatin and darkened with lampblack.

The President was sure he should be doing what would commend itself to the whole meeting, in proposing a vote of thanks to Mr. Evans and his colleague Mr. Smith, for the very interesting exhibition for which they were indebted to them, and upon the success of which they were to be very heartily congratulated.

The thanks of the meeting were then unanimously voted to Mr. Evans and Mr. Smith.

List of Photo-Micrographs.

(*The diameters given are those of the magnification on the lantern slide.*)

No.
1. Foraminifera, grouped, × 14.
116. Ditto, from Porto Seguro, × 19.
117. Ditto, ditto, × 21.
118. Ditto, from Connemara, × 12.
119. Ditto, Lagenæ, × 27.
121. Ditto, Operculina, × 23.
122. Ditto, Section of Nummulite, × 34.
123. Ditto, Quinqueloculina, × 27.
124. Ditto, Dentalina, × 30.
128. Ditto, siliceous casts of, × 16.
13. Ophiocoma Rosula, × 12.
14. Ray of ditto, × 19.
15. Dental apparatus of ditto, × 10.
16. Ditto plates of ditto, × 25.
18. Ophiocoma neglecta, × 8.
19. Urastea rubens.
5. Polycystina, grouped, × 35.
4. Ditto, ditto, × 28.
6. Ditto, "Bull's Horns," × 62.
39. Ditto, grouped, × 17.
40. Ditto, ditto, × 42.
22. Echinus, grouped sections, × 9.
23–8. Ditto, section of spine, × 18–34.
8. Coralline, × 14.
9. Ditto, ditto, × 12.
10. Bicellaria grandis, × 14.
11. Ditto, ciliata, × 20.
30. Head of Vanessa urticæ, × 10.
33. Ditto of Tipula oleracea, × 11.
34. Antenna of vapourer moth, × 10.
74. Synapta, anchors and plates, × 33.
90. Pinna shell, section of, × 66.
98. Eider down, × 13.
99. Scales of fern, × 38.
149. Fairy fly, × 43.
156. Cecidomyia, × 32.
151. Oak-apple fly, × 10.
154. Exuvia of Cercopsis (on oak leaf), × 17.
72. Scale of perch, × 14.
75. Sponge spicules, × 31.
148. Winged parasite of Indian bat, × 18.
109. Section of chalcedony, × 14.

No.
143. Ditto of Lapageria rosea, × 18.
97. Diatoms on coralline, × 17.

The whole of the above were taken by spot lens, or as opaque objects, except Nos. 72, 90, 98, 99, *these being taken by polarized light.*

The following were taken by transmitted light:—

No.
135. Flea of wild rabbit.
59. Parasite of ox.
126. Ditto of elephant.
44. Ovipositor of saw-fly.
42. Proboscis of blow-fly, × 124.
50. Jaws of spider, × 21.
48. Spinnerets of spider, × 135.
49. Claws from house-spider, × 240.
36. Trachea of silkworm, × 34.
43. Cirri of barnacle, × 14.
70. Spiracle of Dytiscus, × 32.
67. Eye of ditto, × 160.
64. Pygidium of flea, × 248.
147. Leiosoma palmicinctum, × 60.
38. Glyciphagus plumiger, × 147.
37. Maple aphis, × 63.
57. Nycteribia of Indian bat, × 14.
56. Abdominal fringe of ditto, × 104.
150. Parasite of vampire bat, × 28.
127. Mange insect of horse, × 100.
130. Foot of parasite of queen bee, × 164.
101. Section of sugar-cane.
111. Section of ovary of tiger lily, × 13.
83. Triceratium favus, × 485.
86. Ditto quadratum, × 357.
85. Ditto septangulatum, × 192.
79. Licmophora flabellata, × 154.
139. Auliscus cœlatus, × 216.
86. Gephyrea, × 338.
137. Pinnularia, × 389.
89. Aulacodiscus margaritaceus × 192.
138. Coscinodiscus, × 343.
82. Heliopelta, × 208.

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

Mr. T. Bolton:—Spawn of Perch.

Mr. Crisp:—Ahrens's new Polarizing Prism.

Mr. F. H. Evans and Mr. G. Smith:—Photo-micrographs shown with the Sciopticon.

Mr. Swift:—Radial Microscope with rack and pinion to arc, Mayall's removable mechanical stage and fixed mirror fitting.

New Fellows:—The following were elected *Ordinary* Fellows:—Messrs. Marshall D. Ewell, Charles F. Forshaw, D.D.S., William Johnson, Alfred H. Mason, F.C.S., John D. Thomas, M.D., T. B. Tyson, Walter Wier, M.B., and Thomas S. Wilkins. Prof. W. A. Rogers was elected an *Honorary* Fellow.